PSYC3363 SPRING 2017
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 nor 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.

This course contains a significant lab component. 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.
- Know how to run a simple experiment on Amazon Mechanical Turk (AMT).
- Understand how to design, conduct, and analyze a statistical learning experiment.

Lecture Days

January 18 – Introduction I: Why is language possible at all, and why can't everyone do it?

1. "Where are the Talking Robots?" Joshua Hartshorne, *Scientific American*
2. "Descriptive and Prescriptive Grammar" by The Ling Space
3. "The Language Instinct – Clip of Richard Dawkins Interviewing Steven Pinker"

January 20 – Introduction II: The Shape of Language Development

Readings:

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

Videos:

1. "Deb Roy – The Birth of a Word"
2. "Developmental Milestones: Baby Talk from First Sounds to First Words"
3. "Talking Twin Babies"
4. "Phonological Acquisition in American Sign Language: From Cooing and Babbling to Articulating Words"

January 25 – Introduction III: Bilingualism

First, read "Bilingualism" by Ellen Bialystok, one of the main researchers in this literature. Compare Bialystok's review with Maria Polinsky's take in "Cognitive Advantages of Bilingualism". Also watch "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 "Bilingual and monolingual baby brains differ in response to language", which describes 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 "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 "Code-switching", which focuses on switching between languages, and "Key & Peele on 'code-switching' & the 2017 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. Watch "My Bilingual Baby – Our Daily Routine", where a mother talks about her efforts 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"

January 27 – 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.

Anyway, please start by going through the following sections from Week 2 of the Coursera course "Human Language":
   o Distinguishing consonants
   o Production of speech sounds
   o Consonants of world languages
   o Sounds in systems
   o 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 and on vowel 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.

- World Atlas of Language Structures (WALS)
   o Consonant Inventories
   o Vowel Inventories

Next, we have two short videos about how to learn phonology. The first one has a very short description of the classic findings on phonology acquisition. The second one describes a more recent study in this line of work, and shows in detail how the study is actually run.
Finally, **not** required but *lots* of fun, two videos on the difficulty of teaching machines to do what babies do

Videos
1. "Infant Speech Discrimination"
2. "The Baby Human – Werker – Ba/Da Study"
3. Optional: "CAPTION FAIL: Lady Gaga Putt-Putt Rally"
4. Optional: "Burnistoun S1E1 – Voice Recognition Elevator!"

February 1 – What is Language: Syntax

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.) For this unit, you only need to watch until he starts on phonology (around minute 32), though if you were confused last week about phonology, you may find that section useful, too.

Next, read this review paper on syntactic theory. You don't need to be able to construct your own syntactic trees, but you should feel at least vaguely comfortable reading the ones in this paper, just in case you are asked to explain them on an exam (just sayin').

Once you've gotten through that, the worst is over. Next, watch two videos (about 13 min. total) from the "Miracles of Human Language" Coursera course on syntax and word order. Then watch the language informant videos from the 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 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 3 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).

Recommended
Not required, but recommended, is Crain et al.'s paper on syntax acquisition.
Similarly, if you are wondering how we got through a unit on grammar without really discussing word endings, then the Coursera video on Morphology is for you.

Readings:

1. Adger, David. "Syntax." *Wiley Interdisciplinary Reviews: Cognitive Science* (2014).
2. World Atlas of Language Structures (WALS): Order of Subject, Object and Verb
3. *Recommended*: Crain, Stephen, and Rosalind Thornton. "Syntax acquisition." *Wiley Interdisciplinary Reviews: Cognitive Science* 3.2 (2012): 185-203.

Videos:
1. "Steven Pinker: Linguistics as a Window to Understanding the Brain"
2. "Miracles of Human Language" Coursera
    a. Lesson 31 – syntax and word order (a)
    b. Lesson 31 – syntax and word order (b)
    c. Language informant videos (week 3)
    d. Optional: Lecture 28 – Morphology

February 3 – What is Language: Semantics & Pragmatics

Semantics is the study of what sentences mean. Pragmatics is the study of what people mean when they use sentences. Your primary job for this session is to understand the difference, and to understand some of the basic phenomena. In a few weeks, we'll talk about how semantics and pragmatics are acquired.

Most of the material is about pragmatics, because you probably know less about that. Watch "The Study of Meaning: Semantics and Pragmatics" by our friends at Coursera on "Layers of Meaning", "Semantics", and "Pragmatics".

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 "Experimental Pragmatics: A Gricean Turn in the Study of Language" which talks about some of the phenomena Noveck and his colleagues were working on.

If you are still confused by implicatures, watch "Language: Conventional Implicature" by Khan Academy.

Since this pioneering work by Noveck and colleagues, the experimental study of pragmatics has grown considerably. Watch "Why Is Language Veiled?", where Steven Pinker discusses some of the research in the first decade of the 21st century.

Recommended

If you find semantics and pragmatics fascinating (and I do!), there are two short articles you might be interested in. The first is "Pragmatic Language Interpretation as Probabilistic Inference", which describes recent mathematical models of pragmatics. The second is "The Acquisition of Semantics" which provides a nice review of some of the literature on children's acquisition of semantics.

Readings:
1. Noveck, Ira A., and Anne Reboul. "Experimental pragmatics: A Gricean turn in the study of language." *Trends in Cognitive Sciences* 12.11 (2008): 425-431.
2. Recommended: Goodman and Frank (2016) "Pragmatic Language Interpretation as Probabilistic Inference," Elsevier.
3. Recommended: Wagner (2010) "The Acquisition of Semantics," Cognitive Science.

Videos:
1. "Miracles of Human Language" Coursera
   a. Lesson 42 – Layers of meaning
   b. Lesson 43 – Semantics
   c. Lesson 45 – Pragmatics
2. Khan Academy, "Language: Conventional Implicature"
3. "Why is Language Veiled?" by Steven Pinker

February 8 – What is Language: Typology & 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".

We've already used WALS a few times. WALS has 144 chapters on different aspects of language that may vary. Spend at least half an hour looking over a few different that seem interesting to you. You don't need to be memorizing any of this information, but it will give you some insight into the problem facing the infant. Anything that varies is something that infants can't be born already knowing.

Then, watch this 3-minute video by Noam Chomsky, giving his perspective on the ways in which languages are similar.

Then, watch this 20-minute video 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.

There has been a lot of speculation over the years as to why we don't all speak the same language. Or, since vocabulary itself can't be innate, why don't we all have the same syntax. Wouldn't that be easier?

The Sinnemåki and Levinson & Gray papers try to grapple with why there is variation across languages and why we see in particular the variation that we actually see. As you are reading them, think about the implications for acquisition. The articles 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, and purely for fun, read my open letter to the creator of the Dothraki language for *Game of Thrones* and his reply.

Readings:
1. World Atlas of Language Structures (WALS): look over a few different <u>chapters</u> that you may find interesting
2. Sinnemåki (2014) "Cognitive Processing, Language Typology, and Variation," *Cognitive Science.*
3. Levinson and Gray (2012) "Tools from Evolutionary Biology Shed New Light on Diversification of Languages," *Trends in Cognitive Sciences.*
4. Hartshorne (2010) "Fantasy TV in the Service of Science: An Open Letter to HBO about "Dothraki," *Scientific American.*
5. Emrys and Peterson (2010) "The Dothraki Response to a Call for Science in a Created Language," *Scientific American.*

Videos:

1. "Noam Chomsky: <u>Language's Great Mysteries</u>"
2. "TYP 103 – <u>The Classification of Languages</u>"

<u>February 10 – How Do We Know What Children Know? Methods</u>

We have completed our whirlwind tour of language. We are finally ready to start talking about children again! Before getting into the data, though, we should learn a bit about where the data come from. That is, how do we child language?

The first Ling Space video provides an overview of a few of the methods used with infants.

Next, watch this much older video from the Infant Language Learning Lab at Johns Hopkins 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 video from the Infant Language Lab left out one very common method that is used with slightly older infants, dishabituation. Watch the video my friend Mike Frank made for his students at Stanford. Later in the semester, I'm going to need to make some videos myself. You can tell me if they are as good as his.

Next, the second Ling Space video gives an overview of methods used with toddlers and preschoolers.

Finally, take a look at the Ambridge & Rowland review paper, 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:

Readings:
1. Ambridge and Rowland (2013) "Experimental Methods in Studying Child Language Acquisition," *Cognitive Science.*

Videos:
1. "How to Test Language in Babies" by the Ling Space
2. Infant Language Learning Lab at Johns Hopkins: "Three Procedures for Investigating Infant Speech Perception and Language Development"
3. Mike Frank: "Habituation (Stanford Psych 60)"
4. "Child Language Experiments" by the Ling Space
5. Recommended: "Habituation: Studying Infants Before They Can Talk"

February 15 – The Language Instinct: Critical Periods

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

Next, watch "Genie", which covers the most famous case study of a child brought up without language.

Following that, watch the first 10:20 of "The Linguistic Genius of Babies" by Patricia Kuhl, who has done the foundational work on critical periods in phonology. We saw some of this work earlier.

In Kuhl's video, 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 my paper with Pinker and Tenenbaum, "A Critical Period", (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. Pinker (1994) *The Language Instinct.* pp. 290-296
2. J. K. Hartshorne, J. B. Tenenbaum, and S. Pinker. The optimal period for language learning: A study of 650,000 English-speakers. (*submitted*)

Videos:

1. "Genie"
2. Patricia Kuhl: "The Linguistic Genius of Babies | Patricia Kuhl"

February 17 – The Language Instinct: Creoles and Pidgins

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*: pages 32-39. Also take a look at what the Ling Space has to say about pidgins and creoles.

The pioneering work was done by Derek Bickerton. Read his 1983 *Scientific American article.*

Many sign languages are creoles as well. We'll be learning more about them next week. In the meantime, let's look at a couple examples of creoles. The first one, confusingly called "Hawaiian 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. Note that the speakers are discussing Jamaican Patois, but in English.
Of course, not all creoles are heavily influenced by English. Check out the clip of Haitian Creole, which is based more heavily on French. (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 scifi drama on television. 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.

You can also learn about some of the sociopolitical issues surrounded Haitian Creole in the last video.

Readings:

1. Pinker (1994) *The Language Instinct. pp.* 32-39
2. Bickerton (1983) "Creole Languages," *Scientific American.*
3.

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!"
5. Recommended: "Ars talks with the creator of Belter Creole from 'The Expanse'"
6. Recommended: "Creoles and Pidgins: A Focus on Haitian Creole"

February 22 -The Language Instinct: Sign Language

For this class, we're going to have a special guest speaker: Annemarie Kocab. Annemarie is a graduate student at Harvard, where she works on Nicaraguan Sign Language (which you'll learn about in this lesson). She is also a native speaker of American Sign Language, and she'll be talking with you via simultaneous translators.

So please be prepared for class in order to make full use of her time and expertise. You should plan on questions you want to ask her specifically.

First, an overview of sign language. Something not always appreciated is that there are many, many different sign languages (we'll get to why in a moment).

Videos

1. "Is Sign Language Universal? | ASL Stew"
2. Here is a demonstration of the differences between three common sign languages: "Japanese American French Sign Languages"
3. Here is a musical take on the same issue: "When I Was Your Man ASL-BSL"
4. Here is some information on a much less well-known sign language: "Hand Talk - Science Nation"
5. Sign languages are languages, with many of the features you are familiar with, including poetry: "What is SASL Poetry?"
6. 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 here.

Little-known fact: My great-great aunt actually spoke 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? Watch the video "The Birth of a new Sign Language in Nicaragua" and read the 2013 Brentari et al. Cognitive Science paper.

Videos and readings:

1. "The Birth of New Sign Language in Nicaragua"

2. Brentari and Coppola (2013) "What Sign Language Creation Teaches Us About Language," *Cognitive Science.*

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 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.

February 24 – 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. Read *The Language Instinct* pages 335-342 for Pinker's overview of the landscape up through the early '90s.

Don't just take his word for it. Read "Transcript of the chat with Koko". 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. Watch "Kanzi, the Bonobo talks to reporters", a pop-science overview of one of the more famous case studies, Kanzi. Also watch "Kanzi with 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. 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. Watch "The Dog Who Knows 1,000 Words".

There is work with dolphins as well. In theory, anyway. It's very hard to find published scientific papers. I did find the following TV segment, "The Language of Dolphins". 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 wok 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. Watch "Alex the Smart Parrot".

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?

Highly Recommended

Want more Kanzi? The video "Kanzi with lexigram" 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: watch "Snowball – Another One Bites the Dust." (This is not just one exceptional parrot, either. Dancing parrots 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. "Kanzi, the Bonobo talks to reporters" by Michael Keller
2. "Kanzi and Novel Sentences" by Iowa Primate Learning Sanctuary
3. "The Dog Who Knows 1,000 Words" by ABC News
4. "The Language of Dolphins"
5. "Alex the Smart Parrot - Talking bird distinguishes colors, shapes, sizes, numbers"
6. Recommended: "Kanzi with lexigram" by Iowa Primate Learning Sanctuary
7. Recommended: "Snowball (™) - Another One Bites The Dust"

March 3 – Bonus Reading

Please read the following before class and ask a question:

Gómez and Gerken (2000) "Infant artificial language learning and language acquisition" *Trends in Cognitive Sciences*

March 15 – Poverty of the Stimulus: Syntax

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. 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.

> 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, 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

The project failed in a number of fascinating ways. For one thing, it turns out that it's [impossible to make mathematics internally consistent](#) 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](#): 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](#)).

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](#). 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 (pages 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 video "Is correcting your Kid's Language Helpful? Negative Evidence"

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 video "How Complex is Natural Language? The Chomsky Hierarchy."

Now keep the Chomsky Hierarchy in mind as you watch my video -- made specially for this class! -- about 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.

Reading:
  1. Pinker (1994) *The Language Instinct.* pp. 39-45
  2. Laurence and Margolis (2001) "The Poverty of the Stimulus Argument", *British Society for the Philosophy of Science*

Videos:
  1. "Is Correcting Your Kid's Language Helpful? Negative Evidence" by The Ling Space
  2. "How Complex is Natural Language? The Chomsky Hierarchy" by The Ling Space
  3. "Baker's Paradox" by Joshua Hartshorne

March 17 – Poverty of the 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.

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 have known that it's not quite so simple: watch the Ship of Theseus video.

In case mythical ships are too abstract for you, watch the 9 min. excerpt from a talk by Chomsky, in which he applies a very similar object to everyday concepts like 'river' (The video should start and stop automatically at the right places, but just in case: Watch from 54:20 to 103:50).

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 pages 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: watch the video "Bleen or grue?"

Readings:
1. Pinker (1994) *The Language Instinct.* pp. 153-157

Videos:
1. Ship of Theseus: "PHILOSOPHY - Metaphysics: Ship of Theseus [HD]" by Wireless Philosophy
2. "Noam Chomsky speaks about Universal Linguistics: Origins of Language"
3. "Bleen or grue?"
4. Recommended: This video explains the importance of 'grue' and 'bleen' to philosophy

March 22 - 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. You may find it useful to brush up some of the basics of syntax before moving on: watch the video "Generative Grammar."

While we talk about *the* theory of universal grammar, in reality there are many theories. The 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. "Generative Grammar"
2. "GEN120 - Universal Grammar - Part 1"

March 24 - 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 in her 1990 Cognitive Science paper.

There's a lot of important information in that paper. This video covers gives you a second look at many of the highlights:

There's a lot of important information in that paper. The Ling Space video gives you a second look at many of the highlights.

One of the classic heuristics is mutual exclusivity. The video "The Baby Human" 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, the experiment in the JoVE video 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 (1990) "Constraints Children Place on Word Meaning," *Cognitive Science.*

Videos:
1. "Word Learning" by the Ling Space
2. "The Baby Human - Amanda Woodward - Dax Learning"
3. JoVE Science Education Database: Mutual Exclusivity: How Children Learn the Meanings of Words

March 27 - 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. Watch Nicolette Noonan's video on statistical language learning for a very short introduction to some of the issues (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 the **first 14 minutes** (up until the 2nd commercial break) of the interview with Prof. Saffran.

Now, take a look at the 2010 Romberg and Saffran paper that provides an overview of the literature up through about 2010.

Interestingly, this kind of unsupervised learning isn't specific to language learning. Watch the JoVE video on Visual Statistical Learning for a brief overview 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 my short video "Cross-Situational Learning."

Is cross-situational learning really unsupervised? Not exactly. In *supervised* learning, you are always presented with the correct answer (i.e. 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 video "Steven Pinker asks Noam Chomsky a question." How might Saffran respond?

Readings:

1. Romberg and Saffran (2010) "Statistical Learning and Language Acquisition," *Cognitive Science.*

Videos:

1. "Supervised Learning – Georgia Tech – Machine Learning"
2. "Unsupervised Learning – Georgia Tech – Machine Learning"
3. "Nicolette Noonan: Statistical Language Learning - 3MT"
4. Interview with Prof. Saffran "Office Hours: Infant Learning and Intelligence"
5. JoVE: Visual Statistical Learning
6. "Cross-Situational Learning" by Joshua Hartshorne
7. "Steven Pinker asks Noam Chomsky a Question"

April 3 – Learning Mechanisms: Constructivism

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.

Start with "Items and Generalizations at Work", in which Adele Goldberg gives an overview of her brand of Constructivism (currently one of the most influential).

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, 252-256

Videos:
1. "Items and Generalizations at Work" by CSDL

April 5 – Learning Mechanisms: Rules, Connections, & the Great Past Tense Debate

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 clearest example of this line of questioning was the Great Past Tense Debate of the 1990s. The linear algebra account had been largely unchallenged since Chomsky's pioneering work of the 1950s. In 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", which describes the complex neural networks now used to power Google Translate, make self-driving cars, and play the board game Go). Watch "Intro to Neural Networks" brief introduction to neural networks.

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 read McClelland and Karalyn Patterson's 2002 paper for the other side. In the same issue, both authors then replied to each others' papers.

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

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'll be covering them in my course "Computational Models of Cognition" next Spring.

Videos:
1. "[Intro to Neural Networks](#)" by Jesus Suarez

Reading:
1. Pinker and Ullman (2002) "The past and future of the past tense", *TRENDS in Cognitive Sciences*
2. McClelland and Patterson (2002) "Rules or connections in past-tense inflections: what does the evidence rule out?", *TRENDS in Cognitive Sciences*
3. Pinker and Ullman (2002) "Combination and structure, not gradeness, is the issue", *TRENDS in Cognitive Sciences*
4. McClelland and Patterson (2002) "'Words *or* Rules' cannot exploit the regularity in exceptions", *TRENDS in Cognitive Sciences*

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

1. Seidenberg and Joanisse (2003) "Show us the model", *TRENDS in Cognitive Sciences*
2. Ramscar (2003) "The past-tense debate: exocentric form versus the evidence", *TRENDS in Cognitive Sciences*
3. Pinker and Ullman (2003) "Beyond one model per phenomenon", *TRENDS in Cognitive Sciences*
4. Marslen-Wilson and Tyler (2003) "Capturing underlying differentiation in the human language system", *TRENDS in Cognitive Sciences*
5. McClelland and Patterson (2003) "Differentiation and integration in human language", *TRENDS in Cognitive Sciences*
6. Hartshorne and Ullman (2006) "Why girls say 'holded' more than boys", *Developmental Science 9,* 21-32.

April 12 – Learning Mechanisms: Syntactic Bootstrapping

This session is about a very important theory often seen to be at odds with Constructivism. Before diving into that, though, some more on Constructivism. After I assigned the materials for our Constructivism unit, Adele Goldberg gave a great keynote talk across the river at a conference. I've now got the video of that talk. It covers a lot of what was in the previous video of hers that we watched, but in much more detail.

Both Constructivism but especially Syntactic Bootstrapping make a lot of reference to theories of verb argument structure: that is, how verbs encode meaning. This has come up several times, and it's worth learning a bit more about it. See the TED talk by Steve Pinker for a fairly detailed overview (watch only the first 10min, 15sec).

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."

The earliest version of the theory of syntactic bootstrapping was formulated by Roger Brown in the middle of the 20th Century. The theory was significantly expanded and developed starting in the late

1980s by Lila Gleitman and several of her students (including Cynthia Fisher, the first author of the paper above). The theory continued to develop. See the video "Propose but verify" for a recent interview with Prof. Gleitman, describing some of the latest work.

Syntactic bootstrapping is complex and requires internalizing the fact that verb syntax conveys meaning. If you are still fuzzy on this, you may find it useful to read the Kako and Wagner (2011) paper (not required but recommended):

Reading:
1. Fisher, Gertner, Scott and Yuan (2010) "Syntactic bootstrapping", *WIREs Cognitive Science*
2. *Optional:* Kako and Wagner (2001) "The semantics of syntactic structures", *TRENDS in Cognitive Sciences*

Videos:
1. "Goldberg CUNY 2017" posted by Joshua Hartshorne
2. TED Talk by Steven Pinker: "What our language habits reveal"
3. Lila Gleitman: "Propose but verify"

April 19 – Learning Mechanisms: Semantic & Prosodic 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 my video on semantic bootstrapping, which goes through the ideas in more depth

Like semantic bootstrapping, prosodic bootstrapping is focused on understanding how children might get started learning the incredibly complex system that is syntax. Instead of focusing on how children might use syntax-semantics correspondences, prosodic bootstrapping uses the relationship between syntax and prosody. If you need a quick refresher, read through the Wikipedia page on prosody.

Next, read the 2003 Christophe et al. paper about prosodic bootstrapping. You do not need to commit the experimental method to memory, but you should be clear about the logic of the theory and how the experiment was intended to test that theory.

Readings:
1. Christophe, Nespor, Guasti, Ooyen (2003) "Prosodic structure and syntactic acquisition: the case of head-direction parameter", *Developmental Science 6(2), 211-220.*

Videos:
1. "Semantic Bootstrapping" by Joshua Hartshorne

April 21 – Bootstrapping III

In our final session on human language learning, we try to put together many of the ideas we've covered over the last few weeks. First, though, you need to know a little bit more about infant cognition. Watch the short video by Mike Frank discussing "Core Knowledge."

Next, read my paper with Jesse Snedeker "An Emerging Consensus on How Children Learn Language" for an overview on what I've been working on that tries to tie together some emerging trends in the study of language acquisition. 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.

For a somewhat different take on similar issues, read the 2015 paper by Deb Roy, which takes goes even farther in trying to tie the structure of language to the structure of thought.

Reading:
1. Hartshorne and Snedeker (DRAFT) "An Emerging Consensus on How Children Learn Language"
2. Roy (2005) "Grounding words in perception and action: computational insights", *TRENDS in Cognitive Science*

Videos:
1. "Core Knowledge" by Michael Frank

April 26 – 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.
I have not been able to find a good recent overview. So instead, we are going to look at four case studies:
1. Bird song:
    a. Video: Bird Brains (Nova – Science Now)
2. Squirrels:

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

3. Campbell's monkeys:

    a. Ouattara, Lemasson and Zuberbühler (2009) "Campbell's monkeys concatenate vocalizations into context-specific call sequences", *Proceedings of the National Academy of Sciences*

4. Dolphins

    a. Janik (2013) "Cognitive skills in bottlenose dolphin communication", *Trends in Cognitive Sciences*
    b. "Could we speak the language of dolphins? | Denise Herzing" by TED
    c. Recommended: King and Janik (2013) "Bottlenose dolphins can use learned vocal labels to address each other", *Proceedings of the National Academy of Sciences*

April 28 -- Language in the World: Second Language Education and Speech & Language Pathology

We will have two visitors today. First up will be Prof. Hiram Brownell who will talk about speech and language disorders and treatment of speech and language disorders. Second will be Prof. Esther Gimeno Ugalde who will talk about second language education and language assessment.

The speakers will have some prepared material, but I've told them to expect lots of questions. So please come with questions!

May 1 - Language in the World: Career Services & Graduate School

The first 25 minutes of this class will be a presentation from Career Services. I'm not completely sure what they are planning on doing and how specific it will be to our class. So we'll see. After that, I'll talk and answer questions about language research within academia.

It'll be hard to generate questions in advance for Career Services (since we don't quite know the topic), but please think about what questions you might have about academic research (how it works, what preparation is required, where the money comes from, etc.).

May 3 - 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, works at BBN technologies, a private research institute that works on a variety of such technologies. We may also have a speaker from Amazon (TBA).

Lab Days

January 29 – Problem Set 1: Research Ethics

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 Cyber IRB. Send your username to info@l3atbc.org (subject line: CyberIRB).

February 5 – Problem Set 2: Collecting Data through Amazon Mechanical Turk

Instructions are in this document.

February 12 – Problem Set 3: Git

Instructions are in this document.

February 19 – Problem Set 4: Introduction to R

Instructions are in this document.

February 26 – Problem Set 5: R - Part 2

Instructions are in this document.

March 5 – Problem Set 6: R - Part 3

This week, we are going to do basic statistical analyses in R. DataCamp doesn't haven't any courses that cover the topics we need, so we're going to use swirl. Swirl is similar to DataCamp but runs inside of your personal copy of R, rather than online. The major disadvantage is that it's not easy to go back and look at a topic again, so I **highly recommend** you take notes.
(Advanced R users may choose instead to do a course on DataCamp and submit the certificate showing completion.)

1. Install swirl if you haven't already. In R, run *install.packages("swirl")*.

2. Then, install the two modules we'll be using. In R, type the following:

> *library(swirl)*

> *install_from_swirl("Data Analysis")*

> *install_from_swirl("Mathematical Biostatistics Boot Camp")*

3. To load swirl, type *swirl()*.

4. Follow the prompts. Then choose the "Data Analysis" course. Allow swirl to install any required packages. Then complete the Mathematical Biostatistics Boot Camp.

5. Return to your experiment. Write some more code to analyze your data. Include at least two t-tests. Push the finished R script to your repository.

6. Submit the word "done" here so that I know you are done.

March 13 – Problem Set 7: Prepping for experiment

For our bonus assignment, we are going to be writing an analysis script for our upcoming experiment.

1. First, read "Word Segmentation: The Role of Distributional Cues" (Saffran) This is the paper that we are going to replicate. We will be replicating both experiments.

2. Next, we're going to write the analyses for these experiments. Luckily, the authors only used t-tests. This is actually the wrong analysis for these kind of data, but it was the mid-'90s and people didn't know any better. For a replication, it's important to replicate the original analyses as well, otherwise we are comparing apples and oranges. (We'll discuss how to do the analyses correctly later.)

   Of course, we don't have the original data. So I have written an R script that will simulate the first experiment and return the data. I have written in stubs for the analyses that I want you to do (there are a couple from the paper that we are skipping for now). Your job is to fill in those analyses. Then you will simulate the data for the second experiment and analyze those data, too. **I highly recommend that you work in groups**.

3. First, create a repo on bitbucket. You only need one per group, though you all need access. You should know how to add each other to the repo. Then download the Problem Set 7 R file and commit it to your repo (only one of you needs to do this). Then finish the analyses! I recommend that you commit and pull/push regularly. **If you are working in a group (which I recommend!), you must each push at least one commit to the group repository**. No fair having one person do all the work.

4. When you are finished, share the repository with me and then each of you should submit the word "done" here.

March 19 – Problem Set 8: Making the experiment

This week, we are making the experiment!

You should have access to the repository "word_segmentation" through bitbucket. Don't clone this repository, however. Since you will all be working on it individually (or in groups -- which I recommend), we don't want your work to conflict. Instead, use what's called a "fork" of a repo.

In Bitbucket, choose the "..." button on the left-hand panel. From the menu, select "Fork". This will create a new repository. Name it something like "jkh_nonword", but use your initials (or your group's initials) instead of mine.

Once the repo is created, add me and the members of your group to it (select the Settings wheel and choose "User and group access" from the menu).

Forks are what they sound like: independent versions of a repo. It is possible to merge code between different forks, though we won't be using that functionality.

Then clone the repo and following the instructions in guide.pdf.

March 29 – Problem Set 9: Interlude

Instructions are in [this document](#).

April 7 – First Paper

You should have access to a repo on Bitbucket named "Paper1." If you do not, inform an instructor ASAP.

Read guide.html. If you double-click guide.html, it should open in a browser. If not, drag-and-drop it into a browser. The guide will explain what to do.

You should also have access to two other very useful repositories: saffranexp1_word_segmentation_nonword and saffranexp1_word_segmentation_partword. These contain the actual files we used to collect data for the nonword and partword conditions, respectively. They also contain an updated guide.html which explains in excruciating detail how exactly I completed Problem Set 8.

With these repos, you have all the information you need to complete this paper. However, some of you may have difficulty remembering where specific pieces of information are. So I recommend you work on this early in order to give yourself time to ask clarification questions or seek out help. As with the problem sets, this paper is open-book, open-classmate, and open-instructor.

May 8 – Final Paper

Instructions are in [this document](#).