

[SQUEAKING] [RUSTLING] [CLICKING]

NORVIN
RICHARDS: Early on in this class, I think, I gave you examples-- it might have exactly been these examples. I meant to look back at the old slides to see. But it was something with this character anyway. I invited you to tell me-- if I ask you a question like "Who did Biden ask to see him?" I asked you, who's "him"? And I think, at the time-- who knows, we could do this exercise again and find out whether your minds have been warped by a semester of 24.900.

I think, at the time, what you said was that "him" could refer to Biden. It was possible for this to mean "who"'s the person such that Biden asked that person to come to his, that is Biden's, office and see him, right? It could mean that. And then so it could also refer to someone else, of course. But it could refer to Biden. We weren't doing this at the time, at the beginning of the class. But we can represent that with these subscripts, since we've since talked about binding theory. This is the kind of fact we're in a position to talk about.

And then what we also did at the beginning of class was to think also about questions like "Why did Biden ask to see him?" And what you all agreed at the time-- and feel free to jump in and stop me if you-- oh, Faith's about to stop me.

AUDIENCE: I was just going to be like, I feel like now with everything we've learned about wh-movement, it feels wrong because you're moving something out of an island, I think. But you're keeping it there at the same time. Like "him," I feel like it was more appropriate to omit "him" because you're moving the "who" anyway.

NORVIN
RICHARDS: Oh, the first one? "Who did Biden ask to see him?" Oh, so in the first one, "Who did Biden ask to see him?" is supposed-- the answer is supposed to be the-- whatever, the head of the Joint Chiefs of Staff. He asked the head of the Joint Chiefs of Staff to come and see him, Biden. So Biden's worried about something that he wants that guy's advice on. And so he asked him to come see him.

I think that's an OK question that you can ask that way. Yes, so you have been warped, you specifically, by a semester of 24.900. You're starting to fear islands everywhere, which is good. It's an important part of your training as a syntactician, yeah.

Cool. So the first one then, "him" can refer to Biden, but it doesn't have to. For the second one, I think what people said at the time was that it wasn't possible for "him" to refer to Biden anymore. So "Why did Biden ask to see him?" That has to be, "Why did Biden ask to see some person, some particular person, but not Biden?"

Do people still have that feeling? It's been a whole semester of suffering through this stuff. No? Yes, many of you do. Some of you, it's too early in the morning to have feelings about binding theory. You don't have to have feelings exactly. I'll settle for opinions.

So I think there's this contrast between these sentences. And you know what I said at the beginning of class was look, these sentences, they look pretty darn similar-- they only vary in, like, one vowel, right? It's the difference between "who" and "why." And yet, you make that small change to the first word in the sentence and the last word in the sentence changes who it can refer to. Pretty complicated array of facts. And I think what I also promised, incautiously, was that by the end of class, you would understand why it worked this way. And so I just wanted to stop and talk about why it worked this way, partly as a way of segueing into what we're going to talk about today, which is language acquisition.

So why does it work this way? So first, as Faith just said, one of the things we know about the first example is that "who" is moving, it's starting off as the object of "ask." So "Biden asked the chairman to see him." "The chairman" is the object of "ask." Instead of "the chairman," you've got "who." And "who" is undergoing wh-movement. "Why" is presumably also undergoing wh-movement. Let's not worry about where it's coming from.

And the other thing that maybe you're in a position to believe by now-- we talked about this when we were doing binding theory-- was that these infinitival clauses, although they don't appear to have subjects, that they actually do have subjects. Their subjects are just null. We were calling it "PRO." It's this null pronoun that refers back, in both cases, to something in the higher clause.

So in the first example, "Who did Biden ask to see him?" We consider the non-wh-moved version of this-- "Biden asked Harris PRO to see him." Here, PRO refers to Harris, right? This means Biden asked Harris to do the following thing. He wanted Harris to come see him. Does that sound right? That's what that means. So that PRO is an instance of what we called object control. PRO is referring back to an object in the higher clause. Yeah, Joseph?

AUDIENCE: Sorry.

NORVIN It's OK.

RICHARDS:

AUDIENCE: PRO in to satisfy the EPP.

NORVIN Yeah, that's right. That's what it was for. It satisfies the EPP. C needs a subject and doesn't appear to have one.

RICHARDS: And the claim back then was it really does have one. We went through this idea very quickly. One of the things we discovered about it was that it made the statement of binding theory simpler. It made it easier to understand why pronouns and anaphores inside infinitives act the way they do.

And this is, in a way, an instance of that. So this PRO is referring back-- I'll give it the same subscript that it's got up there. If we change "Harris" to "who" and move it-- "Who did Biden ask to see him?" This PRO is controlled-- we say it refers back to the object of the higher clause.

In the second example, the higher verb, "ask," doesn't have an object. It doesn't have to have an object. So you can say "Biden asks Harris to see him." Can also say "Biden asked--" this is with no object-- "to see him." And then the PRO gets controlled by the subject. So "ask," when it has an object, it's what's called an object control verb. The object of "ask" controls PRO. When it doesn't have an object, it's the subject.

I think I said when we very briefly talked about this, it sure would be nice to understand why a verb-- what it is that conditions, which thing controls PRO. That's a topic of serious research. People try to figure out what the rules for that are. And it's not simple.

So yeah, this is a way of representing what's going on in these sentences. Those embedded clauses have a subject, a subject you can't see, that refers back either to the object of "ask," in the first example, or to the subject of "ask," Biden, in the second example. This has been review, sort of. Does this make sense? Do people sort of remember this? No?

And this, finally, allows us to understand why the pronoun at the end is behaving the way it is. So there's this general principle, principle B, that says pronouns have to be free in a certain domain. That is, they have to not have a binder, not have something that c-commands them and corefers with them. That's too close. We have to figure out what "too close" means.

We can account for these data if we decide that the domain in which the pronoun has to be free is the domain that I've got brackets around, the embedded clause. So it has to be free in that clause. I don't care. Go away. No. It has to be free in that clause.

What does that mean? Well, in the first example, it just means that "him" has to not refer to Harris. Well, there are lots of good reasons for it not to refer to Harris. I should have used a male name. It can't refer to the object of the higher clause because that object is controlling this pro.

So if we kept Harris, if we said "Biden asked Harris to see him," then "him," of course, couldn't refer to Harris. But if you said "Biden asked Harris to see her," then "her" still couldn't refer to Harris-- background knowledge for anybody who has forgotten this Harris is female. "Her" still couldn't refer to Harris because "her" is too close to PRO would be the story, yeah. So that "him" is capable of referring to Biden because "Biden" is outside the bracketed domain.

What about the "him" in the second example? Well, "Biden" is outside the bracketed domain in that example, too. But there is a PRO in the bracketed domain, the embedded clause, that is controlled by "Biden" and refers to Biden. So "him" cannot refer to Biden because there's-- not because "Biden" is too close, but because PRO is too close. PRO is inside the bracketed domain. And it binds him. It's too close.

Yeah? People remember principle B? Principle B was meant to account for the fact that if I say "Biden thinks Harris likes him," that "him" can refer to Biden. "Biden" is far enough away. Whereas if I say "Harris thinks Biden likes him," now "him" cannot refer to Biden. "Biden" is too close. So we have a principle B that says "him"-- pronouns generally-- can't refer to a c-commanding noun phrase that's too close. We have to define "too close." But it's something like inside the same clause.

So here, "Biden" is far enough away for "him" to refer to Biden. It doesn't have to. It could be somebody else. Here, "Biden" is too close and "him" can't refer to it. And something similar is going on in the slide.

So this is me making good on my promise at the beginning of the semester. Beginning the semester, I said, by the end of the semester, you'll understand why this is. So now, you do, right? Do you have questions about this? Does this make sense?

Well, so now we understand this-- yeah, yeah, I did all that. Now, we understand all this. But you know, all of you are exceptionally smart, right? And here you are getting an expensive university education, where someone is explaining this to you in great detail. And so that's why you understand what's going on here.

But there's another sense in which you understood something about what was going on here. You had these intuitions. You knew what those pronouns could refer to before you ever set foot in this class. And people who don't have your advantages, people who are not getting expensive university educations, people who are not as smart as you, they also have those judgments. You can wander around Boston, ask any native speaker of English, they'll agree about these sentences, about who "him" refers to, yeah?

So question-- how did that happen? How do you end up with this, in the sense, exceptionally complicated knowledge? How are you doing all of this? This is a subpart of what Chomsky likes to call Plato's problem. Plato, I guess, in his writings somewhere asked this question-- how is it that-- he wasn't talking about language specifically.

How is it that we know so much about the world, despite the fact that our evidence is kind of random and spotty? It's not as if your parents ever sat you down and explained, "Oh by the way, if I say 'Biden asked to see him,' then 'him' can't refer to Biden." Nobody ever explained that to you. You just kind of figured it out, despite the lack of any relevant instruction-- not just this fact, but a whole bunch of complicated facts, all the complicated stuff we've been talking about in this class.

Your parents never explained that to you, I assume. Who knows? Maybe there's somebody in this class whose parents were exceptionally helpful about this stuff. But presumably, not all of you had your parents explain this to you. People who have studied the interactions of parents with children, it's pretty clear that parents very occasionally give children direct instruction about how to speak. But they usually have other kinds of priorities.

So this is an actual dialogue between a child and the mother. The child says, "Mama isn't a boy, he a girl." The mother says, "That's right." The child says, and "Walt Disney comes on Tuesday." The mother says, "No, he does not." So this is an actual dialogue between a small child and a mother. And something that you notice about it is that if the child is relying on the parent to get explicit instruction about grammar, then the child is out of luck, right?

So the child's first sentence has some grammatical problems. The child is using "he" to refer to-- to refer to the mother. The response that the mother gets-- the child gets from the mother for that is "That's right," right? Because the mother is not thinking too much about the grammar. The child has made an accurate observation about the world, right? We can worry later about pronouns. The point is the child is figuring something out about the gender of their mother.

And then the child says this perfectly grammatical sentence at the end-- "And Walt Disney comes on Tuesday." And the mother says, "No, you're wrong," right? Well, OK, so apparently, the mother is not paying too much attention to stuff like grammar. The mother is paying attention to accuracy about the world. And this child is therefore going to grow up to be a normal and well-adjusted human being because that's what you want from your parents. It would be odd for the mother to say "No,, no, you're using the masculine pronoun for me. And that's not correct."

There actually are dialogues-- if you've ever been around a small child, you know when parents do attempt to instruct their children in how to speak, it often-- it's not clear that the children are paying any attention. So here-- again, I swear I am not making this up. Somebody recorded this. A child said, "Nobody don't like me." And the father, who should really have had his fatherhood license taken away, said, "No, say 'Nobody likes me.'"

This dialogue repeats six times on the tape. And then finally, the child says, "Oh, nobody don't likes me." And curtain. I don't know what happened after that. I mean, this particular dialogue is hopefully not one you'll often hear, but you do. There's another classic that somebody recorded.

A child said, "Give me other one spoon. I want other one spoon," right? And the parent tries many times to get them to say "the other spoon." "No, say 'the other spoon.'" "Other one spoon." "Say 'the other spoon.'" "Other one spoon." "Say 'the other'"-- "No, other one spoon." They go back and forth like this. And the parent says one word at a time-- "the, the, other, other, spoon, spoon." "Yeah, the other spoon," says the child. "Now give me other one spoon?" asks the child.

So parents do-- I have been a parent. If you've ever been around children-- so I can attest that this is how it works. Even if you are trying to tell children how to speak, they're not listening to you. And most of the time-- the first dialogue illustrates this-- the parents quite rightly are not really paying too much attention to the grammar of their children's utterances. They're just excited by the fact that their children are talking.

So how are we learning all this complicated stuff? It's not because your parents teach it to you. Even when they try, you don't pay attention, apparently, at the relevant stage. And there's an answer that I've been pushing in this class. It's this idea of universal grammar, which is that human beings can't help building our languages in certain ways.

And so you, of course, need some data in order to build your language because there are 6,000 some languages out there. So you need to learn which of those languages it is that you're learning. But languages come with certain properties sort of factory preset. You don't actually have to learn all this stuff about controlled PRO, and condition B, and so on. Universal languages just work that way.

It's just a matter of learning which of the words in your language means "ask," and which one means "see," and which one means "him," and so on. And once you know those things, then you know that your language will work this way because you can't help it. That's the way languages work.

So we've spent the whole semester trying to figure out exactly what it is that you know when you know your native language. And I hope I've convinced you that it's more complicated than you might have thought. You know quite a lot, lots of complicated stuff going on in your head.

And so a question arises. What's innate? What is this stuff that's preset? And what is learned? And as I've just said, it's obvious that not everything is innate because there's more than one language out there. You've got to learn which string of sounds means "ask," which string of sounds means "cat," which string of sounds means "spoon," and so on.

There's some evidence also that evidence matters, which comes from the idea of what's called a critical period. It looks as though-- it's very hard to get direct evidence about this, but it looks as though there may be a period in the life of a child when they're especially well-designed to acquire language. And after that period is over, they get worse at it.

There's a lot of anecdotal evidence for this. All of us fluently learn one or more languages as a child. When you're a small child, you learn the languages that are around you. For me, it was one language. There are lots of people who learn more than one language growing up.

But anecdotally, for most of us, once you're an adult, it's much harder to fluently pick up another language just by being exposed to it. Even if you imagine being surrounded by people who are willing to just talk to you all the time in another language, it's not clear that you would learn it in a matter of six years or seven years, which is what you did with your first language.

There are some cases that bear directly on this hypothesis. They're sort of awful cases, but I feel the need to tell you about them. One of them is the story of a child who was given the pseudonym Genie. Genie was discovered, I think, in LA in 1970. She was the child of a mother who was almost blind. Her mother had a degenerative disease of her eyes. She was gradually going blind. And by the time Genie was discovered, she was almost completely blind.

And her father was crazy, so probably paranoid schizophrenic. He pathologically hated noise. He couldn't stand noise. And so if you've ever been around small children, you know that they sometimes make noise. So he was-- I mean, talk about people who should have had their license to be a father taken away.

Genie had one older sibling who died of exposure because they were kept in the garage of the house because they were noisy and the father couldn't take it. She had another older brother who did survive, I don't know how. Maybe her father wasn't quite as crazy when her older brother was born.

But when Genie was born, they had learned not to keep the babies in the garage anymore. What they did was to keep her in a dark room strapped to a chair and to punish her for making sounds. So no one ever spoke to her. She apparently could sometimes hear piano music from a nearby house. So when she grew up, she always loved piano music.

Her father and her older brother would sometimes bark at her like dogs. So she was always afraid of dogs. That went on for the first 13 years of her life, after which she was discovered and taken away from her parents. She was discovered because her mother somehow-- who as I said, was almost blind-- had gotten out of the house with Genie and was trying to find a government office where somebody could help her-- not with Genie, but with something having to do with their blindness. She was looking for an office that would help her with that and wandered by accident into an office that was about child welfare. And they immediately spotted that there was something off about Genie.

So Genie was taken away from her parents-- sorry-- and put in a series of institutions, where lots of people did their best to help her recover from the first 13 years of her life. And she did, in a sense, recover, in the sense that she acquired the ability to stop attacking people when she saw them. And she was wild when she was first out of the house. And she learned to say some words.

But she never learned to speak, in the sense of putting words together in anything that resembled grammar. So she was just saying words. So she knew words for things that she wanted. And insofar as it was possible to do intelligence tests on somebody who was as profoundly traumatized as she was, she scored as a perfectly intelligent person. She had a normal mind in all kinds of ways. But she never learned to speak.

So that's one case that people say, ah, so if you deprive a child of linguistic information for the beginning of their life, then this has profound consequences for their ability to learn to speak. And it could be that that's what this shows. It could also be that if you terribly traumatize someone for the first 13 years of your life, that you damage their ability to learn to speak. As an example of the critical period, it lacks a certain scientific rigor, it seems to me.

So I apologize for telling you this story. I feel as though anyone who takes intro linguistics should learn about Genie. Though, as I say, Genie is a pseudonym. I have no idea what her name is.

There are better stories than that. Chelsea, also a pseudonym-- and actually, Chelsea's case is a case that used to be common-- not common-- used to be more common than it is now. There are safeguards in place now to stop this from happening as often. Chelsea is another girl who grew up in Northern California-- I don't know what it is about Northern California-- whose parents believed that she was profoundly developmentally disabled.

This is not a story like the Genie story. So her parents were perfectly loving, caring people. They were doing their best to raise her. They treated her very well. She had a happy life. But she wasn't-- she was developmentally behind on all kinds of milestones. In particular, she wasn't learning to speak. And so her parents just did their best to deal with that.

At some point-- I want to say when she was 12 or 13-- it was discovered that she wasn't developmentally disabled at all. She was deaf, that she was profoundly deaf. And her parents-- I mean, again, perfectly kind, loving, sort of unobservant people had never noticed this, I guess. So the fact that she wasn't speaking, it wasn't because she was developmentally disabled. It was because she hadn't heard any speech. And nobody had been signing to her because they didn't realize that she was deaf.

So she hadn't been exposed to language in any form either. And as I say, it's a happier story than the Genie story because there was no actual abuse involved. And as I also said, this is something that happens much less common these days. So all of you hopefully were screened for deafness in schools. And this is one of the reasons that this happens, is to stop this kind of thing from happening, stop people from slipping through the cracks in this way.

Chelsea, like Genie, wasn't exposed to language for the first 12 years or so of her life. And Chelsea, like Genie, never really learned to speak. So once they gave her cochlear implants and she was able to hear people-- again, she learned some words. But she didn't learn how to put words together into sentences. So she learned words like "banana," and "cookie," and so on. She knew how to say those words when those were the things that she wanted or she wanted to comment on the world. But she never got past that stage.

So those are two cases-- one of them maybe more convincing than the other-- that lead people to think that there might be something like a critical period. It might really be true that you're especially good at learning language in your first seven or eight years of your life.

There are cases in the opposite kind. If you're in the linguistics business, you always hear about these hyperpolyglots. They're people who somehow never seem to exit their critical period. I had a professor like this, Ken Hale, who was here when I was a grad student here, somebody who seemed to just be able to learn languages by being in the same room with the speaker for a little while. He had this amazing ability to pick up languages.

There are lots of Ken Hale stories, including a story about him. So he spent a big chunk of the '60s wandering around Australia, going from Aboriginal community to Aboriginal community, learning the local languages, and studying them, and writing grammars, and so on.

There's at least one community that no one has been able to work with since because he was the first person who went there, and so he went and he was there for like a week, and he learned to speak the language fluently, and then he left. And then the next group of linguists came to try to work with these people.

And the people were like, "You people are all so slow. Why does it take you so long to learn? We've been telling you over and over again these words." And linguists were like, "Well, it takes a while to learn the language." And they're like "No, no, no, the last guy who came through here-- it was very easy. I don't know what your problem is." Did you have a question?

AUDIENCE: Yeah, is there any evidence of actual physical cerebral damage or atrophy in these cases?

NORVIN RICHARDS: So for Genie, I don't know whether the relevant scans have been done. I don't know. For people like Chelsea, I also don't know. But it would be interesting to find out. Yeah, yeah. Genie-- I mean, there are all kinds of sad things about the story of Genie.

After she was taken from her parents, she lived in a series of institutions. And then her mother-- her father committed suicide pretty soon after she was taken away. And her mother-- eventually, I think her mother got custody of her again for a while. And then she was back in the institutions for a while.

So she lived for a while with some linguists who wrote books about her, studied her, tried to help her. And then her mother successfully convinced the court that she would be better off living with her mother. So they did that for a while. So there was a period there where she was hidden from the eyes of linguists after this initial period, where she was being intensely studied.

OK, all right, so it's possible anyway that there's a stage that children go through where they're especially good at acquiring language, a stage that most people then exit around six or seven years of age, though there might be people like my old Professor Ken Hale for whom it just never ends. And then lots of questions about how this knowledge works-- how do you acquire it? And we've been spending the semester talking about the nature of this knowledge.

There are people who specialize in what's called language acquisition. This is the study of what kids know and when they know it. And so I wanted to tell you a few of the results from that subdomain. There is an undergraduate class that specializes in language acquisition. I forget what its number is. But if this is a series of topics that interests you, we have people who can teach you about this.

There is a frequent discovery that the people who do language acquisition make, which is that children are smarter than you might think. So they know stuff that it's not obvious that they know just by watching them. Lots of cases where children are making what we may as well call an error-- that is, they're doing something that adults don't do. But if you look harder, you can show that they actually do have a representation, some knowledge that resembles what adults do. I'll show you a phonological example first.

Here are some data from a Japanese child. This is a standard representation of children's ages. So this Japanese child, at the time that these observations were made, was three years and two months old. That's what that 3:2 thing means. So observation about this Japanese child-- this Japanese child didn't have the velar stop that Japanese has. So they were changing the velar stops to alveolar stops-- to "t"s, right? So mikaN, which is an orange-- it's not exactly an orange, it's another kind of citrus fruit-- is "mitaN" for this child. Or "poketto," which is a borrowing from English "pocket," is "potetto." Or "neko," which is "cat," becomes "neto."

Yeah, so this child is changing "k" to "t." They also have "t." So Japanese words that have "t" in them, like "tama," which is "ball," or "terebi," which is "television"-- it's another borrowing-- it's a clipped borrowing. They do that a lot. They have "t" in those, too. So this is a child who has changed "k" to "t" and also has "t."

Now, here's the thing about "t" in Japanese. "t" in Japanese undergoes some phonological changes, depending on the following vowel. So if "t" is followed, for example, by the vowel "a," it's just a "t." So "doesn't wait" is "matanai." But if you put that verb in the positive form, then the vowel that follows the "t" won't be an "a," it'll be an "u"-- the high back unrounded vowel. And before "u," "t" changes to "tsu." That's just a general rule. If you ever learn Japanese, you'll see it's encoded in their writing system, in the kana, that a "t" before an "u" is a "tsu."

So "waits," the positive version of "matanai," is "matsu." The "t" changes to a "tsu." And if "t" is before the vowel "i," the high front vowel, it [INAUDIBLE] to a "ch." So the word for "city," for example, is "matchi," yeah, or the formal version of "waits" is "matchimas," so you add "imas" to "mat-," that stem "mat-," which means "wait." You get the "t" changing to a "ch." OK, so basic Japanese phonology.

Now, here's the thing. This child had all of that basic Japanese phonology. So that child was saying, at three years and two months, "matanai," "matsu," and "matchi." But this child was also saying, for autumn, "ati." That is, the child was changing "k" to "t." And the child changing "k" to "t"-- so the adult word for autumn is "aki." And the adult word for "bear" is "kuma." And this child knows that "t" becomes "ch" before "i," right? But autumn, for this child, is not "achi." It's "ati," right? And "bear" for this child is not "tsuma," where "t" normally becomes "tsu" before "u" like it does in "wait." For this child, the word for "bear" is not "tsuma." It's "tuma," yeah?

If we were doing this in terms of rule ordering, I guess we could say, yeah, this is a child for whom there is a distinction between "t" and "k." And then there's a set of rules. There are the rules that change "t" to "tsu" or "ch" before certain vowels, right? And then after that, there's another rule that changes "k" to "t."

Your first thought, looking at the first set I did, "orange," and "pocket," and "cat" would be, oh, how cute this child can't say "k," and they say "t" instead. And that's right in a sense, right? You might have thought then-- this is a child who-- their Japanese doesn't have as many sounds in it as adult Japanese. And that's also right, in a sense.

But there's another sense in which it's not right. The child does distinguish "t" and "k," right? It's just that they pronounce them both "t." So the "t" that's really a "t" is the one that undergoes these sound changes before vowels. And the "t" that comes from "k" is just always a "t." It doesn't matter what the following vowel is.

Yeah, so there's some sense in which this child has a full adult representation. You have to imagine them having "aki" in their head, right? And it's just that there is some rule that goes between their head and their lips that changes "k" to "t" all the time, no matter what the following vowel is. There's something like that going on.

There's a small instance of a general pattern. What you find is kids are doing something wrong. They're doing something that's not what adults do. But if you look very closely, you can convince yourself that they know more than they seem to.

Yeah, so just to remind you of stuff that we talked about earlier on-- so what I just showed you-- and I'll show you some more examples like this in a second-- involve just making lots of recordings of children speaking naturally, and then studying them. And that is one kind of thing that acquisitionists do. There are other kinds of work in which you run experiments on children.

We talked about some of this kind of work early on in the class. So we're talking about selective looking tasks and sucking rate tasks. So sucking rate tasks make use of the fact that if you give a very small infant something to suck on-- first of all, they will. Sucking on things is one of their favorite things to do at that age. And it turns out that if you give them something to suck on, they will suck on it at first fairly rapidly. And then they will start to slow down.

And how quickly-- they say you can give them something to suck on to which you have attached a clever device that will record the rate at which they suck, pay attention to how often they're going-- they're making sucking motions. And the observation is that if you give a child something interesting to look at, if they've started to slow down, and then you show them an interesting picture, they'll speed back up again. They perk up. And language acquisition is to make use of this.

So if you want to know-- so here's the kind of experiment people have done. They've shown that Japanese infants-- so very small Japanese children-- can distinguish an "r" sound from an "l" sound. That is, if you play "rah" or "lah" at them, that they can distinguish these from each other. This is interesting because adult Japanese speakers can't do that. Japanese doesn't have a distinction between "r" and "l." They only have one liquid. So it's a famous fact about Japanese speakers. It's hard for them to distinguish "r" from "l."

But very small Japanese children-- so children who are acquiring Japanese-- can distinguish "r" from "l." They know the difference between "rah" and "lah." And the way you show that is with this sucking rate task. So you give the child something to suck on. And when they start to slow down, you start playing "rah, rah, rah, rah" at them. And they speed up at first because, hey, here's a new thing. It's a recording. And then eventually, they slow down. They're like "rah," yes, I get it. Thank you very much.

And then you switch to "lah." So you go "rah, rah, rah," and they start to slow down. Then you go "lah, lah, lah," and they perk back up again, showing that they can distinguish the "rah" from the "lah," that these are different things as far as they're concerned. They've done similar kinds of tests with English-acquiring children, showing that they can distinguish aspirated from unaspirated stops.

So cast your minds back to the beginning of the semester. We were talking about the fact that in a language like Hindi, for example, there's a difference between "pah" [ASPIRATED] and "pah" [UNASPIRATED]. So English has voiced stops and voiceless stops. We have a distinction between "pah" and "bah." So there's an aspirated voiceless stop. And there's a voiced stop. And then Hindi has a three-way distinction between "pah" [ASPIRATED] and "pah" [UNASPIRATED] and "bah."

And so "pahl" and "pahl" are two different words in Hindi. I think one of them means "knife" and the other means "flour." And I can't remember which is which. Anybody here speak Hindi? OK, those are two different words. So Hindi has these two distinct sounds that are different.

And an observation that people have made with very small infants who are acquiring English is that if you do the sucking rate task with them and you play "pah, pah, pah" at them, that they eventually start to slow down. And if you then switch to "pah, pah, pah," the unaspirated stop, they're like, oh yeah, that's a different thing. So they recognize that as a different sound.

One of the things that they can show-- actually, because the beauty of aspiration is it's the kind of thing that comes in degrees that with-- that you have the release of the closure, and then you have the beginning of the vowel. And you can electronically manipulate exactly how many milliseconds it takes for the vowel to start. And there is a particular cutoff.

So if you give children an aspirated stop and an unaspirated stop, they can distinguish those. If you give them two stops that differ in aspiration by just a little bit, then whether they can distinguish those two stops from each other depends on whether one of them is on one side and the other on the other side of a particular dividing line. I forget what it is, like 50 milliseconds or something like that. There's some particular amount of time that is the cutoff for distinguishing sounds from each other.

For being able to speak adult English, this knowledge is useless. But the theory is that all babies-- Japanese babies are all ready to distinguish "l" and "r." And the English speaking babies are all ready to distinguish aspirated and unaspirated stops. The babies are just born able to distinguish all of the kinds of sounds that they might need. And then as they grow up and start learning the actual language that they're learning, they forget stuff. Anything that isn't useful they get rid of. So Japanese babies stop carefully distinguishing "rah" from "lah" because their parents don't. That's one of the observations people have made about this stuff.

So I want to get on to the next thing. So I don't want to spend too much time on this. So we've spent some time talking about stuff that suggests that babies have just a spooky amount of knowledge in advance, before they learn anything at all. And in fact, in the particular case of acquiring phonology, some of what they're doing is forgetting stuff that they come into the world knowing. That seems to be the way they're set up.

There is stuff that children clearly have to compute. And there's some beautiful work on how exactly children segment the speech stream. So when we write things in English, we write with spaces in between words. But those spaces don't correspond to anything in the phonological signal, right? If you look at a spectrogram of somebody speaking, it's just a long string of sound. You don't put spaces in between your words, unless you're speaking extremely cautiously.

And in fact, children make mistakes in speech segmentation. So a classic example is of a child who's just been told to behave and responds, "I am being hayve." So this is a child who thinks that "behave" is like "be" plus some adjective, right, "hayve"? "Be as hayve as you can," right? The child is doing their best, right? Or the other classic like this is a child who's just been told "We're going to go to Miami" and responds "I don't want to go to your Ami," which is a similar kind of mistake, is thinking that "Miami" is two words, a perfectly plausible thing.

There's all kinds of really interesting work on how exactly children segment the speech stream. And there's lots of evidence that they use statistics about phonotactics-- that is, they make observations like if I see this pair of sounds next to each other, it's because-- so in English, if I have an expression-- if I say a pair of words like "lies beneath" the water, let's say-- so here, I've got a word ending in a "z" and another word beginning with a "b," yeah?

So if you're an English speaking child, even before you know any words, the observation is-- it's as though they look at pairs like that and they go, oh, I don't ever seem to hear speech streams beginning with "zb" in English. So "zb" isn't something that an English word can begin with. And so maybe this is a word boundary.

And there's this experiment that Saffran et al. did in '96 showing that very young children are very good at-- this was, again, using the sucking task, I think. Maybe it was the selective looking task, a similar kind of task, showing the children are very good at making observations about which pairs of sounds occur next to each other frequently in a speech stream.

So in their particular case, what they were doing was exposing small children to streams of syllables. So they made up words. I'm going to make up words, too. So this is not the actual words they had, but they had the shape. They were CV, CV, CV words. So it was like "to, la, vi," and then "mu, ga, pi," whatever. And they made up strings of words. Here, I'll make up one more-- "ri, na, vi."

And the observation was-- so they made up speech streams for the children that involved these words. So the speech streams would sound like "to la bi, mu ga bi, re na vi, re na vi, mu ga pi, re na vi, re a vi, mu ga pi, to la bi," without intonation. Just these syllables one after another. And the children basically very quickly got to where they knew that if you hear a "to," you're going to hear a "la" next. Or if you hear a "ga," you're going to hear a "pi" next. So they got to where they could make those predictions.

And what that meant was that they knew that if you heard a "pi," you didn't know what you were going to hear next. There were a variety of things that you could hear next. So they learned these transitional probabilities very quickly. And it was remarkable. Again, babies are smarter than they look. This is one of the big results of language acquisition research.

So children are good at this. There's a lot of work since '96 on exactly what it is they're good at. So for one thing, the original work involved words, made up words that were all three syllables long. And it was shown that if you'd vary the number of syllables, the babies get less good at it. It was also shown that they get better at it if you give them prosodic cues, like the words are all stressed on the first syllable, that that helps figure out where the word boundaries are.

So however they're doing it, the upshot of it all is that children-- they speak their first words around the end of their first year of life. And then by the time they're about six years old, for English speaking kids, the estimate is that they know about 13,000 words. So there's this period where they're learning about six or seven words every day, which is astonishing. I mean, if you imagine trying to learn six or seven words every day, go study some foreign language and try to learn six or seven words a day. That's a really fast clip. But if you can do it for six years, then you will speak that language really well, whatever it is.

This has all been about phonology. There's a lot of work on the acquisition of syntax. And again, this is sort of like the Japanese child phonology that I was showing you at the very beginning here. A similar kind of case-- there are lots of cases of children doing things that adults don't do. And yet, in the course of doing that, demonstrating that they know more than you might have expected them to.

So children in many languages go through what's called a root infinitive stage. That is, they use verb forms that are infinitives-- the kind of verb that you would use in an infinitival clause. Here are some examples from Danish and from Dutch and from French. This is not universal. There are languages that don't use optional root infinitives. But many languages do. English, arguably, has it.

Of course, English verb morphology is so impoverished that it's hard to see. But the idea is that when children say things like, what? "Doll sleep," which is the kind of thing that a two-year-old might say, that that's a way for the child to say "The doll sleeps." And they're using an infinitive. They're using an optional infinitive, so a verb that's missing the morphology that you would expect it to have if they were an adult.

But the observation is that although they are confused about whether it's OK to have a main clause be an infinitive, what's interesting is that they know all kinds of sophisticated stuff about what it would mean for it to be an infinitive. So for example, when we were talking about German, I think I told you German's a V2 language. So in ordinary main clauses, the verb is in second position.

In infinitives-- well, infinitives are usually not main clauses in German. So the verb is typically not in second position. It's at the end of the clause. It goes at the end of the clause. And German-speaking children go through this root infinitive stage, a stage when they're around two or three years old, where they use infinitival verbs a lot. And they put those verbs where they should.

So they are confused about something. They're confused about whether it's OK for a main clause to be infinitive. But they're not confused about the rules for where the verb goes in German. So when they're using-- when they do use tense verbs-- and they do-- they put them in second position. And when they use the infinitival verbs, they put them at the end.

And that kind of fact has been replicated in a bunch of different languages. So here's a German two-year-old saying-- the child wants to say "Thorsten has Caesar"-- I think Thorsten was a teddy bear-- and "have" is in the infinitive. And so it's at the end. But in that second example, the child is trying to say, "I have a big ball." And that's pretty good German, apart from mispronouncing the word for "big." The word for "have" is in second position. It's inflected. It's not infinitival. And it goes in second position.

So yeah, this child is acting like an adult German, except for the fact about having an infinitive in a main clause. So there's a mistake, but it's a constrained kind of mistake. And this is pretty-- again, this is-- we're back now to studying this stuff by just studying what children actually say. This is a recording study of this German child, Andreas, who was two at the time-- 281 utterances. And a healthy proportion of them were these root infinitives. And if you look at them, it turns out that the finite verbs are in the second position mostly and the infinitives are in final position mostly. So he's confused about where he can use infinitives. But he knows what to do with them once he has them.

Yeah, we have time for this, I think. OK, so all of this has been about studying children's naturalistic output. That is, it's been about studying what children actually say, so making careful recordings. So a lot of this involves putting tape recorders in the homes of parents of young children. The parents volunteer for this. Hopefully, they're paid. I don't know if they're paid or not.

Anyway, recording devices are put in their houses. And you end up with many, many recordings of children speaking, parents speaking to children. And you transcribe these recordings. There's an online database of a lot of these classic recordings. It's called the CHILDES database, which I think is publicly accessible. Actually, if you Google it, you can probably find it.

But there's another kind of work that people do-- and we have a lab here at MIT where this kind of work is being done-- where you do what you could think of as consultant work, kind of the work you're doing with the languages that you've been doing field work on, except the children are probably more likely to cry and to demand cookies and things like that. So some of this consultant work involves showing a child a story-- either telling them a story or showing them a series of pictures that demonstrate the story-- and then asking them whether something is true or not.

So one classic way to do this kind of experiment-- you have somebody who is telling the story, and then another experimenter who has a puppet. And the child's job is to tell the puppet whether the puppet is right or wrong. The people who do this kind of work have discovered it's easier to get a child to tell a puppet that the puppet is wrong than to tell an adult that the adult is wrong. So you have the puppet say, I know what happened. And then the puppet describes what happened.

And that way, you learn whether the child thinks that the sentence that the puppet utters is a true description of what has happened or not. So there's a lot of work, for example, on something that children do, which is kind of interesting. But if you show children a picture-- I've done this work with five-year-olds. This goes on fairly late. If you show children a picture of, let's say, four elephants-- and now, you will have to apologize-- you will have to forgive my inability to draw an elephant. Please pretend that these are elephants. Here, let's make it a story about three elephants.

So there are three elephants, you tell the child. And you tell them there are-- and there are rabbits sitting-- here some rabbits. Why am I telling the story this way? Why did I not put these pictures on the slide? OK, and there are rabbits on two of the elephants. Yes?

AUDIENCE: Those are remarkably good elephants and rabbits.

NORVIN
RICHARDS: Oh thank you very much. Thank you. After all that self-deprecation, that's exactly what I was hoping somebody would say. Please write that on the course evaluation: "Surprisingly good at drawing elephants and rabbits." So here are three elephants and two rabbits. You show a child a picture like this that has elephants and rabbits in it. And you ask-- the puppet says, "I know what's happening. Every rabbit is riding an elephant."

And an adult-- you also do this experiment with adults, just to have a control. So you tell the adults, this is going to be for children, but please humor us. Here's a puppet. You have to tell the puppet whether it's right or wrong. The puppet looks at this picture and says, "I know what happened. Every rabbit is riding an elephant."

And adults will say yes. But children at a certain age will say no. And then when you ask them why not, they'll point at this elephant and say, "This elephant doesn't have a rabbit." And so people are trying to figure out what is going on in the heads of these children. Why are they doing this? So this is an active area of research, trying to figure out what's going on. Yeah?

AUDIENCE: Isn't that complicated by syntax [INAUDIBLE] because when I first heard that [INAUDIBLE] was a nightmare [INAUDIBLE]

NORVIN
RICHARDS: Oh yeah, you were traumatized by the guards standing in front of the building. I'm so sorry. Every rabbit is riding an elephant. Yeah, so the thing is the children-- how shall I say this? I mean, so first of all, if you have the puppet say this, the children-- so the children will say, no, that's not right. And when you ask them why not, they point at the elephant. They don't panic. They don't like start to cry. I mean, some of them do. You exclude those.

But the ones who can handle this experiment, they have a theory about what the sentence means, apparently. And then if you give children another picture which is just like this one but there's an extra rabbit, then the adults-- there's the third rabbit. Then the adult-- that's about as large as an elephant. Then the adults and the children agree. They all say, oh no, now it's not true. It's not true that every rabbit is riding an elephant. So children apparently have some-- at a certain age, have something interesting that they're doing with qualifiers that is not what adults are doing. Yeah?

AUDIENCE: In this picture with the rabbit, do the children point to the rabbit [INAUDIBLE] not true always? [INAUDIBLE]

NORVIN
RICHARDS: Or do they point to the elephant? Oh, I'm sorry. Yeah, I should also have said, you can also point-- you should give them a picture like this, where every elephant has-- where there isn't an extra elephant, but there is an extra rabbit. And then again, they will say, "No, that's not true." And they'll point to the rabbit. I actually don't know if you give them an extra of both of them whether they always point the elephant or the rabbit. That's a good question, interesting to find out.

So this is the kind of thing that people study. They do all this interesting work with children, try to figure out what exactly is going on in their little heads. And one of the big takeaways from this research is that they-- first of all, they're not like adults, which any parent could have told them. But also, although they are not like adults, they have mistakes of certain kinds and other kinds of things that they don't make mistakes about. So they may use optional infinitives, if they're learning a language that has optional infinitives. But they put the infinitives where the infinitives ought to go in the sentence. They've got a particular thing that they're wrong about.

And it's for a particular stage of their life. They eventually age out of it. Or similarly here, this is a very common phenomenon, that children, if you show them this kind of picture, will say "No, no" because of the extra elephant. And we're still trying to figure out what exactly it is that children are confused about there. So there's lots of work to do.

If you are interested in linguistics and interested in children, as I say, there's a lab that works on this kind of thing. And they're always looking for volunteers, people who want to help out. And there is a class specifically about language acquisition, undergrad level class for language acquisition, where people study how to do this kind of thing.

Questions about any of this? When I put up the slides, I'll try to find the actual pictures with the elephants and the rabbits. OK, all right, well then, let's end a little bit early today. Next week, we will start up on Tuesday. It'll be our last day. I'm debating-- oh, actually, maybe I can get feedback from you guys about this.

On our last day, there are two things that I could do. I could try to do a summary of everything that we have done and, well, probably a brief summary in which we wouldn't talk for very long, and encourage you again to do the evaluation forms, and then send you on your way. Or I could do a class on signed language, which is a topic that I haven't gotten to during the semester. But we could spend a spend a class doing that.

Think about that and send me an email. Some of you are using your facial expressions to give me ideas about which of those things you'd prefer. But send me email if you have a preference one way or another about which of those things I should do. And I will take your preferences into account. All right, have a good rest of your day.