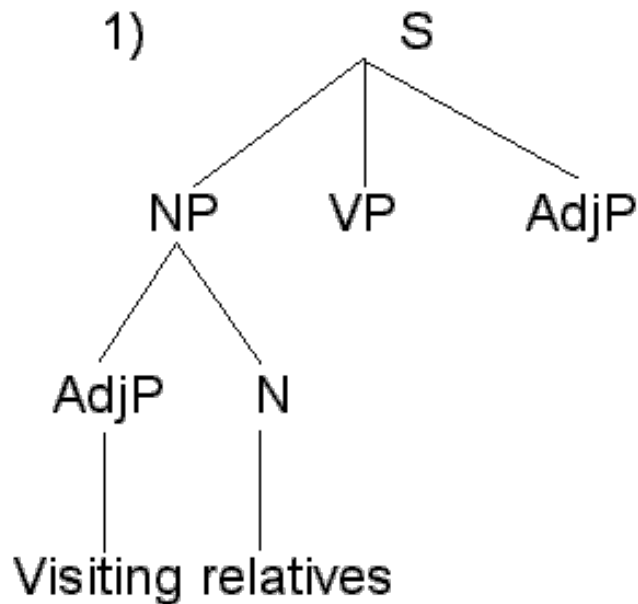


LSci 51/CogS 56L: Acquisition of Language

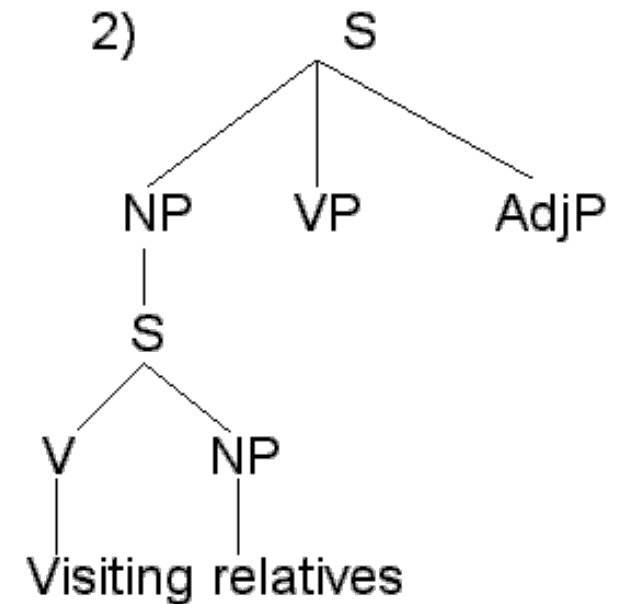
Lecture 16 Syntactic acquisition III

What sentences mean

“Visiting relatives can be irritating.”



[Relatives visiting us]



[We visiting our relatives]

Silent things



<http://itre.cis.upenn.edu/~myl/language-log/archives/002155.html>

Do they need people to decorate?

Typical: People are the ones doing the decorating.

Possible: People are the ones being decorated.

Silent things

Some sentences allow other sentences inside of them:

We know something.

We know children eventually acquire language.

Here, the sentence “children eventually acquire language” acts like the direct object of the verb *know* (it’s the sentence inside the main sentence, called the embedded clause or sentential complement).

Silent things

Sometimes, certain verbs will allow **partial or incomplete sentences** to follow them that do not have tense (these are called **non-finite clauses**, and they're signaled in English by “to” before a verb):

The girl tried **to save her brother.**

The king hopes **to win the game.**

The goblins wanted **to keep the boy.**

The dwarf decided **to help the girl.**

Silent things

Implied Subject

The girl ← tried — to save her brother.

the girl

The king ← hopes — to win the game.

the king

The goblins ← wanted — to keep the boy.

the goblins

The dwarf ← decided — to help the girl.

the dwarf

The subject of the **embedded clause** (the sentence following the main verb) is **implied**, not overtly stated.

[Extra]

Verbs with silent subjects

<https://www.youtube.com/watch?v=SYoYNeaSYrU>

<http://www.thelingspace.com/episode-52>



Especially 6:02 - 7:02

More complicated silent things

Sometimes there is more than one potential noun phrase that could act as the implied subject of the non-finite **embedded clause**:

Jareth told Hoggle **to give the peach to Sarah.**

Who's giving the peach – Jareth or Hoggle?



More complicated silent things

Sometimes there is more than one potential noun phrase that could act as the implied subject of the non-finite **embedded clause**:

Jareth told **Hoggle** to give the peach to Sarah.

Who's giving the peach – Jareth or Hoggle?

Adults say: **Hoggle** (Object of main clause)



More complicated silent things

Sometimes there is more than one potential noun phrase that could act as the implied subject of the non-finite **embedded clause**:

*Jareth told **Hoggle** to give the peach to Sarah.*

Who's giving the peach – Jareth or Hoggle?

*Adults say: **Hoggle** (Object of main clause)*

Hoggle promised Jareth to do so.

Who promised to do so – Jareth or Hoggle?



More complicated silent things

Sometimes there is more than one potential noun phrase that could act as the implied subject of the non-finite **embedded clause**:

*Jareth told **Hoggle** to give the peach to Sarah.*

Who's giving the peach – Jareth or Hoggle?

*Adults say: **Hoggle** (Object of main clause)*

Hoggle promised Jareth to do so.

Who promised to do so – Jareth or Hoggle?

*Adults say: **Hoggle** (Subject of main clause)*



More complicated silent things

How do we test what kids think?

Carol Chomsky 1969: testing 5 to 10-year-old children

After making sure children understood the meaning of *promise*, she asked them to act out sentences like the following:



“Bozo *tells* Donald to hop up and down. Make him do it.”

More complicated silent things

How do we test what kids think?

Carol Chomsky 1969: testing 5 to 10-year-old children

After making sure children understood the meaning of *promise*, she asked them to act out sentences like the following:



“Bozo *tells* Donald to hop up and down. Make him do it.”

Who’s hopping? Adults: *Donald*

More complicated silent things

How do we test what kids think?

Carol Chomsky 1969: testing 5 to 10-year-old children

After making sure children understood the meaning of *promise*, she asked them to act out sentences like the following:



“Bozo *tells* Donald to hop up and down. Make him do it.”
Who’s hopping? Adults: Donald

“Bozo *promises* Donald to hop up and down. Make him do it.”

More complicated silent things

How do we test what kids think?

Carol Chomsky 1969: testing 5 to 10-year-old children

After making sure children understood the meaning of *promise*, she asked them to act out sentences like the following:



“Bozo *tells* Donald to hop up and down. Make him do it.”
Who’s hopping? Adults: Donald

“Bozo *promises* Donald to hop up and down. Make him do it.”
Who’s hopping? Adults: Bozo

More complicated silent things

How do we test what kids think?

Carol Chomsky 1969: testing 5 to 10-year-old children

After making sure children understood the meaning of *promise*, she asked them to act out sentences like the following:



“Bozo *tells* Donald to hop up and down. Make him do it.”

Who's hopping? Adults: Donald

Kids: Donald

“Bozo *promises* Donald to hop up and down. Make him do it.”

Who's hopping? Adults: Bozo

Kids: Donald

Initial child strategy: Pick nearest potential subject.



More complicated silent things

How do we test what kids think?

Kids must eventually learn that *promise* does not behave like *tell* – the implied subject of the embedded clause is the subject of the main clause, not the object of the main clause. They may learn this through repeated exposures to *promise* and other verbs that behave the same way.



“Bozo *tells* Donald to hop up and down. Make him do it.”

Who’s hopping? Adults: Donald

Kids: Donald

“Bozo *promises* Donald to hop up and down. Make him do it.”

Who’s hopping? Adults: Bozo

~~Kids: Donald~~

Bozo!

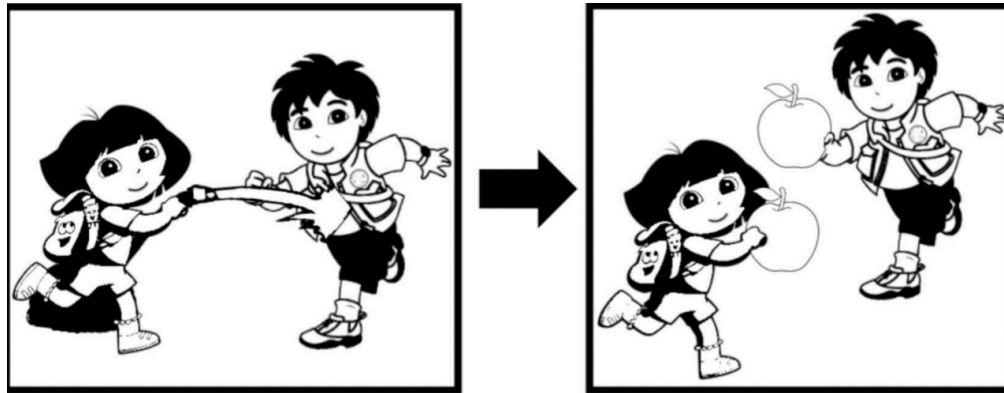


More complicated silent things

Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018

“Dora washed Diego before eating a red apple.”



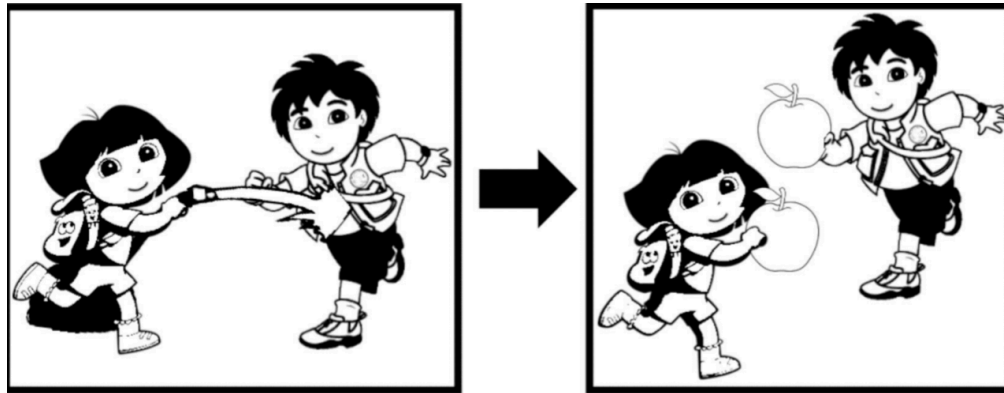
Who ate a red apple?

More complicated silent things

Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018

“Dora washed Diego before ??? eating a red apple.”



Ask participants to
color the appropriate
apple red.

Who ate a red apple?

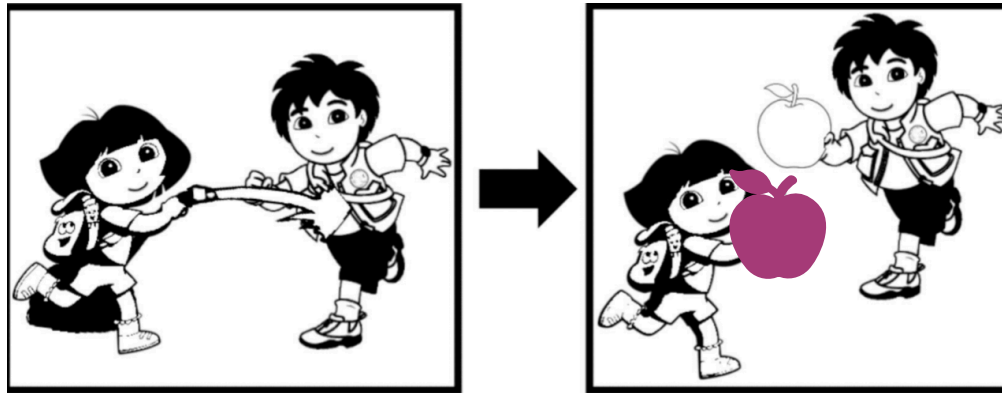
More complicated silent things

Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018

Adults: Dora

“Dora washed Diego before ??? eating a red apple.”



Adults all color
Dora's apple red.

Who ate a red apple?

More complicated silent things

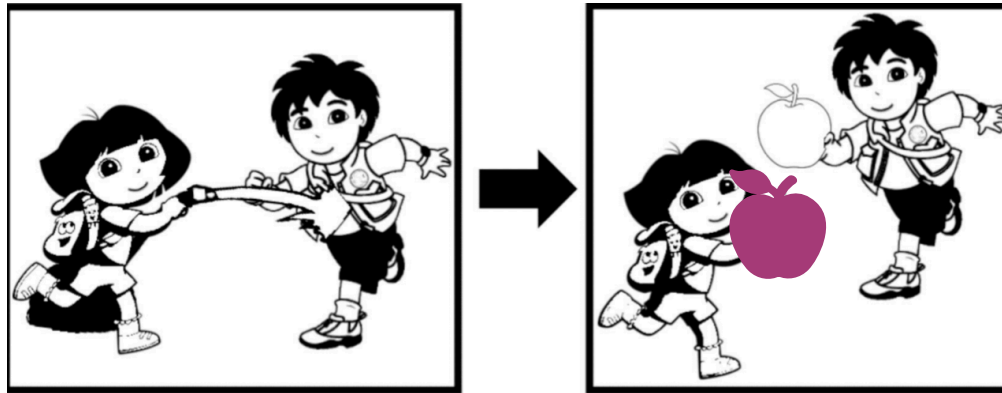
Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018

Adults: Dora

4 and 5-year-olds: Dora

“Dora washed Diego before ??? eating a red apple.”



Children age 4 to 5 mostly do, too.

Who ate a red apple?

More complicated silent things

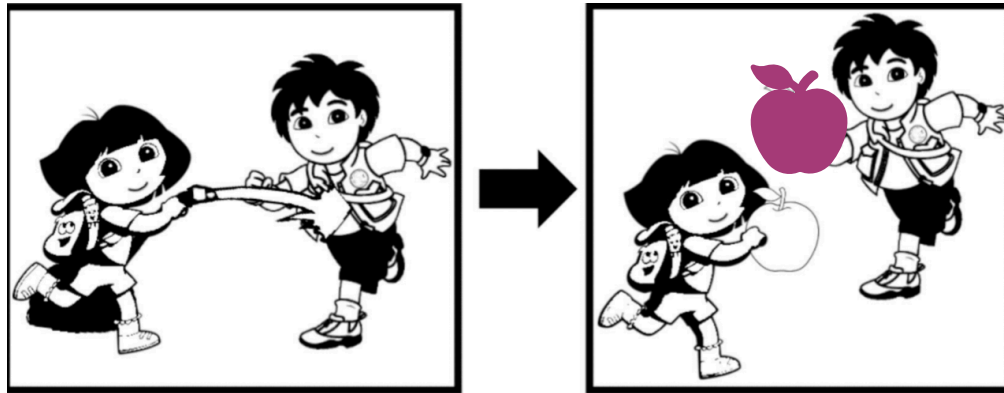
Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018 **Adults:** Dora

4 and 5-year-olds (less cognitive demand): Dora

4 and 5-year-olds (more cognitive demand): Diego

“Dora washed Diego before ??? eating a red apple.”



Who ate a red apple?

But in tasks that are **more cognitively demanding**, the same-aged children often behave as if they think **Diego** did.

More complicated silent things

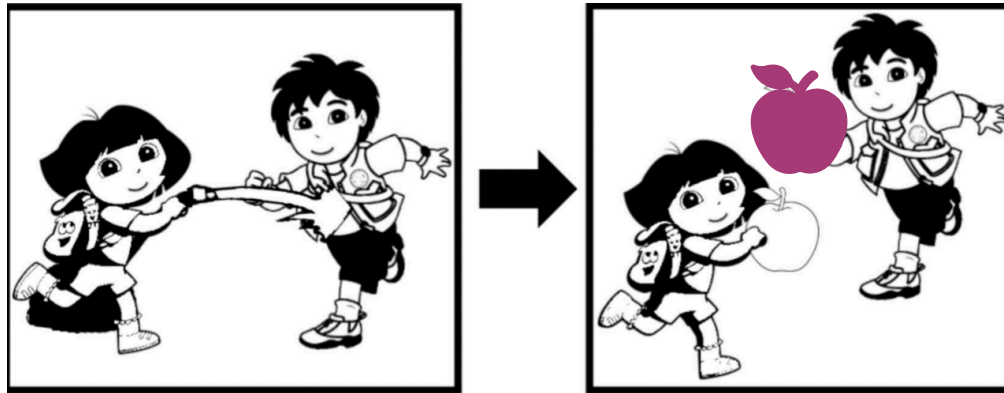
Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018 **Adults:** Dora

4 and 5-year-olds (less cognitive demand): Dora

4 and 5-year-olds (more cognitive demand): Diego

“Dora washed Diego before ??? eating a red apple.”



Who ate a red apple?

So, part of the issue is that young children **have adult-like knowledge** of how to interpret implied subjects, but they **sometimes can't deploy that knowledge effectively** (as in more cognitively-demanding tasks).

More complicated silent things

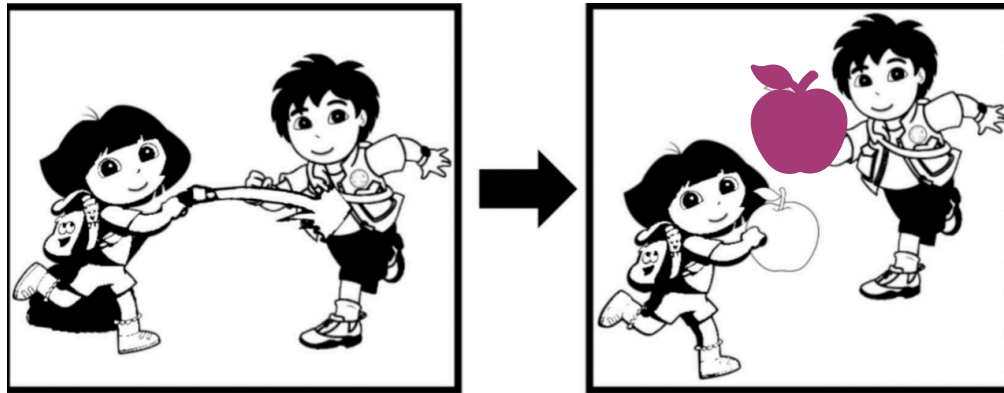
Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018 **Adults:** Dora

4 and 5-year-olds (less cognitive demand): Dora

4 and 5-year-olds (more cognitive demand): Diego

“Dora washed Diego before ??? eating a red apple.”



Who ate a red apple?

Note: This issue of **immature deployment** also happens when children interpret passives (Messenger & Fisher 2018, Ud Deen, Bondoc, Camp, Estioca, Hwang, Shin, Takahashi, Zenker, & Zhong 2018).

More complicated silent things

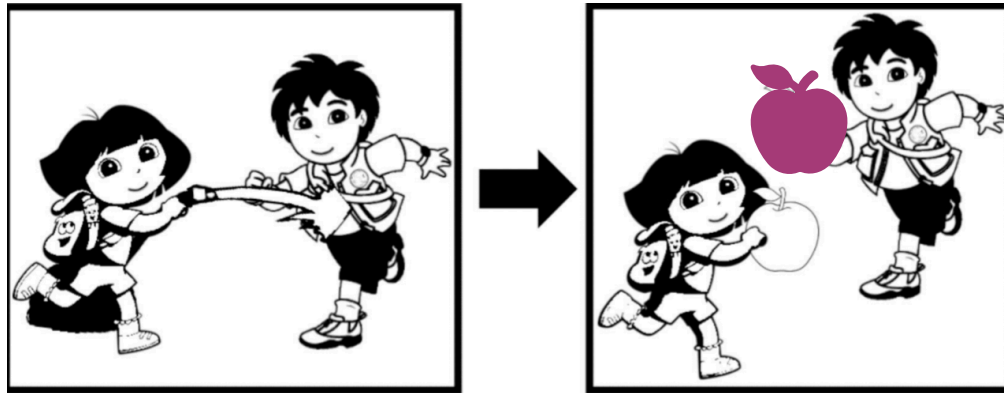
Another example of implied subjects

Gerard, Lidz, Zuckerman, & Pinto 2018 **Adults:** Dora

4 and 5-year-olds (less cognitive demand): Dora

4 and 5-year-olds (more cognitive demand): Diego

“Dora washed Diego before ??? eating a red apple.”



Who ate a red apple?

Development in these cases seems to involve **developing processing abilities**, not developing knowledge.

More complicated silent things

Sentences that have both an implied subject and implied object.

The girl is afraid to see .

Who/what is doing the seeing (subject of see)?



Who/what is being seen (object of see)?

More complicated silent things

Sentences that have both an implied subject and implied object.

The girl ← is afraid → to see .

Who/what is doing the seeing (subject of see)?

The girl.

Who/what is being seen (object of see)?



More complicated silent things

Sentences that have both an implied subject and implied object.

The girl ← is afraid → to see → .

Who/what is doing the seeing (subject of see)?

The girl.



Who/what is being seen (object of see)?

Something unspecified.

This sentence means approximately something like

“The girl is afraid to see (something).”

More complicated silent things

Sentences that have both an implied subject and implied object.

The girl is easy to see .

Who/what is doing the seeing (subject of see)?



Who/what is being seen (object of see)?

More complicated silent things

Sentences that have both an implied subject and implied object.

The girl ← is easy — to see → .

Who/what is doing the seeing (subject of see)?

Who/what is being seen (object of see)?

The girl.



More complicated silent things

Sentences that have both an implied subject and implied object.

The girl ← is easy [] to see [] .

Who/what is doing the seeing (subject of see)?

Someone not mentioned.

This sentence means the same thing as

“It is easy (for someone) to see the girl.”

Who/what is being seen (object of see)?

The girl.



More complicated silent things

Sentences that have both an implied subject and implied object.

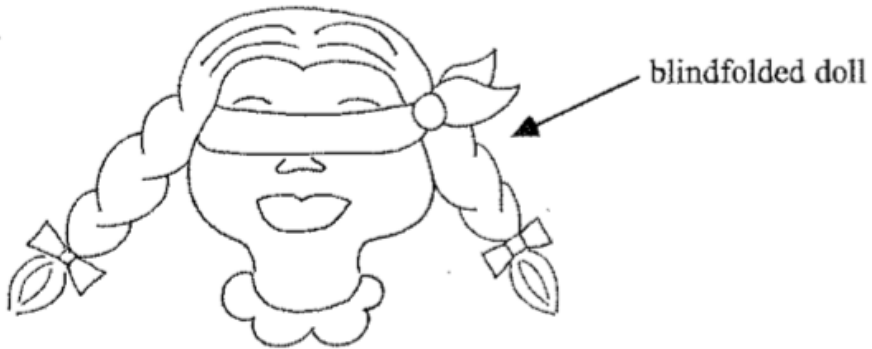
The girl ← is easy [] to see [] .

How can we tell what children's interpretations are for these kinds of sentences?



More complicated silent things

Carol Chomsky 1969



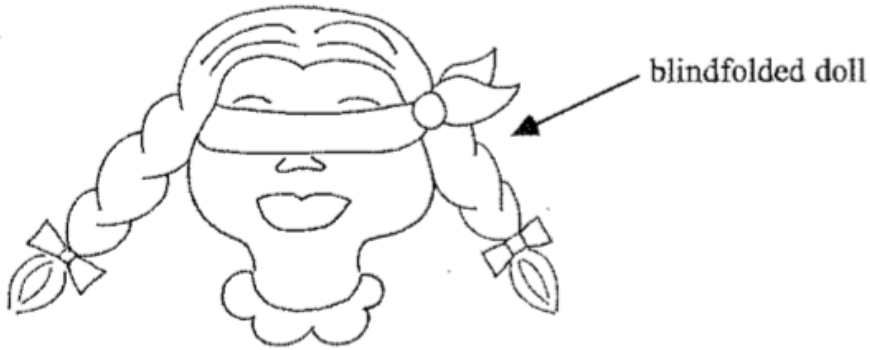
“Is the doll easy to see?”

Is the doll easy to see?

Adults say yes, since the doll is in plain sight. What do children say?

More complicated silent things

Carol Chomsky 1969



“Is the doll easy to see?”

Is the doll easy to see?

Some say yes:

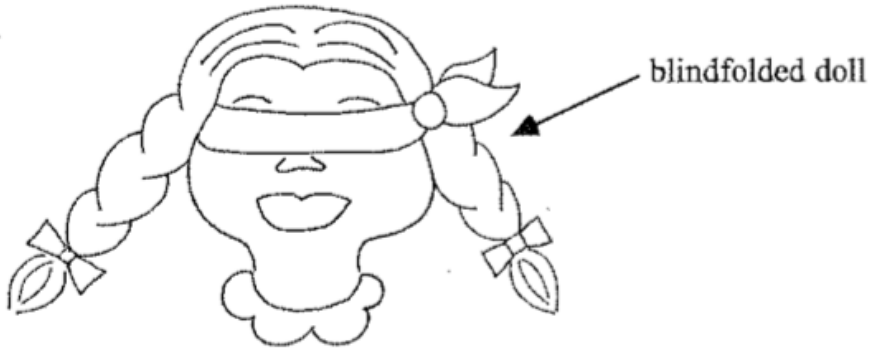
Ann C. (8;8): “Easy”

Experimenter: “Could you make her hard to see?”

Ann C: “In the dark.”

More complicated silent things

Carol Chomsky 1969



“Is the doll easy to see?”

Is the doll easy to see?

However, more than a third say no.

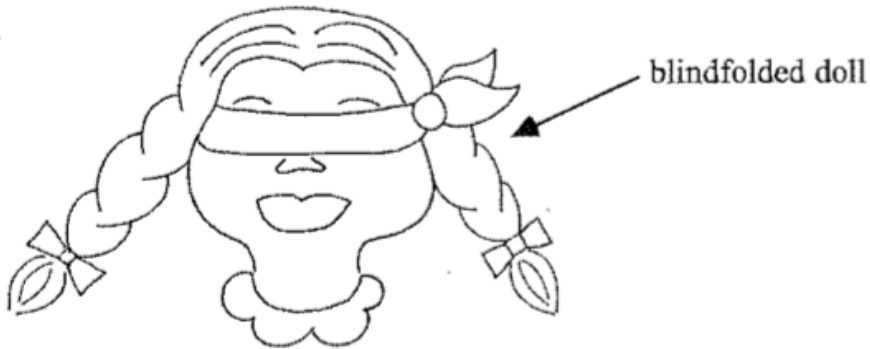
Eric (5;2): “Hard to see.”

Experimenter: “Will you make her easy to see?”

Eric: “Okay.” (He removes the blindfold.)

More complicated silent things

Carol Chomsky 1969



“Is the doll easy to see?”

Is the doll easy to see?

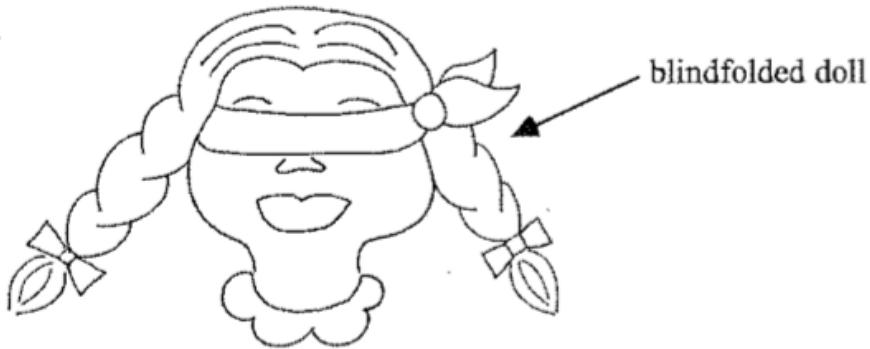
Child misinterpretation:

“Is the doll ← easy → to see ?”

(Mis)Interpretation: “Is it easy for the doll to see (something)?”

More complicated silent things

Carol Chomsky 1969



“Is the doll easy to see?”

Is the doll easy to see?

Child misinterpretation:

“Is the doll ← easy → to see ?”

Children probably need more exposure to these kinds of constructions (*is easy to*, *is hard to*, ...) in order to learn the correct interpretation.

Learning more complicated silent things

Sentences that have both an implied subject and implied object.

The girl ← is easy [] to see [] .

“...the main reported finding is that children err in their interpretation of these constructions until **quite late in development**, around age 6 to 10 years (C. Chomsky 1969, Cromer 1970, i.a.). More recent investigations (Anderson 2005) have likewise found that children give at best inconsistent interpretations, and at worst consistently incorrect interpretations, **until age 5 or 6 years**.” — Becker, Estigarribia, & Gylfadottir 2012

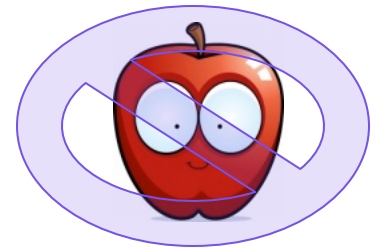
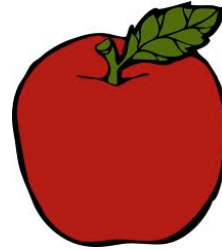
Error: (girl = implied subject) “It is easy for the girl to see someone else.”

The girl ← is easy [] to see [] .

Learning more complicated silent things

Becker et al. 2012, Becker 2015: The **animacy** of subjects may help distinguish these constructions from each other. When children hear inanimate subjects (like “apple”) used many times with a construction, they could assume the subject is the implied object.

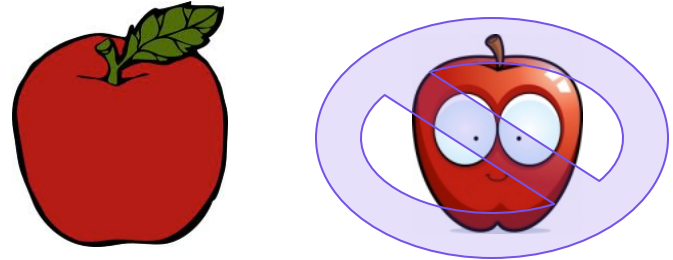
“Is the apple greppy to see?”



Learning more complicated silent things

Becker et al. 2012, Becker 2015: The **animacy** of subjects may help distinguish these constructions from each other. When children hear inanimate subjects (like “apple”) used many times with a construction, they could assume the subject is the implied object.

“Is the apple greppy to see?”



Important insight: Only adjectives like *easy* or *tough* (called *tough-adjectives* as a class) allow inanimate subjects.

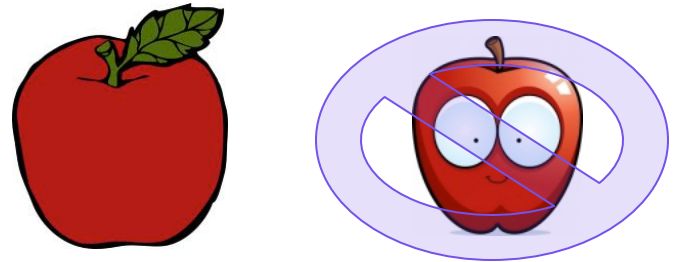
The apple is *easy* to see.

*The apple is *eager* to see.

Learning more complicated silent things

Becker et al. 2012, Becker 2015: The **animacy** of subjects may help distinguish these constructions from each other. When children hear inanimate subjects (like “apple”) used many times with a construction, they could assume the subject is the implied object.

“Is the apple greppy to see?”



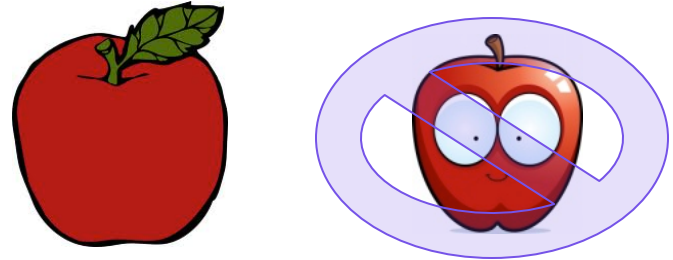
When the child encounters a new adjective with an inanimate subject like “the apple”, the child could assume it’s a *tough*-adjective like “easy”.

The apple is *greppy* to see.

Learning more complicated silent things

Becker et al. 2012, Becker 2015: The **animacy** of subjects may help distinguish these constructions from each other. When children hear inanimate subjects (like “apple”) used many times with a construction, they could assume the subject is the implied object.

“Is the apple greppy to see?”



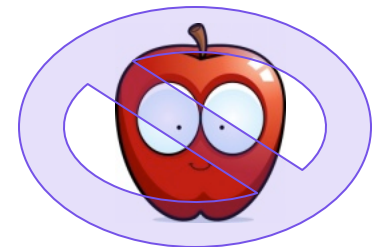
This means that the subject “the apple” is the implied object of “see”, and so the interpretation is “It is easy for someone to see the apple.”

The apple is greppy ☐ to see ☐.

Learning more complicated silent things

Becker et al. 2012, Becker 2015 implications: Inanimate subjects seem to not only be a **useful cue** (based on corpus analysis of which adjectives they're used with) but also **a cue that children actually do use** to help them decide how to interpret a new word in context.

“Is the apple greppy to see?”



Pronouns

Pronouns

Pronouns are tricky because what they refer to in the world changes depending on context, in a way that **many other words don't**.

I you she he



kitty



Pronouns

Pronouns are tricky because what they refer to in the world changes depending on context, in a way that **many other words don't**.

I = speaker

she = 3rd party, female

you = addressee

he = 3rd party, male



kitty



Pronouns

Pronouns are energy-saving devices that allow us to **refer** to someone or something (whose identity we know) without using a name (like “**Sarah**” or “**Jareth**”) or other noun phrase (like “**the girl**” or “**a very impressive goblin king**”).

Sarah thought that **she** could save **her** brother.



Pronouns

Pronouns are energy-saving devices that allow us to **refer** to someone or something (whose identity we know) without using a name (like “**Sarah**” or “**Jareth**”) or other noun phrase (like “**the girl**” or “**a very impressive goblin king**”).

Sarah thought that **she**_{Sarah} could save **her**_{Sarah} brother.



Pronouns

Pronouns are energy-saving devices that allow us to **refer** to someone or something (whose identity we know) without using a name (like “**Sarah**” or “**Jareth**”) or other noun phrase (like “**the girl**” or “**a very impressive goblin king**”).

Sarah thought that **she**_{Sarah} could save **her**_{Sarah} brother.



Jareth was surprised **the girl** summoned **him**, and resolved to show **her** **he** was **a very impressive goblin king**.



Pronouns

Pronouns are energy-saving devices that allow us to **refer** to someone or something (whose identity we know) without using a name (like “**Sarah**” or “**Jareth**”) or other noun phrase (like “**the girl**” or “**a very impressive goblin king**”).

Sarah thought that **she**_{Sarah} could save **her**_{Sarah} brother.

Jareth was surprised **the girl** summoned **him**_{Jareth}, and resolved to show **her**_{the girl} **he**_{Jareth} was **a very impressive goblin king**.



[Extra] Pronouns

<http://www.thelingspace.com/episode-40>

https://www.youtube.com/watch?v=9sqm_cex4kA

1:18 - 2:24



Pronouns

Young children seem to know how to use pronouns for communicative goals – children like to use pronouns **if a preceding noun has already established what the pronoun refers to.**

Imitation task results with 2 ½ and 3-year-old children (Lust 1981):

Experimenter says a sentence with two names:

“Because **Sam** was thirsty, **Sam** drank some soda.”

Child replaces second name with a pronoun:

“Because **Sam** was thirsty, **he** drank some soda.”



Pronouns

Young children seem to know how to use pronouns for communicative goals – children like to use pronouns **if a preceding noun has already established what the pronoun refers to.**

Imitation task results with 2 ½ and 3-year-old children (Lust 1981):

Experimenter says a sentence with a pronoun before a name:
“Because **he** was thirsty, **Sam** drank some soda.”

Child replaces name and pronoun so the name comes first:
“Because **Sam** was thirsty, **he** drank some soda.”



Pronouns

Moyer et al 2015: “Production studies (Strayer 1977, Shipley & Shipley 1969, Macnamara 1980) suggest that children begin producing pronouns around 15-18 months, starting with first person, then second person, and finally third person pronouns (Shipley & Shipley, 1969, Strayer, 1977; Chiat, 1981; Clark, 1978; Charney, 1980; Oshima-Takane, 1985, 1988, 1996).”

1st person: I, me, my, mine,
myself, we, us, our, ours,
ourselves

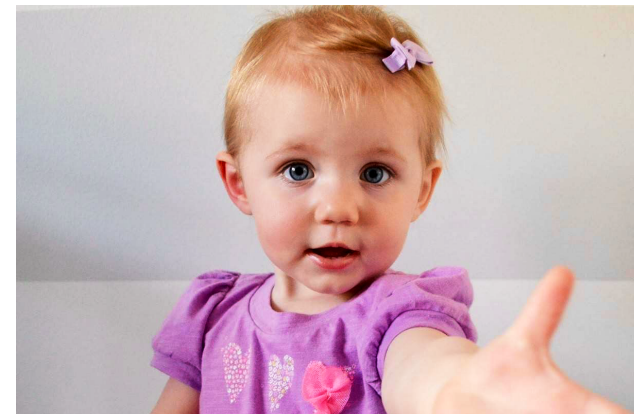
2nd person: you, your, yours,
yourself, yourselves

3rd person: he, she, it, they, him, her, them, his, hers,
its, theirs, himself, herself, themselves



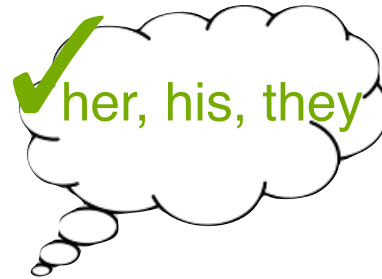
Pronouns

Moyer et al 2015: “These early productions typically include some errors where the child reverses first and second person, but on the whole consistent errors are few (Shipley & Shipley 1969, Bloom, Lightbown & Hood 1975, Huxley 1970, Nelson 1975, Sharpless 1974, Chiat 1982, Oshima-Takane 1985, 1988).”



Pronouns

Moyer et al 2015: “On the other hand, comprehension data focusing on speech addressed to the child, suggest that **children first understand second person pronouns**, **then first person**, and **finally third person** (Sharpless 1974, Strayer, 1977; Charney, 1980; Loveland, 1984). These studies have looked at a range of ages, from 15 months to 3 years.”



Pronouns

Jasmine Falk, Zhang, Scheutz & Yu (2021), on child input to children 12 - 25 months: caregivers tailor their use of pronouns to enable communication success. They use **pronouns more frequently with older children** who have developed greater linguistic knowledge of pronoun use.



Trickier pronouns

Reflexive pronouns have different forms than “plain” pronouns

myself

me, I

herself

she, her

yourself

you

itself

it

himself

he, him

ourselves

we, us

themselves

they, them

Trickier pronouns

Reflexive pronouns behave differently than “plain” pronouns:
they’re interpreted differently

Jareth thought that Hoggle tricked himself.

Jareth thought that Hoggle tricked him.



Trickier pronouns

Reflexive pronouns behave differently than “plain” pronouns:
they’re interpreted differently

Jareth thought that Hoggle tricked himself.
= Jareth thought that Hoggle tricked Hoggle.

Jareth thought that Hoggle tricked him.
= Jareth thought that Hoggle tricked Jareth.



Trickier pronouns

Reflexive pronouns behave differently than “plain” pronouns:
they’re interpreted differently



Jareth thought { that Hoggle ← tricked himself. }

must refer to NP in same clause

~~Jareth~~ thought { ~~that Hoggle tricked~~ ~~him.~~ }

must not refer to NP in same clause,
but can refer to NP in different clause

Rule: Reflexive pronouns must refer to a noun phrase inside the
same clause while regular pronouns must not.

[Extra] Pronouns

<http://www.thelingspace.com/episode-40>

https://www.youtube.com/watch?v=9sqm_cex4kA

2:24 - 3:24, 6:24 - 7:20



Trickier pronouns

How can we test when children learn this distinction?

Act-Out Task:

“Donald thinks that Mickey Mouse scratched **himself**.
Show me what Mickey did.”

“Donald thinks that Mickey Mouse scratched **him**.
Show me what Mickey did.”



Trickier pronouns

How can we test when children learn this distinction?

Act-Out Task:

“Donald thinks that Mickey Mouse scratched **himself**.

Show me what Mickey did.”

(Action: Mickey scratches **Mickey**)

“Donald thinks that Mickey Mouse scratched **him**.

Show me what Mickey did.”

(Action: Mickey scratches **Donald**)



Trickier pronouns

How can we test when children learn this distinction?

Comprehension Task (Chien & Wexler 1990):

“Here’s a picture of Mama Bear and Goldilocks.”



or



“Is Mama Bear touching **her**?”

Children who understand plain pronouns will answer

YES

NO

Trickier pronouns

How can we test when children learn this distinction?

Comprehension Task (Chien & Wexler 1990):

“Here’s a picture of Mama Bear and Goldilocks.”



or



“Is Mama Bear touching **herself**?”

Children who understand reflexive pronouns will answer

NO

YES

Trickier pronouns

Children between the ages of 3 and 5 years old often do fairly well on the interpretation of **reflexive** pronouns.

“Here’s a picture of Mama Bear and Goldilocks.”



or



“Is Mama Bear touching **herself**?”

NO

YES

Trickier pronouns

However, these same children seem to have trouble with **plain** pronouns – they'll interpret them as reflexive.

“Here's a picture of Mama Bear and Goldilocks.”



or



“Is Mama Bear touching **her**?”

NO

YES

Trickier pronouns

Interestingly, even though children mistakenly interpret plain pronouns as reflexive, they don't seem to make this mistake in their own productions.

Bloom et al. (1991): Looking at 100,000 spontaneous utterances of three children, beginning at age 2.

me and *myself* were used correctly 95% of the time.

This suggests that children know the distinction between some reflexive and plain pronouns (as evidenced in their own productions), but they have trouble making this distinction for the pronouns tested in the experiments. Perhaps the experiments aren't good at really getting at children's knowledge? (Conroy et al 2009 suggest that previous results are due to experimental artifact.)

Trickier pronouns

Lukyanenko, Conroy, & Lidz (2014), Emond & Shi (2024), experimental demonstration: 2.5-year-olds also realize some facts about how to interpret plain pronouns in relation to reflexive pronouns and names.

Other-directed

She's patting **Katie**

= One girl patting another one



Self-directed

She's patting **herself**

= One girl patting her own head

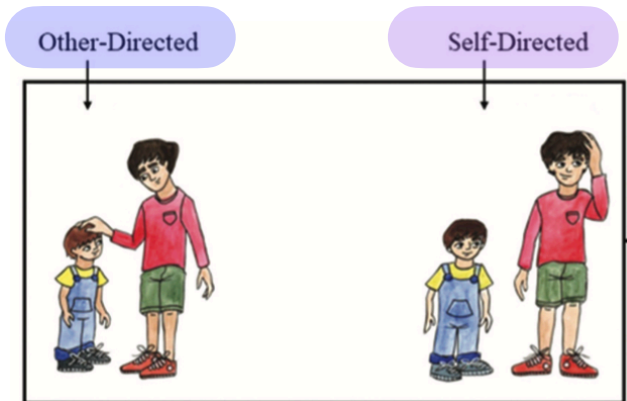


Trickier pronouns

Emond & Shi (2024) experimental demonstration: 2.5-year-olds also realize some facts about how to interpret plain and reflexive pronouns in relation to names and other longer expressions, depending on syntactic position.

The little brother sees that Other-directed Leo touches Self-directed him/himself.

Same clause



Trickier pronouns

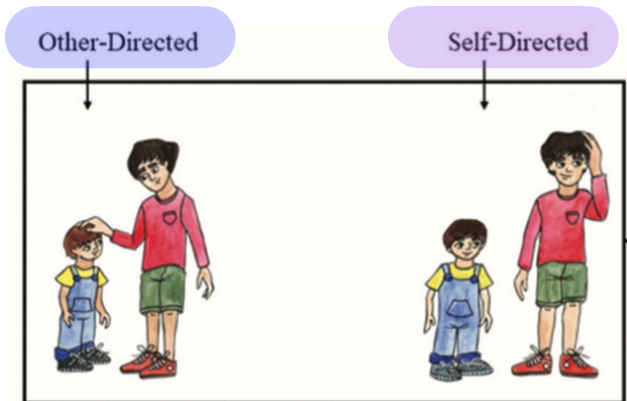
Emond & Shi (2024) experimental demonstration: 2.5-year-olds also realize some facts about how to interpret plain and reflexive pronouns in relation to names and other longer expressions, depending on syntactic position.

The little brother sees that Leo touches him/himself.

Same clause

The little brother of Leo touches him/himself.

Same clause



Trickier pronouns

Evidence for incomplete knowledge? Children do seem to have trouble using plain pronouns in ways that make it easy to understand what these pronouns refer to.

An excerpt from a four-year-old's description of a picture:

“...she's sitting on the seat airplane...she's giving something to a girl, now she's looking at a book...now she's putting the thing up high.”

So what's the problem with this description?

Trickier pronouns

Evidence for incomplete knowledge? Children do seem to have trouble using plain pronouns in ways that make it easy to understand what these pronouns refer to.

An excerpt from a four-year-old's description of a picture:

“...*she's* sitting on the seat airplane...*she's* giving something to a girl, now she's looking at a book...now she's putting the thing up high.”



So what's the problem with this description? The first *she* refers to a girl and the second *she* refers to a woman. This would be a bit strange for an adult to say, unless there was some indication that the second *she* is different (perhaps by pointing at the new referent).



The problem of assuming knowledge of a pronoun's referent

Alice in Wonderland, Chapter 12, by Lewis Carroll

They told me you had been to her,
And mentioned me to him:
She gave me a good character,
But said I could not swim.

He sent them word I had not gone
(We know it to be true):
If she should push the matter on,
What would become of you?

The problem of assuming knowledge of a pronoun's referent

Alice in Wonderland, Chapter 12, by Lewis Carroll

I gave her one, they gave him two,
You gave us three or more;
They all returned from him to you,
Though they were mine before.

If I or she should chance to be
Involved in this affair,
He trusts to you to set them free,
Exactly as we were.

The problem of assuming knowledge of a pronoun's referent

Alice in Wonderland, Chapter 12, by Lewis Carroll

My notion was that you had been
(Before **she** had this fit)
An obstacle that came between
Him, and ourselves, and **it**.

Don't let **him** know **she** liked **them** best,
For **this** must ever be
A secret, kept from all the rest,
Between yourself and me.

Recap

Implied subjects and implied objects vary by the specific lexical item, and children need to use other cues (like animacy) to help them figure out whether a new lexical item will create an implied subject or implied object.

Pronouns can also be difficult, since there are different rules of interpretation, depending on the type of pronoun it is. Children have to learn (1) that something is a pronoun (a word whose referent changes depending on context), and (2) what type of pronoun it is. Both of these are hard!

Questions?



You should be able to do up through 21 on the review questions, and up through 15 for HW5.