

Psych 56L/ Ling 51: Acquisition of Language

Lecture 14 Language & Cognition

Announcements

HW 3 due 3/4/10

Review questions available for language and cognition

A Recap from Sound Perception

We do “hear” language sounds differently depending on what language we speak. But when we fail to hear a contrast that a speaker of another language does hear, it isn't because our physical ability to register the sound has disappeared. It's because we have learned that that type of contrast is not a meaningful contrast for our language.

Our mental representations of the sounds of words are an abstraction of the physical signal. (ex: Dental d and retroflex D sound the same to English speakers, but sound different to Hindi speakers.)

Language experience has altered our perceptions (of language sounds)...

Sapir Whorf Hypothesis

The structure of one's language influences the manner in which one perceives and understands the world.

“Don't you see that the whole aim of Newspeak is to narrow the range of thought? In the end, we shall make thought crime literally impossible, because there will be no words in which to express it...” - George Orwell, *1984*



Degrees of Whorfianism

Linguistic Relativism (weak Whorfianism) = Language *biases* our perception of the world

Linguistic Determinism (strong Whorfianism) = Language *determines* our perception of the world

Sound perception supports linguistic relativism since there is evidence that the changes imposed by language are not permanent or insurmountable. (Adults can learn to hear non-native sound contrasts.)

Degrees of Whorfianism

Linguistic Relativism (weak Whorfianism) = Language *biases* our perception of the world

Linguistic Determinism (strong Whorfianism) = Language *determines* our perception of the world

Is there any evidence for linguistic determinism?

“Neo”-Whorfian Question

Language as a Toolkit: Does language augment our capacity for reasoning and representation (and thereby determine our perception of the world)?





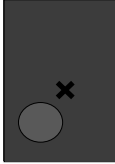
Language as a Toolkit

Navigation (combining core knowledge system information)
[geometric & landmark information]

Number (combining core knowledge system information)
[small, exact numbers & large, approximate numbers]

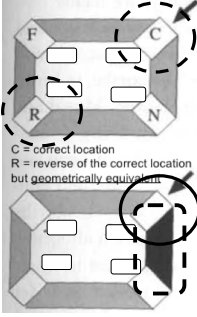
Theory of Mind (realizing that someone can have a different point of view than you - when does this realization come, and how?)

Navigation

<p>Geometric "At the northeast corner"</p>  <p>*rats *human infants *adult humans</p>	<p>Object Landmark "At the cylinder"</p>  <p>*rats *human infants *adult humans</p>	<p>Combination "Northeast of the cylinder"</p>  <p>*adult humans ONLY</p>
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Navigation

Can find it here.



C = correct location
R = reverse of the correct location but geometrically equivalent

But toddlers (1.5 to 2 years old) are able to encode the location of the hidden object with respect to the geometric shape of room (left of a short wall)


But toddlers are unable to use the color of the wall to encode a location best described as "left of a black wall"

Explanation: the length of a wall is part of the geometry of a room, but the color of a wall is not. The geometric system can't talk to the system that represents the colors of objects.

Can't find it here by combining cues.

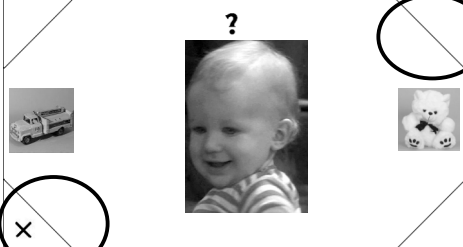
But can toddlers *really* not do it?

Maybe wall color just isn't a very salient property for toddlers. How about trying more salient landmarks? (Hermer & Spelke 1996)



But can toddlers *really* not do it?

Maybe wall color just isn't a very salient property for toddlers. How about trying more salient landmarks? (Hermer & Spelke, 1996)



No change in navigation behavior in toddlers even with more salient landmarks (toys like truck and teddy bear).

So when does this ability develop?

Hermer-Vazquez, Moffet & Munkholm (2001): children with a high production of spatial language (like "left" and "right") succeed. This usually happens somewhere between 4 and 5 years old.

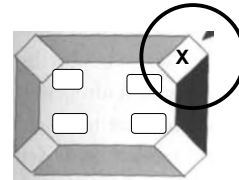
Implication: Spatial language use seems integral in solving this task that requires representing information from different domains (geometry & color).

However... rats (who don't have spatial language) can be trained to do the same thing after hundreds of trials. Spatial language is useful, but not necessary?

Is language really responsible?

Hermer-Vazquez, Spelke & Katnelson (1999)

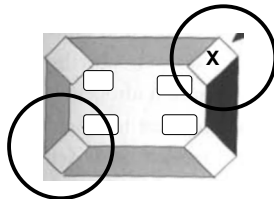
Testing adults, who were asked to verbally shadow as they performed the task. Verbal shadowing = repeating as fast as they could a passage recorded on tape. Interferes with linguistic combination abilities.



Is language really responsible?

Hermer-Vazquez, Spelke & Katnelson (1999)

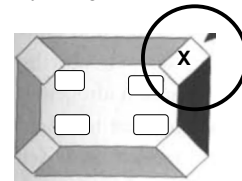
Verbal-shadowing adults behaved just like toddlers! They searched equally the correct corner and the rotationally equivalent one, seemingly unable to combine the information from geometry and color.



Is language really responsible?

Hermer-Vazquez, Spelke & Katnelson (1999)

Experiments with adults who were doing nonverbal shadowing (repeating a rhythm by clapping) did not show this result, despite the fact that the nonverbal shadowing (rhythm shadowing in this case) is as cognitively taxing as verbal shadowing.



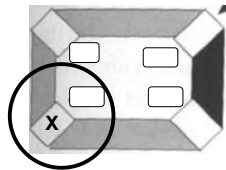
Is language really *necessary*?

Goutoux, Thinus-Blanc, & Vauclair (2001):
testing Rhesus monkeys (who do not
have spatial language)



Tested 3 monkeys on location "left of
wall opposite the blue wall".
~50 trials each.

Two monkeys: ~85% correct
Other monkey: ~70% correct



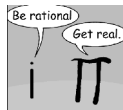
Pretty good for no spatial language!

Is language really *necessary*?

So language *does* seem to play a very important role in the
ability to combine information from different core knowledge
systems. (Perhaps not absolutely necessary, but extraordinarily
helpful - kind of like motherese for language development.)

Or maybe rhesus monkeys are just clever enough to do this
without the spatial language that humans seem to rely on.
Maybe humans rely on language because they have it as a tool
at their disposal...

Number

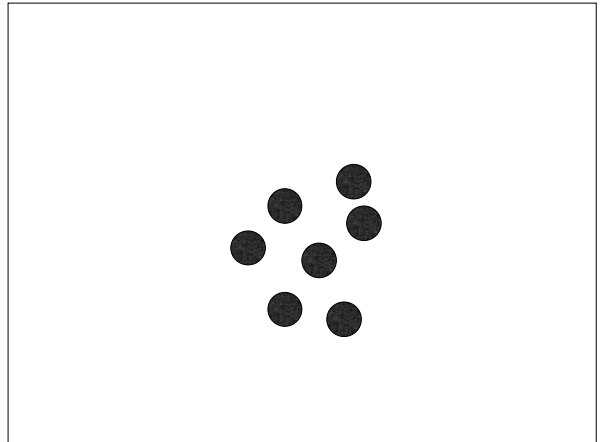
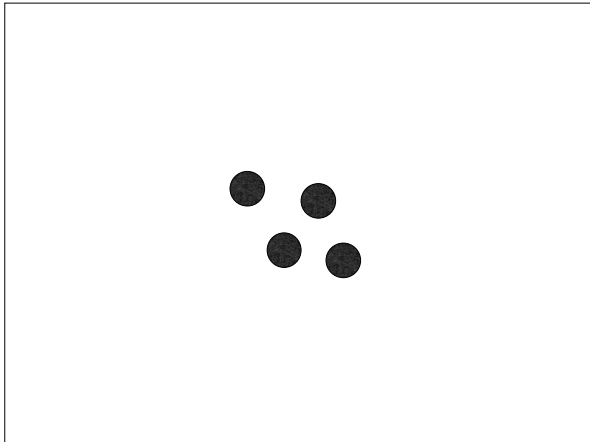
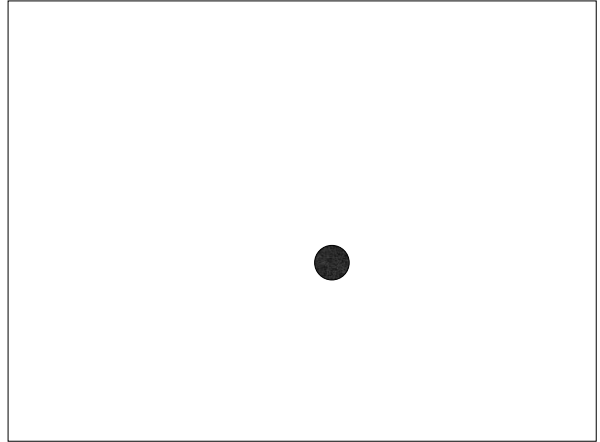
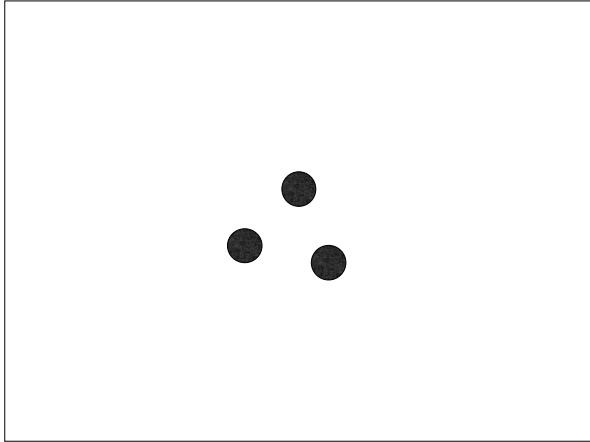


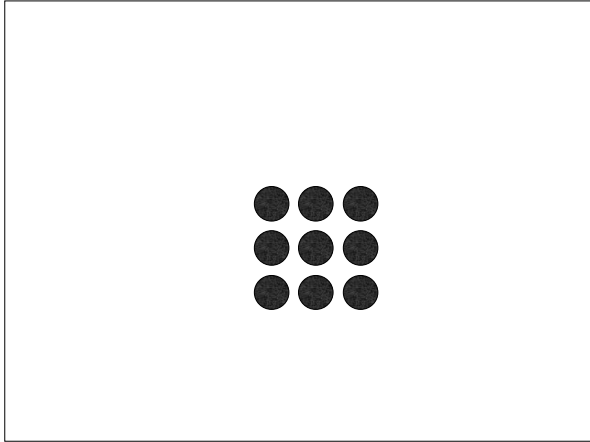
Core number systems shared by humans and other animals:

System for representing approximate numerical magnitudes
(large, approximate number sense)

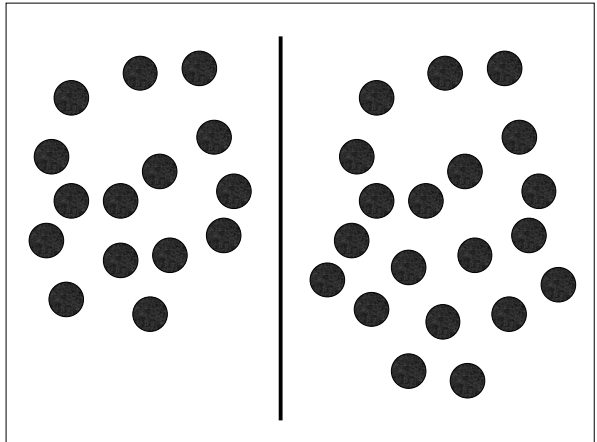
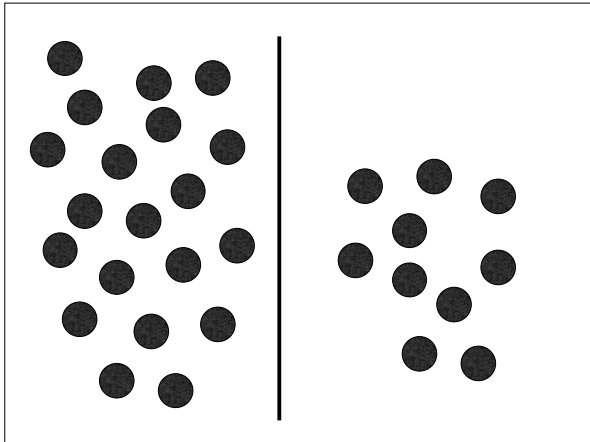
System for representing persistent, numerically distinct individuals
(small, exact number sense)

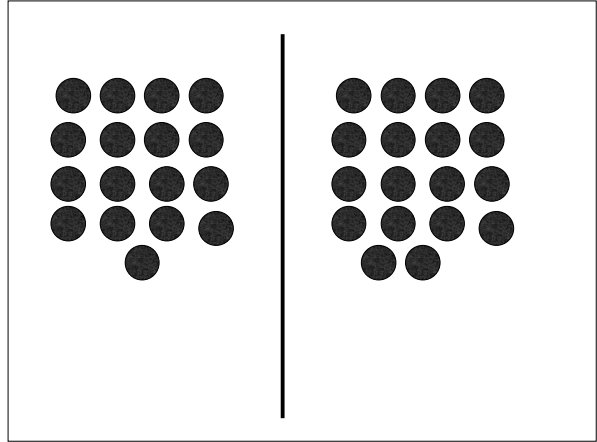
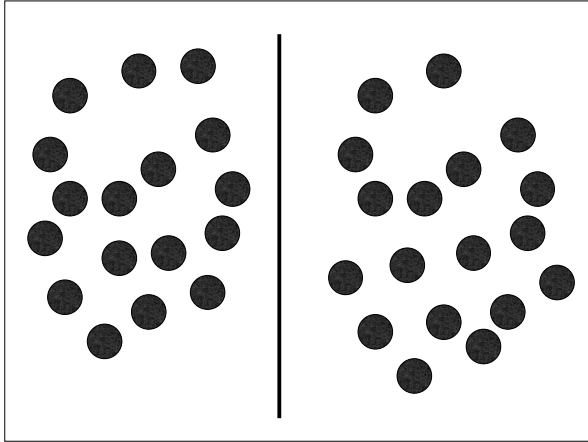
Decide Fast:
How Many?





Decide Fast:
Which side has more?





How We Deal With Number	
Amount Being Represented	How Represented
Very small numbers	“Subitizing”- up to 4; can tell what set looks like at a glance
Large approximate numerosities	System for representing approximate numerical magnitudes (adults at a glance can tell apart groups with a ratio of about 1.1 to 1)
Large exact numerosities	Combo of 2 above systems plus language

What human language does...

Many languages have an *exact* number system that provides names for exact quantities of any size

1, 2, 3, 4, 5.....578, 579, 580, 581, 582...

This bridges the “gap” between the two core systems.

Testing this: Look at numerical cognition of people whose languages *don't* have an exact number system.

Languages without Exact Number Systems

Pica, Lemer, Izard & Dehaene (2004): Mundurucu speakers in Brazil who only have exact numbers for 1-5. When doing simple tasks like addition and subtraction with numbers outside this range (ex: 8-6), they do much worse than speakers who have an exact number system (though still better than chance).

Gordon (2004): Pirahã speakers in Brazil who only have words for "one/two" and "many". Exact arithmetic on larger numbers that are both outside the small, exact system and outside the language is very, very hard to do.

Gelman & Gallistel (2004)

"Language and the Origin of Numerical Concepts"

"Reports of subjects who appear indifferent to exact numerical quality even for small numbers, and who also do not count verbally, add weight to the idea that learning a communicable number notation with exact numerical reference may play a role in the emergence of a fully formed conception of number."

No language for large exact numbers =
no representation for large exact numbers

Language as a Toolkit: Theory of Mind



Sarah thought that Hoggle had betrayed her.



The embedded proposition encodes the contents of Sarah's mind.
The 'truth value' of the embedded proposition cannot be evaluated with respect to this world. It must be evaluated with respect to Sarah's mental world.

What if a child didn't know this?

What You Need to Know To Evaluate the Truth Value of These Statements

Syntactic Knowledge: you know that some verbs can take sentential complements (think, believe, say, ...)

Social Cognitive Knowledge: you know that other people can have a false belief

Bridge: you know that there is a connection between this syntactic form and the expression of potentially false beliefs

Which comes first, social or syntactic knowledge?
Usual Pattern: Social/Conceptual ---> Linguistic
Whorfian: Linguistic ---> Social/Conceptual

A Leeetle Problem...

How do you measure children's understanding that other people can have false beliefs?

(abstracted away from their linguistic ability to represent false beliefs)



False Belief Task

The child is introduced to two puppets, Sir Didymus and Ambrosius.



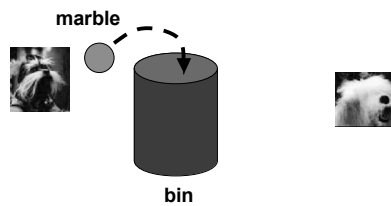
Sir Didymus



Ambrosius

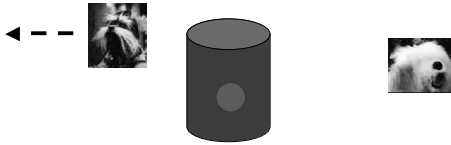
False Belief Task

While playing, Sir Didymus puts a marble into a bin and then goes outside (the puppet disappears under the table, for example).



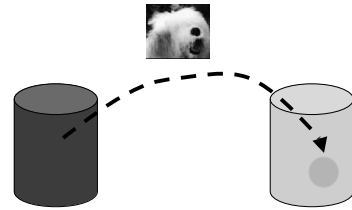
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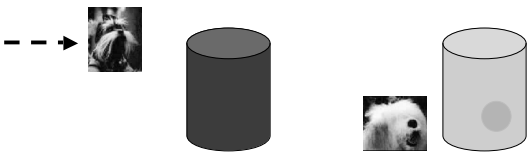
False Belief Task

When Sir Didymus is not around, naughty Ambrosius changes the location of the marble. He takes it out of the bin and puts it in a different bin.



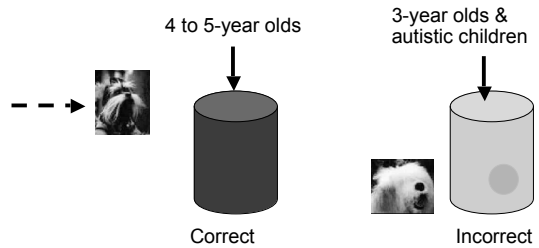
False Belief Task

Some time later Sir Didymus comes back and wants to play with his marble. Children are then asked the critical question: Where will Sir Didymus look for his marble?



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If we're looking for a language connection...

At what age do children start talking about thoughts/beliefs? At what age do children first begin to use sentential complements?

2-year-olds talk a lot!

- ... about what they did, what they want
- ... about what others do
- ... possibly about what others say
- not about what others think

If we're looking for a language connection...

At what age do children start talking about thoughts/beliefs? At what age do children first begin to use sentential complements?

Children's comprehension of sentential complements

"Sir Didymus said he bought peaches. But look! He really bought oranges. What did Sir Didymus say he bought?"

3-year-olds: oranges (reality, not mental state)

4-year-olds: peaches (key into "say that")

If we're looking for a language connection...

At what age do children start talking about thoughts/beliefs? At what age do children first begin to use sentential complements?

At around four years of age, children understand that mental verbs can take a whole sentence in their scope (a complement)

Sir Didymus thought that the shampoo was the toothpaste.

And the embedded sentence can be FALSE from the child's Point of View, but TRUE for Sir Didymus.

Once the child has this capacity, he can represent two worlds: his own, and someone else's mental world.

This usually coincides with children's production of mental state verbs.

Testing typically developing children

De Villiers & Pyers (2002): Measures of comprehension and production of sentential complements far more correlated with children's performance on false belief tasks than any other linguistic measure.

Causation? "In every case, children who passed false beliefs gave us evidence that they had productive command of complementation."

Learning Trajectory: Easier to observe what people say than what they think. Can get more helpful data with communication verbs that take sentential complements (like say), and then extend that by analogy to mental verbs like think.

Testing the Connection in Other Ways and in Other Populations

What if you train children on communication verbs that take sentential complements? Do they improve on false belief tasks?

Test development in deaf children who are language-delayed vs. not

Test false belief understanding in non-humans

Training children on communication verbs

Hale & Tager-Flusberg (2003): Children who were trained on sentential complements ("say that...") did well on both sentential complement tests and false belief tasks. However, children trained only on false belief tasks also did well on false belief tasks.

Familiar implication: Sentential complements not required, just extraordinarily helpful.

Testing deaf children (delayed v.s non-delayed language)

de Villiers & de Villiers (2003): Oral deaf children (who are language-delayed) with normal IQ and active social intelligence are significantly delayed in false belief tasks. Performance on both verbal and non-verbal false belief tasks are delayed to the same degree. Best predicted by sentential complement production with verbs of communication or mental state, not just by general language ability.

Implication: Language (specifically sentential complements) required for success on false belief tasks. (Maybe no one trained them explicitly on false belief tasks?)

Testing (Necessarily Non-linguistic) Non-humans

Call & Tomasello (1999): While apes and young children can both succeed at understanding the indication method in non-verbal false belief tasks, tracking visible displacement of an object, tracking hidden displacement of an object, and ignoring a communicator indicating the wrong answer, only 5-year-olds (not 4-year-olds or apes) could successfully pass the final step of a false belief task - which involves realizing someone can have a different belief than you.

Implication: Sentential complement language required for theory of mind.



So what is it about language?

Perner, Stummer, Sprung, & Doherty (2002): Ability to simultaneously consider multiple names for a single object (Name-Name task) is strongly correlated with performance on False Belief tasks.

Name/Name
(Synonym)
Man/Guy



So what is it about language?

What do sentential complements and multiple names for a single object have in common?

Both require the use to represent an object or event from multiple perspectives simultaneously



“Our claim is that the ability to confront different perspectives emerges around 4 years and underlies the co-emergence of success on the False Belief and the Name-Name tasks” - Perner, Stummer, Sprung, & Doherty (2002)

Theory of Mind: Link to Language is...?

Familiar implication: Language is extraordinarily helpful but not explicitly required.

However, animals cannot seem to achieve this knowledge. Something about human brains and the way they develop may be responsible.

Language & Cognition: Recap

Whorfianism is the belief that language influences (or determines) someone's experiences in the world.

In several cases, we have seen evidence for cases where language seems to enable more complex thought- or at least to enable it to happen more easily.

Questions?

