Psych 156A/ Ling 150: Psychology of Language Learning

Lecture 10
Poverty of the Stimulus I

Announcements

Be working on HW3 (due: 2/24/09)
Be working on the review questions
Review questions posted for poverty of the stimulus & learning biases
HW2 returned on Tuesday (2/17/09)

About Language

One way to think about how to classify the knowledge that you have when you know a language:

You know what items (sounds, words, sentences, questions, etc.) are part of the language. You can tell whether or not a given item is grammatical in the language.

Hoggle is definitely an ornery dwarf. [grammatical]
* Hoggle an dwarf definitely ornery is. [ungrammatical]
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One way to think about how to classify the knowledge that you have when you know a language:

You know what items (sounds, words, sentences, questions, etc.) are part of the language. You can tell whether or not a given item is grammatical in the language.

The reason you can do this is because you know the rules & patterns that generate the items that are part of the language. (mental grammar)

About Children Learning Language

Adult knowledge: rules & patterns that generate the items that are part of the language. (mental grammar)

The child’s job: figure out the rules that generate the items that belong in the language and that don’t generate items that don’t belong in the language.

For example, the child wants rules to generate “Hoggle is definitely an ornery dwarf” but not “Hoggle an dwarf definitely ornery is”.

In English

Hoggle is an ornery dwarf
Can the girl who can summon the Goblin King solve the Labyrinth?

Fairies bite adventurers

Not in English

Bite adventurers fairies
Can the girl who summon the Goblin King can solve the Labyrinth?

Want to learn rules that generate this set of items...
So what’s the problem?

It’s not clear that children encounter all the items that are part of the language. If they only encounter a subset of the language’s items, how do they know everything that belongs in the language?

One solution: children generalize...
So what's the problem?
One solution: children generalize
But how do they generalize?

Items Encountered
Items in English
Items not in English

To here?

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Poverty of the Stimulus: Logic

The problem is that children must make the right generalization from data that is compatible with multiple generalizations. In this sense, the data (stimulus) encountered is impoverished. It does not single out the correct generalization by itself.

Poverty of the Stimulus: Logic
Children encounter data that is compatible with many hypotheses about the correct rules and patterns of the language.
Poverty of the Stimulus: Logic
Specifically, the data encountered is compatible with both the correct hypothesis and other, incorrect hypotheses about the rules and patterns of the language.

A rational learner would consider all compatible hypotheses, and perhaps make errors before choosing the correct hypothesis. Maybe some rational learners would choose the incorrect hypotheses in the end.

Expectation for rational learners: errors in performance. Rational learner children will behave as if they think ungrammatical items are part of the language.

But what if children never behave as if they consider the incorrect hypotheses? That is, they never produce errors compatible with the incorrect hypotheses. They only seem to produce items that are compatible with the correct hypothesis.
Nativist conclusion: children have some prior knowledge (possibly innate) that causes them never to consider the incorrect hypotheses. Instead, they only consider the correct hypothesis for what the rules and patterns of the language might be.

Innate knowledge restricts children's hypothesis to this

Specific Example: Yes/No Question Formation

Jareth can alter time.

Can Jareth alter time?

To turn the sentence into a yes/no question, move the auxiliary verb ("can") to the front. Other examples of auxiliary verbs: could, should, might, would, will, did, do, may

The child's task: figure out a rule that will form yes/no questions from their corresponding sentences.

Specific Example: Yes/No Question Formation

Jareth can alter time. Can Jareth alter time? Rule?
Rule: Move first auxiliary?

Specific Example: Yes/No Question Formation

Jareth can alter time. Can Jareth alter time?

Anyone who can wish away their brother would be tempted to do it. Would anyone who can wish away their brother be tempted to do it?

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Rule?

Someone who can solve the labyrinth can show someone else who can't how. Can someone who can solve the labyrinth show someone else who can't how?

Idea: Try looking at the sentence structure, not just the linear order of the words in the sentences.

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Someone who can solve the labyrinth can show someone else who can't how. Can someone who can solve the labyrinth show someone else who can't how?

Idea: Try looking at the sentence structure, not just the linear order of the words in the sentences.
Let’s look just at the main clauses in these examples.

Specific Example: Yes/No Question Formation
Jareth can alter time.
Can Jareth alter time?

Anyone who can wish away their brother would be tempted to do it.
Would anyone who can wish away their brother be tempted to do it?

Someone who can solve the labyrinth can show someone else how.
Can someone who can solve the labyrinth show someone else how?

Rule that works for all of these examples (and all English examples): Move the auxiliary verb in the main clause to make a yes/no question.

This is a rule dependent on the structure of the sentences, since it refers to “main clause”.

Specific Example: Yes/No Question Formation
Jareth can alter time.
Can Jareth alter time?

Anyone would be tempted to do it.
Would anyone be tempted to do it?

Someone can show someone else how.
Can someone show someone else how?

Children’s Knowledge
Children seem to know this rule by the age of 3. (Crain & Nakayama 1987)

Learning problem: Children don’t encounter all the examples we saw. They encounter a subset of the possible yes/no questions in English.

Most of the data they encounter (particularly before the age of 3) consists of simple yes/no questions.

Jareth can alter time.
Can Jareth alter time?
Learning Difficulties: Yes/No Questions

The problem is that these simple yes/no questions are compatible with a lot of different rules.

Rule: Move first auxiliary?
Rule: Move last auxiliary?
Rule: Move main clause auxiliary?
Rule: Move auxiliary in even-numbered position in sentence?
Rule: Move auxiliary closest to a noun?

Rational learner prediction: if children considered all these hypotheses, they should make mistakes on more complex yes/no questions. Let’s look at two hypotheses in detail.

Rule: Move first auxiliary?
Rule: Move main clause auxiliary?

The girl who can solve the labyrinth is happy.

Predictions of questions generated

Rule: Move first auxiliary?
* Can the girl who solve the labyrinth is happy?

Correct rule = grammatical question
Is the girl who can solve the labyrinth happy?
Learning Difficulties: Yes/No Questions

Crain & Nakayama (1987) showed that children as young as 3 years old don’t make these mistakes. They use the right rule for this complex yes/no question.

Predictions of questions generated

* Can the girl who solve the labyrinth is happy?

Is the girl who can solve the labyrinth happy?

But the simple questions they see are compatible with both of these hypotheses (along with many others). How do children choose the right rule from all the possible rules that are compatible? That is, how do they generalize the right way from the subset of the data they encounter?

Nativist position: Children have an innate bias to look for rules that make use of sentence structure. Specifically, they only consider rules that are structure-dependent.

It is this structure-dependent learning bias that allows children to generalize the correct way from “impoverished” data.

Nativists say: Children constrain their generalizations in a specific way, based on their prior knowledge of language.
Another example of children’s constrained generalization
Crain & McKee (1985): pronoun interpretation

While he danced around the throne room, Jareth smiled.
(Adults: he = Jareth)  
(Children: he = Jareth)

Possible generalization for the language: Can put pronoun before name or name before pronoun

Crain & McKee (1985): pronoun interpretation

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Another example of children’s constrained generalization

Crain & McKee (1985): pronoun interpretation

While Jareth danced around the throne room, he smiled.

(he = Jareth)

He smiled while Jareth danced around the throne room.

(Adults: he ≠ Jareth)

(Children: he ≠ Jareth)

Possible generalization fails: Order of pronoun and name matters. Children seem to know this without being taught it. Why?

Crain & McKee (1985): pronoun interpretation

While Jareth danced around the throne room, he smiled.

(he = Jareth)

He smiled while Jareth danced around the throne room.

(Adults: he ≠ Jareth)

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Answer: Prior knowledge about interpreting pronouns in sentences. This constraint is structure-dependent, it turns out.
Another example of children’s constrained generalization

Crain & McKee (1985): Summary

While he danced around the throne room, Jareth smiled.
(he = Jareth)
Jareth smiled while he danced around the throne room.
(he = Jareth)

While Jareth danced around the throne room, he smiled.
(he = Jareth)
He smiled while Jareth danced around the throne room.
(he = Jareth)

Poverty of the Stimulus leads to Innate Knowledge about Language:
Summary of Logic

1) Suppose there are some data.
2) Suppose there is an incorrect hypothesis compatible with the data.
3) Suppose children behave as if they never entertain the incorrect hypothesis.

Conclusion: Children possess prior (innate) knowledge ruling out the incorrect hypothesis from the hypotheses they do actually consider.

Questions?