Psych156A/Ling150: Psychology of Language Learning

Lecture 14
Poverty of the Stimulus I

Announcements

Quiz 5: average 12.5 out of 15 (good!)

HW5 due today

HW6 available, but not assigned for another week (recommendation: work on it as we go along)

In-Class Assignment: Adult Knowledge State

Complete assignment for full credit, counts in the quiz category

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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Hoggle is definitely an ornery dwarf. [part of English]
* Hoggle an dwarf definitely ornery is. [not part of English]

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.

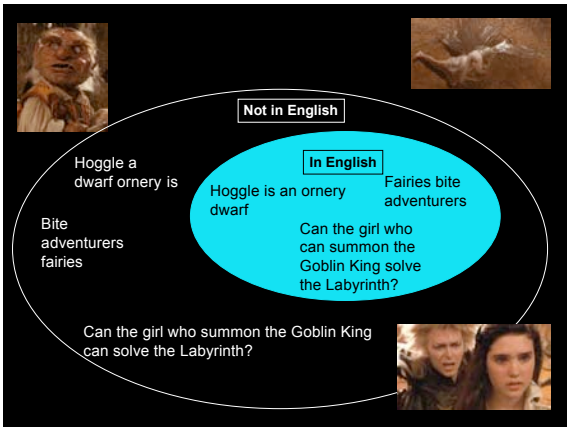
The reason you can do this is because you know the rules & patterns that generate the items that are part of the language. (mental grammar)

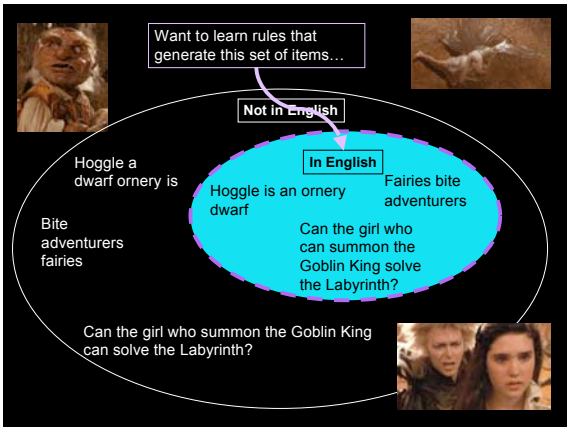
About Children Learning Language

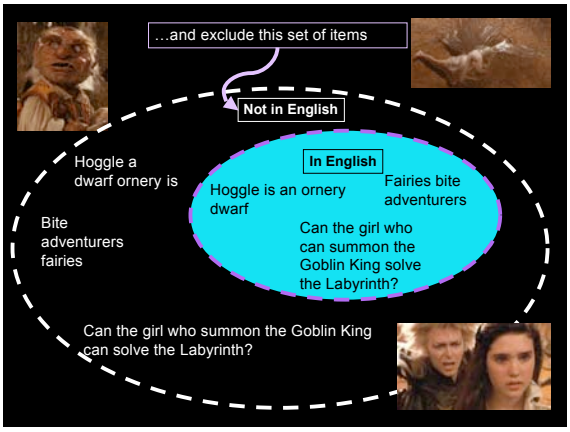
Adult knowledge: rules & patterns that generate the items that are part of the language. (mental grammar)

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.

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







So what's the problem?

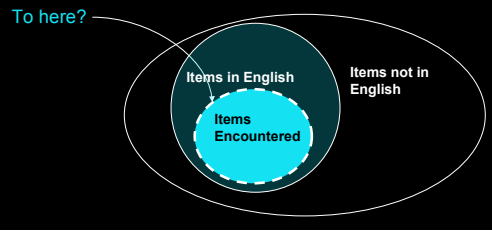
It's not clear that children encounter all the items that are part of the language.

If they only encounter a subset of the language's items, how do they know everything that belongs in the language?

So what's the problem?

One solution: children generalize

But how do they generalize?



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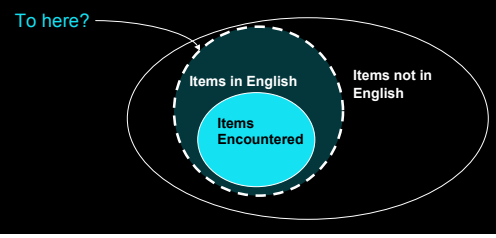

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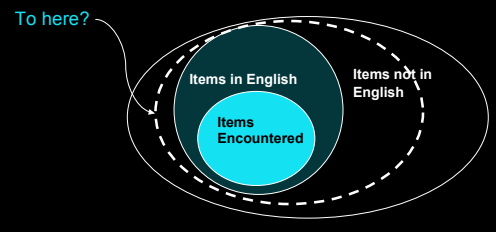

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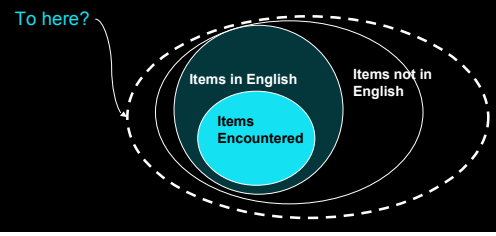
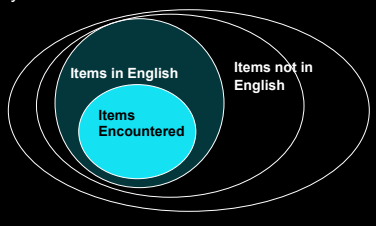


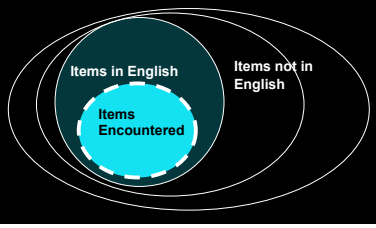
So what's the problem?

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.



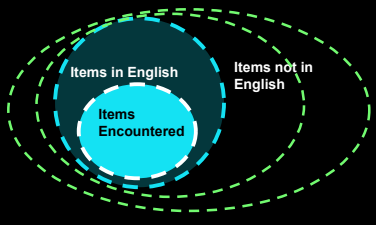
Poverty of the Stimulus: Logic

Children encounter data that is compatible with many hypotheses about the correct rules and patterns of the language.



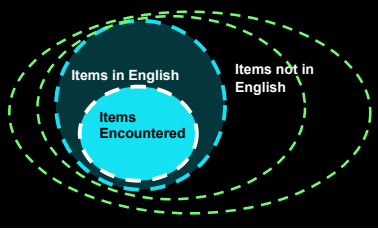
Poverty of the Stimulus: Logic

Specifically, the data encountered is compatible with both the correct hypothesis and other, incorrect hypotheses about the rules and patterns of the language.



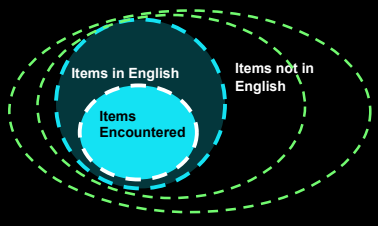
Poverty of the Stimulus: Logic

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.



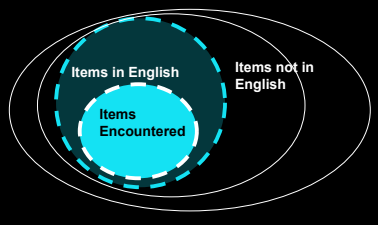
Poverty of the Stimulus: Logic

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



Argument about Innate Knowledge

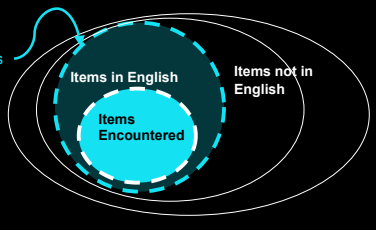
But what if children never behave as if they consider the incorrect hypotheses? That is, they never produce errors compatible with the incorrect hypotheses. They only seem to produce items that are compatible with the correct hypothesis.



Argument about Innate Knowledge

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.

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

Specific Example: Yes/No Question Formation

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Rule?

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

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Need a rule that is compatible with *all* of these, since they're all grammatical English questions.

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

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embedded clauses = additional descriptive sentences that are not part of the main clause

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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.

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.

Jareth can alter time.
Can Jareth alter time?

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?

Learning Difficulties: Yes/No Questions

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?

Learning Difficulties: Yes/No Questions

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?

Learning Difficulties: Yes/No Questions

The girl who can solve the labyrinth is happy.

Predictions of questions generated

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Rule: Move main clause auxiliary?

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

Rule: Move first auxiliary?

* Can the girl who solve the labyrinth is happy?

Rule: Move main clause auxiliary?

Is the girl who can solve the labyrinth happy?

Learning Difficulties: Yes/No Questions

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?

Rule: Move main clause auxiliary?

Is the girl who can solve the labyrinth happy?

Learning Difficulties: Yes/No Questions

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.

~~Rule: Move first auxiliary?~~

~~Rule: Move last auxiliary?~~

~~Rule: Move auxiliary in even-numbered position in sentence?~~

~~Rule: Move auxiliary closest to a noun?~~

Rule: Move main clause auxiliary?

Is the girl who can solve the labyrinth happy?

Learning Difficulties: Yes/No Questions

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

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)

Another example of children's constrained generalization

Crain & McKee (1985): pronoun interpretation

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

Jareth smiled while he danced around the throne room.

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Possible generalization: Can put pronoun before name or name before pronoun

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He smiled while Jareth danced around the throne room.
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He smiled while Jareth danced around the throne room.
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Possible generalization fails: Order of pronoun and name matters. Why?

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Answer: Constraint on pronoun interpretation. This constraint is structure-dependent, it turns out.

Another example of children's constrained generalization

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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)

Another example of children's constrained generalization

Crain & McKee (1985): Summary

The point: Children generalize only in a very specific way. In particular, they don't just generalize everything that they can. Their generalizations appear to be constrained.

Nativist idea for how their generalizations/hypotheses are constrained: prior (possibly innate) knowledge about language.

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

1) Suppose there is 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?