Syntactic cues alone in Adjective learning

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Adjective types

There is a large and diverse set of adjectives in English which can take an infinitival clause as a complement.

(Bresnan 1971, Lasnik and Fiengo 1974, Hartman 2012)

- John is tough to see
- Flowers are pretty to look at
- I am devastated to hear that
- John is eager to see

Adjective types

One pre-theoretic division among these types is whether the matrix subject is interpreted as embedded subject or object.

- John is tough to see
  - ▸ A sentence about seeing John
- John is eager to see
  - ▸ A sentence about John seeing

Adjective types

We will broadly describe these as Subject- and Object-oriented
adjectives

Also "Control" and "Tough" type, though this simplifies a bit.

- John is tough to see
    - John$_1$ is tough [PRO$_{arb}$ to see (e_1)]
- John is eager to see
    - John$_1$ is eager [PRO$_1$ to see]

Adjective types

An open question: Given this frame, how does one assign a novel adjective to either of these classes?

- John is **daxy** to see
    - ? $John_1$ is daxy [PRO_{arb} to see (e_1)]
    - ? $John_1$ is daxy [PRO_1 to see]

Acquisition of Adjective types

A sizable body of previous acquisition work has shown that children show poor performance in correctly parsing even familiar Tough-type adjectives

C. Chomsky 1969, Solan 1978, Anderson 2005

- John is tough to see
    - Adult: $John_1$ is tough [PRO_{arb} to see (e_1)]
    - Child: $John_1$ is tough [PRO_1 to see]

Acquisition of Adjective types

However, recent work by Becker et al (2012) and Becker (2015) has claimed that certain semantic cues used during nonce word training – namely, animacy – can inform children of the syntactic type of novel adjectives.

- Apples are daxy to draw
    - Apples$_1$ are daxy [PRO$_{arb}$ to draw (e_1)]
- The policeman is daxy to draw
    - The policeman$_1$ is daxy [PRO$_1$ to draw]

Acquisition of Adjective types

What other cues could learners use in disambiguating?

And, would they be more or less reliable cues?

Syntactic cues

An observation: Different adjective types go with different syntactic frames.

a John is eager/easy to see
  ‣ Ambiguous
b It's **easy**/*eager to see John
  ‣ Expletive
c John is *easy/**eager** to see Bill
  ‣ Filled Object gap
d John is **easy**/*eager to look at
  ‣ Obligatorily transitive verb

Syntactic cues

This gives clues about the nature of novel adjectives

a John is daxy to see
   - Ambiguous
b It's daxy to see John
   - $John_1$ is daxy [PRO_{arb} to see (e_1)]
c John is daxy to see Bill
   - $John_1$ is daxy [PRO_1 to see]
d John is daxy to look at
   - $John_1$ is daxy [PRO_{arb} to see (e_1)]

Syntactic cues

The question

Is hearing a novel adjective in a disambiguating frame sufficient information to determine the syntactic type of that adjective?

The present study

To answer this question, we designed a nonce learning experiment manipulating syntactic frames during training.

- Participants heard the novel adjective **daxy** either in only the ambiguous frame or also in one of the disambiguating frames.

- They were then asked for a series of pictures,
  - *Here is an (x) and a (y); which one is daxy to (verb)?*

The present study

In this picture...

a John is daxy to see...

b It's daxy to see John...

c John is daxy to see Tom...

d John is daxy to look at...

... John is daxy to see.

The present study

Training items

- The pictures are semantically vague
  - This picture plausibly could be described with either a Tough or Control type adjective.
- So the only potential cues are from the form of the sentences.

The present study

Test items
Here's a picture of a man and a dog. Can you tell me which one is daxy to clean?

If the participant chooses the man, they have given a Subject response;
If they choose the dog, they have given an Object response.

The present study

Each participant saw one of the four training conditions, followed by four test items.

- Training consisted of three pictures, presented in a consistent order.
- The four test items were invariant across participants, presented in a random order.

The participants were 77 adult native English speakers (UMass undergrads) and 58 children ages 4, 5, and 6.

Idealized results

The ideal result would be consistently using the disambiguating training conditions to give either 100% or 0% subject-oriented responses to the test items.

Training	Ambiguous	Expletive	Filled gap	Transitive
S-oriented responses	50%	0%	100%	0%

Adult results

The results we find for adults are strikingly close to the idealized results.

- Main effect of condition
  ($F = 19.25$, $p < .001$)
- Goes in expected directions
- Ambiguous condition at chance.

Rate of Subject-oriented responses by condition
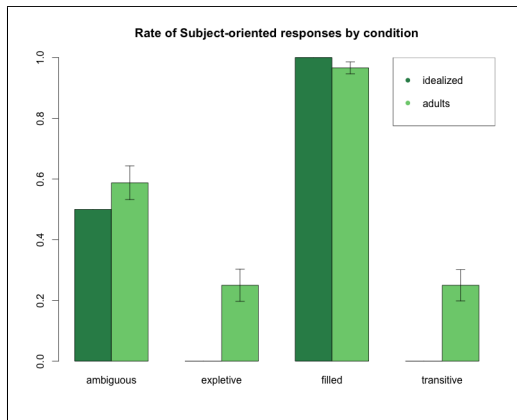
The present experiment

So we have a strong indication that adults can indeed classify adjectives based on purely syntactic information.

Now what about children?

Child results

Several possible results from child study:

- Children are adultlike
  - Effect of condition, response rates comparable to adults
- Children have **Strong Subject bias**
  - No effect of condition, close to 100% Subject responses.
- Children have **Weak Subject bias**
  - Children are adultlike except for ambiguous condition, where they skew more toward Subject responses

Child results

Looking at the child data as a whole we see a strong subject bias.

- No effect of condition
  (F = 1.03, p = .39)
- All skew toward subject
- No condition ideal.

Rate of Subject-oriented responses

- adults
- children
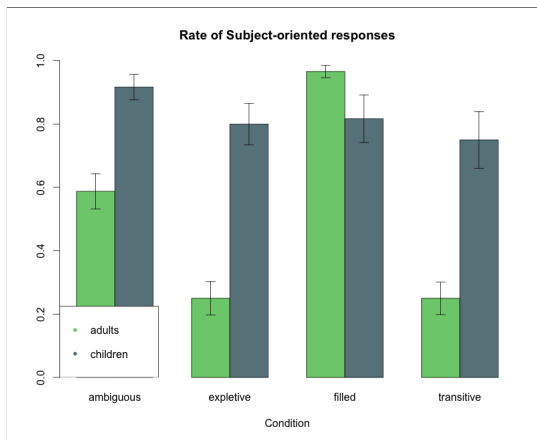
Condition

Child results

Breaking the data down by age shows a slightly more complicated picture

- No effect of condition
- Marginal effect of age ($p < .1$), no interaction.
- Fours show divergent behavior on Filled Gap condition
- Sixes starting to trend adultlike on unambiguous conditions.

Rate of Subject-oriented responses
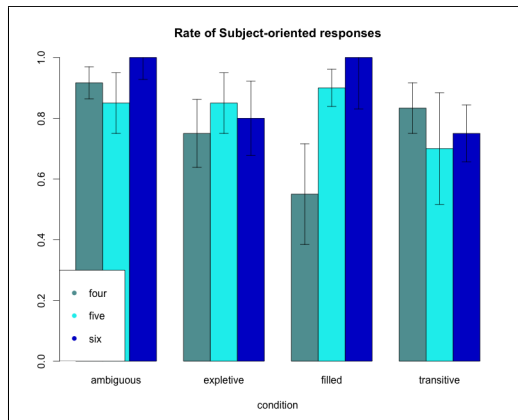
Child results

We can make some preliminary generalizations about children:

- Under these conditions, the bias toward Subject interpretations seems real.
- By age six children still do not reliably use syntactic cues in disambiguating.
- But, six year olds trend in the right direction.
  - Lower rates of Subject-Oriented responses when training should prevent them.
  - Start to resemble Weak Subject Bias predictions.
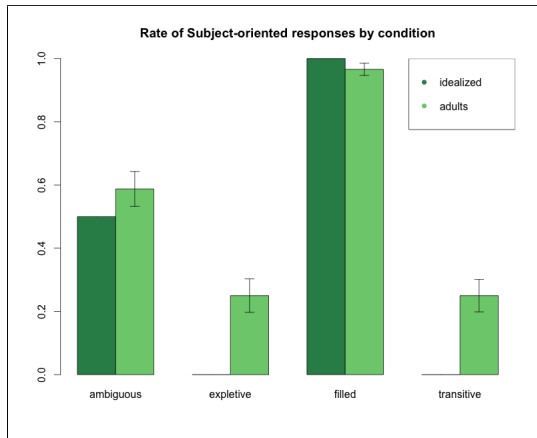
Adults revisited

Two remaining questions are:

- When do children gain the ability to give an adultlike performance?
- Can adults be prompted into *ideal* performance?

Improved training

Adults were better at learning Control adjectives than Tough adjectives.

How robust is this difference? Can it be improved with more robust training?

Improved training

Recall that in the original disambiguating training conditions, both unambiguous and ambiguous frames are heard:

In this picture, It's daxy to see John; John is daxy to see

Can we improve performance by repeating the disambiguating frame?
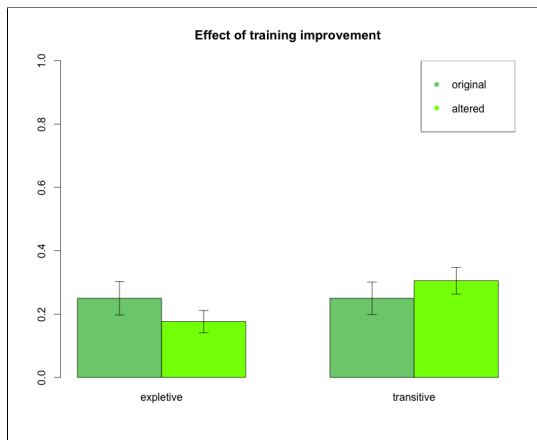
Two New conditions
   b'   In this picture, It's daxy to see John (2x)
   d'   In this picture, John is daxy to look at (2x)

Improved training

The answer seems to be no.

- Essentially no difference from original.

- To be determined: if this affects children's performance.

Strong Subject Bias

The results fit the **Strong Subject Bias** hypothesis.

- This could fit Becker's model
  - ‣ Animate DPs are treated as Subjects wherever they can be.
- Or it could support a more general model
  - ‣ DPs are treated as Subjects wherever they can be
- Repeating this sort of experiment manipulating animacy and related features could address this question.

Strong Subject Bias

Important to consider a wider range of subjecthood correlates:

- Animacy
    - In this picture, the tree is daxy to see.
- Agency
    - In this picture, John is daxy to freeze
- Definiteness
    - In this picture, a boy is daxy to see

Deriving learning difficulties?

Recent work on Tough adjectives (Keine and Poole 2015a,b) has suggested that there are two different predicates 'tough',

- tough$_{TC}$ takes properties as arguments
  - ▸ John is [tough to see]
  - ▸ [tough to see (e)]^j = For some judge j, the set of things x such that j finds seeing x tough
- tough$_{Expl}$ takes propositions as arguments
  - ▸ It is [tough to see John]
  - ▸ [tough to see John]^j = For some judge j, j finds seeing John tough

Deriving learning difficulties?

This sort of theory allows us to say that, since Adjectives in the unambiguous conditions are not necessarily the same as those in the ambiguous condition, learning from syntax is a non-trivial task.

Thus part of the difference between children in adults is ability to reason that for Adj_{Expl} there is Adj_{TC}

However, this only predicts the results for the Expletive condition.

No need to assume different lexical items for 'John is tough to see/look at'

Subject Bias revisited

Becker's (2015) results demonstrated that animacy is available as a cue to syntactic type.

Children's performance differs based on animacy cues in training.

Our results underscore the **need** for such a strategy for children to learn syntactic type.

Children's performance shows no difference based on syntactic cues in training.
Animacy or something like it may be the only option for children 6 and under.

Subject Bias revisited

For now, we can treat the Subject Bias for potentially ambiguous adjectives to be an underived property of learning.

- For children it is at least stronger than for adults
- But it seems to have some sort of realization in adult performance.

Thank you!

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We appreciate any and all feedback you can give us!
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