When Bayes betrays: How linguistic hypotheses shape learning biases

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Learning Biases in Language Acquisition

Learning biases can help to determine:
(1) The hypothesis space a language learner is equipped with
(2) The mechanisms that turn linguistic input into linguistic representations

Biases can stem from:
(3) General properties of a learner's cognitive capacity
(4) Language specific biases related to particular phenomena

Determining whether a bias originates from (3) or (4) tells us more about (1) and (2)

Size Principle in Word Learning

Novel noun learning (Xu & Tenenbaum 2005)
(1) Learners are taught novel label for multiple exemplars from one subset (Dalmatians)

(2) Hypotheses about Noun’s Meaning
   H1: subset interpretation (label means Dalmatian)
   H2: extension (label means dog, mammal, animal...)

(3) Learners do not extend meaning to dogs, animals

(4) In the absence of information to support H2, pick H1

(5) ‘Size Principle’ follows from principles of Bayesian inference

Novel Adjective Learning (Kilbanoff & Waxman 2000)
Basic level categories form basis of adjective learning

Predictions

Size Principle would be overly constraining in certain domains

Noun Class Agreement (e.g., Spanish Gender)
- Feminine: la table, la apple, la woman, la street
- Masculine: el dog, el heart, el man, el tree
  • agreement tends to align with large classes of words, not narrow ones

If size principle is a general learning principle: Learners of both novel words and novel agreement should show subset bias

If size principle is specific to the phenomena being learned: Learners of novel words should show subset bias but learners of novel agreement shouldn’t

Sample trial

Stimuli and Task

Familiarization: Learn new words in Dragon English describing objects in two distinct subsets

Test: Choose items which match description from items from subset, basic levels and superset

<table>
<thead>
<tr>
<th>Novel Word</th>
<th>Adjective</th>
<th>Verb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>animate</td>
<td>walking</td>
</tr>
<tr>
<td></td>
<td>inanimate</td>
<td>stick</td>
</tr>
</tbody>
</table>

Size Principle associated with it is (at least) part of what determines learning biases

Results

Children
N=28, age 4.6-5.6

<table>
<thead>
<tr>
<th></th>
<th>Subset</th>
<th>Basic</th>
<th>Superset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Novel Word</td>
<td>0.15</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>Novel Agreement</td>
<td>0.6</td>
<td>0.2</td>
<td>0.6</td>
</tr>
</tbody>
</table>

p < 0.05

Adults
N=34

<table>
<thead>
<tr>
<th></th>
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<th>Basic</th>
<th>Superset</th>
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p < 0.05

Notes

Only trials where subject showed they had learned the words were used (appropriate choice of big or small, animate or inanimate): 100% adults, 83% of children’s trials (4 agreement, 5 word)

Codings

subset: only picked from subset
basic: picked from basic or basic & subset
superset: picked from superset, or superset & basic, or super & subset, or all 3

Conclusions

The size principle is not a general learning mechanism but one specific to word learning

The phenomenon being learned and the linguistic hypotheses associated with it is (at least) part of what determines learning biases