There is no step more uplifting, more explosive, more momentous in the history of mind design than the invention of language. When Homo Sapiens became the beneficiary of this invention, the species stepped into a slingshot that has launched it far beyond all other earthly species in the power to look ahead and reflect…

Daniel Dennett 1996, Kinds of Minds, Basic Books, p.147
Why study language acquisition?

“Language learning is doubtless the greatest intellectual feat any of us is ever required to perform…” (Bloomfield, 1933)
Tweetle Beetles

What do you know about tweetle beetles? Well… When tweetle beetles fight, it’s called a tweetle beetle battle, and when they battle in a puddle, it’s a tweetle beetle puddle battle. And when tweetle beetles battle with paddles in a puddle, they call it a tweetle beetle puddle paddle battle. AND….

“Fox in Socks” by Dr. Seuss (1965)
Levels of Representation

- Phonology - Sounds
- Syntax - Sentences
- Semantics - Meaning
- Language and Thought
More than one language at once

- childhood bilingualism/multilingualism
- By 2015, 30% of preschoolers in US will not have English as home language
- (Fix and Passel 2003)
Leading Questions:

- How much is built in?
- How much is due to learning?
- When does it begin?
- How does it happen?
- Does acquiring more than one language at once hinder?
How can one study it?

- The difficulties:
  - Tacit knowledge
  - Nothing tangible
  - Acquire before 3+ years of age
How can one study it?

- An interdisciplinary field
  - Linguistics
  - Developmental Psychology
  - Experimental Psychology
  - Neuroscience

- i.e., COGNITIVE SCIENCE
What Book Attempts

- Field exploding with research:
  - Cull that research: Scientific Methodology
- All levels of representation
- Assess the state of the art with regard to leading questions
- Interdisciplinary
Today

- What are some basic discoveries?
- Exemplify some active research
- Some recommendations for education in the future
Some recent new discoveries

- Neonates distinguish languages
- Neonates distinguish sounds
- 4 month olds distinguish well formed clause structure
- 6–8 month olds pick out words
- 12 months:
  - first words produced
  - sound distinctions related to native language
  - Already know a lot about their language(s)
Examples of language acquisition data: active research

1. Syntax and Semantics
2. Early word learning
3. Studies of developing bilingualism
Method

- Work with 2–6 year olds
- In Cornell’s Early Child Care Center
- In collaboration with Elizabeth Stilwell, director, and teachers
- With local nursery and other schools
- Or in child’s home

- Work with Cornell students, graduate and undergraduate
Acquisition of Syntax and Semantics

- An experimental study (Foley et al 1997, 2003)
- “Sloppy Identity”
Acquisition of Syntax and Semantics

- Ernie touches the ground and Big Bird does too
- \([\text{Ernie} \ [\text{touches the ground}]] \) and \([\text{BB} \ [\text{does} \ [\emptyset]]] \) too

(Foley, Nuñez del Prado, Barbier, & Lust 1997, 2003)
Acquisition of Syntax and Semantics

1. Ernie [[touches] the ground] and Big Bird [[does] Ø]] too

2. [ NP₁  VP₁ ] and [ NP₂  VP₂ ] too

Reconstruction:
Ernie touches the ground and Big Bird touches the ground
Acquisition of Syntax and Semantics

Given the sentence:

“Oscar bites his banana and Bert does too”

What does the sentence mean?

What does each one bite?
Acquisition of Syntax and Semantics

Four Possible Interpretations of:

“Oscar bites his banana and Bert does too.”

a. O bites O’s banana and B bites B’s banana
   ii jj

b. O bites O’s banana and B bites O’s banana
   ii ji

c. O bites B’s banana and B bites B’s banana
   ij jj

d. O bites E’s banana and B bites E’s banana
   ik jk
Acquisition of Syntax and Semantics

Impossible Interpretations:

- *O bites O’s banana and B bites E’s banana (ii jk)
- *O bites B’s banana and B bites O’s banana (ij ji)
- *O bites B’s banana and B bites E’s banana (ij jk)
- *O bites E’s banana and B bites O’s banana (ik ji)
- *O bites E’s banana and B bites B’s banana (ik jj)
Acquisition of Syntax and Semantics

- O [bites [his (own) [banana]]] and B [does [too]]
- O [\(\lambda x \ [x \text{ bites } [x \ [\text{banana}]]]\)] and B [\(\lambda x \ [x \text{ bites } [x \ [\text{banana}]]]\)]
Experimental Set-Up:
Act-Out Task

Bert
Oscar
Fozzy Bear

B's
O's
FB's
Acquisition of Syntax and Semantics

ii jj = Sloppy interpretation: Bound Variable
Acquisition of Syntax and Semantics

\[ \text{ii ji} = \text{Strict interpretation} \]
What this example shows:

- Child has extremely complex syntactic and semantic knowledge even before age of 3
- Child can deal with ambiguity: Mapping from one form to multiple possible meanings
- Child knowledge is grammatically constrained
Acquisition of Syntax and Semantics

These characteristics hold for all languages:
For Example, Chinese
Early Word Learning

Rate of acquisition:

- Many new words each day, e.g. 6-8 a day at first, then 45 a day
Acquisition of Words

- 12 months
  - E.g., Lois Bloom’s Allison:
    - 16 mos – 29 words
    - 19 mos – 61 words
    - 20 mos – 103 words

- 24-36 months: 1000
- 5 years: 10000
- 6 years: 14000
- Adult: 50000-300000
  (uncountable)
EARLY WORD LEARNING

- The “over-extension” phenomenon
It’s an Apple

BG21097
Age: 1, 9, 15
It’s not an Apple!

BG21097
Age:4,1,26
What this shows:

- Child creative
- Child abstract
- Child categorizing
- Child not simply copying
- But some form of experience necessary

These are all crucial factors in development
Summary of Major Discoveries

- Language Acquisition begins at birth, even before first word
- Major accomplishments by 12 months
- Basic accomplishment of full system by three years
- All levels of representation being acquired at once
Conclusions

- Cannot explain early complex syntactic and semantic knowledge without some biological programming in a Language Faculty.
Conclusions

- Yet child must acquire a specific language; to do so must integrate learning

- Child using experience from birth, even before, to build their theory of how language works
Conclusions

- Learning is constrained, guided linguistically

- Child creative and constructive in use of experience

- Not just copying
Regarding bilingualism or multilingualism

- Is bilingualism/multilingualism beneficial to cognitive development?
- How does the young child manage to acquire more than one language at once?
- Project Led by: Sujin Yang
Test for Bilingual Cognitive Advantages: Sujin Yang et al

- Executive Attention
- Ability to ‘manage cognitive processes’
- to work in the face of distraction
- inhibit certain distractions
- focus on others
- cognitive flexibility: deal with change
## Early Childhood Bilingualism

(Yang; 2007; Yang & Lust, in preparation)

<table>
<thead>
<tr>
<th>Research Question</th>
<th>How do attention networks mature over the early childhood period and would bilinguals be different from monolinguals in a long-term development?</th>
</tr>
</thead>
</table>
| Sample            | - 129 children; 4, 5, & 6 year olds  
- Balanced Korean bilinguals/ English monolinguals |
The Attention Network Test (ANT)

4 Warning Cue Types

No Cue

Central Cue

Double Cue

Spatial Cue

3 Flanker Types

Neutral

Congruent

Incongruent
ANT Performance

**Significant bilingualism/age effects in accuracy & RT**, $p < .001$

### Accuracy (%)

<table>
<thead>
<tr>
<th></th>
<th>Monolinguals</th>
<th>Bilinguals</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 years</td>
<td>73</td>
<td>84</td>
</tr>
<tr>
<td>5 years</td>
<td>77</td>
<td>91</td>
</tr>
<tr>
<td>6 years</td>
<td>83</td>
<td>96</td>
</tr>
</tbody>
</table>

**NOTE: * p < .05; ** p < .001**

### RT (ms)

<table>
<thead>
<tr>
<th></th>
<th>Monolinguals</th>
<th>Bilinguals</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 years</td>
<td>1143</td>
<td>1086</td>
</tr>
<tr>
<td>5 years</td>
<td>1156</td>
<td>1006</td>
</tr>
<tr>
<td>6 years</td>
<td>960</td>
<td>824</td>
</tr>
</tbody>
</table>

**NOTE: * p < .05; ** p < .001**
How does the child acquire more than one language?

- e.g., case studies
- e.g., young Hebrew–English case
- Young Israeli child brought to Cornell’s ECC (NG081803)
- Hebrew at home; English at ECC
- Studied over 40 interviews (home and ECC)
- Age: 3.00.25–3.08 (years, months, days)
- Project led by: Yarden Kedar
  - with ECC director Elizabeth Stilwell and teachers; and undergraduates: Kristen Pallonetti, Brian Druyan, Julia Rosenberg, Erica Shreck
Now she is here
NG081803_1  Age: 3.0.25
Now I am Playing
NG081803–1 Age: 3.0.25
Barnie is Hebrew
NG 081803-1  Age: 3.0.25
Eight Months Later at home:
NG081803-38  Age:3.08.12
Because it’s Mine
NG081803_38   Age: 3.08.12
Now I’m bilingual in school
NG081803_37  Age: 3.08.09
I Can Speak Both
NG081803_37  Age: 3.08.09
Bilingualism: conclusions

- Any child can learn more than one language
- Will do so naturally if surrounded by the languages
- Earlier the better
- Children benefit cognitively from learning more than one language
- No evidence it hinders acquisition of first language
How can educational contexts help?

- Surround child with as much rich language and language exchange as possible
- Surround with language through literacy
- Surround with more than one language
- Maintain home language
Conclusions

- With language acquisition,
- the child teaches us
- we don’t teach the child
Conclusions

- The Mystery remains
References


Toward the Future

- Virtual Center for Language Acquisition
- www.clal.cornell.edu/vcla
Partnership with the Library
Truly International and Intercultural
On- and Offsite Collaboration

The Elicited Imitation Task

The researcher repeats the model sentence once more.

context

narrative

transcript

input

video

Elmo licks the ice cream.
Elmo licks, licks the ice cream.
Bugs Bunny rolls the peach.
Research and Education Merge

Cornell University
Faculty Innovation in Teaching Program
Acknowledgements

- James Gair
- Elizabeth Stilwell
Acknowledgements:

- Claire Foley
- Suzanne Flynn
- Zelmira Nuñez del Prado
- Isabella Barbier
- Fang Fang Guo
- Yu Chin Chien
- Chi-Pang Chiang
- Matt Klein
- Maria Blume
- Cliff Crawford
- Katerina Boser
- Jung Hoon Son
  and........
- The Cornell Language Acquisition Lab
Grants

- National Science Foundation. Planning Grant: A Virtual Center for Child Language Acquisition Research (BCS-0126546, Barbara Lust and Founding Members). BCS-0535569 NSF Developmental and Learning Sciences Program

- National Science Foundation. IIS-0437603 Small Grant for Exploratory Research: Planning Information Infrastructure through a New Library-Research Partnership (Janet McCue, director of Cornell Albert Mann Library and Barbara Lust). NSF Science and Engineering Information Integration and Informatics
Acknowledgements- Grants

Cornell:

- **CISER Seed Grant**: Building an Interdisciplinary Infrastructure to Foster Collaboration among Research Scientists in the Language Sciences: Proposal to Create Instrument-based Virtual Linguistics Laboratory for the International Study of Language Acquisition and Neural Plasticity.

- **FABIT (Faculty Innovation in Teaching) Awards**: "Integrating Digital Multimedia resources in two interdisciplinary language development courses" and "A VRE (Virtual Research Environment) for Language Acquisition and Cognitive Science."

- **New York State Hatch grant**: "Cornell Language Acquisition Lab: Building an Electronic Library of Words of the World's Children".
Exploring Activation of an Internation component in a Virtual Center for the Study of Language Acquisition

PI: Barbara Lust, Professor, Department of Human Development
co-PI: Sujin Yang

Today, in this digital age, the possibilities for international collaboration have expanded exponentially. By incorporating the possibilities of cyberinfrastructure which have become available to the sciences, research and education can now exploit an international dimension in ways not possible before. At this time, the Cornell Language Acquisition Lab has begun to build a Virtual Center for Language Acquisition (VCLA:www.clal.cornell.edu/vcla) in order to begin to exploit these new possibilities.