# Children's language comprehension: incremental, interactive and abstract

#### Michigan State University March 2014



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#### How does language comprehension develop?





## Adult language comprehension

- 1. Builds a series of linked representations
- 2. Interpretation is incremental
  - cascaded processing
- 3. Processes at each level are interactive
  - influenced by multiple other levels
  - both linguistic and nonlinguistic

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## Comprehension builds series representations



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#### **Interactive Processing**



## Language interacts with other cognitive systems



#### How does this system develop?







## Preschooler's online comprehension is

- 1. Incremental
  - Phono-semantic priming, negation
- 2. Interactive
  - Syntactic ambiguity resolution
- 3. Builds abstract representations
  - Structural Priming

## 1. Incremental Processing



Miseon Lee Hanyang University

#### **Phono-semantic priming**





"Pick up the logs"

Semantic priming via phonological cohort member

Marslen-Wilson & Zwisterlood, 1989; Yee & Sedivy, 2006

### "Pick up the logs"



## "Pick up the logs"







## " Pick up the logs



## Phono-semantic priming in 5 year olds



## Children make incorrect actions as well



#### Incrementality at higher level....

- Lexical storage could support stable associations
  - Facilitating incremental processing
- Are <u>higher-level</u> semantic representations constructed incrementally?
- Negation as test case
  - Reverses the usual pattern of association
- Adult negation processing
  - Negatives often initially treated as affirmatives in weak contexts<sup>1</sup>
  - But not in rich discourse contexts<sup>2</sup>

Kaup et al., 2007; Fischler et al., 1983; Kunios & Holcomb, 1992; Ludke et al., 2008.
Nieuwland & Kuperberg, 2008; Tian, Breheny & Ferguson, 2010.







































#### Negative





#### Affirmative



#### Prediction: associative processing



#### Prediction: incremental semantics



#### Adults are incremental



#### 4 year olds are incremental but slower M=4;7



#### 3 year olds are incremental but noisier



## Incrementality

- Lexical processing is cascaded in children
- By 3 children do incremental semantic interpretation
- Eye-movements reflect processing at several levels (lexical and combinatorial)
# **Interactive Processing**

# Resolution of structural ambiguity in children



John Trueswell



Sylvia Yuan

**Carissa Shafto** 



Amanda Worek

### **Interactive Processing**



# NP-attachment (modifier)



Alice attacked the paper with the flawed data

### **VP-attachment (instrument)**



Alice attacked the paper with the flawed data

# Information for ambiguity resolution

- Adults use:
  - Lexical: verb information
  - Pragmatic: need to resolve referential ambiguity
  - Prosodic: phrase boundaries
  - Conceptual: plausibility of interpretation
- What cues do preschoolers use (4;0-6;0)?

#### **Paradigm**

### "Feel the frog with the feather"



Snedeker & Trueswell, 2004; Snedeker & Yuan, 2008; Snedeker, Shafto & Worek, in prep

# What information do children use?

(Snedeker & Trueswell, 2004)

- Different verbs  $\rightarrow$  different interpretations
  - <u>Choose</u> the pig with the fan (modifier)
  - *<u>Hit</u> the pig with the fan* (instrument)
- Referential ambiguity does not affect parsing
  - Two pigs vs. one pig





#### Do children use prosody in parsing? (Snedeker & Yuan, 2008)

- Instrument Prosody
  You can feel the frawwg....
  ....with the feather
- Modifier Prosody

You can feeeel....



....the frog-with-the-feather

Blocked Design



# children's actions affected by prosody but only for the first block of trials



Snedeker & Yuan, 2008



b. Block 1 Instrument Prosody



Snedeker & Yuan, 2008

Conclusion: Children's parsing is interactive

- Use verb information
- Use prosodic cues

# Why do children fail to use referential ambiguity?

Perhaps they are poor at rapid use of top-down information....



### Plausibility, another top-down constraint

- Plausibility: how likely is a given interpretation given the affordances of the objects?
- Low instrument plausibility:

Tickle the bear with the mirror

• High instrument plausibility:

Tickle the bear with the paintbrush

Snedeker, Shafto & Worek, in prep

#### Eye movement data



Adults, Plausibility Effect

# In adults, plausibility effects emerge early and dominate parsing

Snedeker, Shafto & Worek, in prep

#### Eye movement data



Adults, Plausibility Effect

#### **Five-Year Olds, Plausibility Effect**

In children, lexical effects emerge early and dominate parsing

Snedeker, Shafto & Worek, in prep



prosodic

# Preschooler's online comprehension is

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What representations guide children's comprehension?

#### **Structural Priming**

# Malathi Thothathiri George Washington University





# What representations lurk behind children's utterances?





Adult-like abstract structures?

# What representations lurk behind children's utterances?

Give (me) (a cookie)  $\stackrel{\uparrow}{-}$  GIVE GIVEE GIVEN Give me a cookie!

Item-Based Frames? (Tomasello, 1992)

# How do we tell the difference?

- Do children generalize knowledge to novel verbs?
  - Production: 3 yo often don't
  - Comprehension: 2 yo clearly do
- Issues of interpretation
  - Does the child treat novel verbs as novel (vs. translation)?
  - Are these representations invoked for known verbs?

• Datives: Verbs of transfer (give, show).

- Dative alternation
  - Double-Object Dative (DO)
    *Give the boy the truck*: Recipient-First
  - Prepositional Dative (PO)
    *Give the truck to the boy*: Theme-First



The woman is giving the man a book.

The woman is giving a book to the man.



a book to the man.

man a book.

7



man a book.

# **Priming and Representation**

• Item-Based Frames  $\rightarrow$ 

Within-verb priming only

Abstract Generalizations →
 Within-verb + Across-verb priming

Comparison: 4 year olds and 3 year olds (M=4;0, M=3;1)

# Design

#### Prime: Pass the lion the ball or Pass the ball to the lion



Target: Pass the cowthe bookorPass the coucouch to the dog

# Double Object Primes 4 year olds



Time from Noun Onset (in milliseconds)

# Prepositional Object Primes (4 year olds)



Time from Noun Onset (in milliseconds)

# Structural priming present at 4 and 3



Thothathiri & Snedeker, 2008a

# Children construct abstract representations during comprehension....

For parallel production findings: Bencini & Valian 2008; Rowland et al., 2012

#### But what are the primed representations?

# 1. Surface syntax?

2. Syntax-semantics mappings?

Adults: Bock & Loebell, 1990; Bock et al., 1992; Chang, Bock, & Goldberg, 2003; Griffin & Weinstein-Tull, 2003

#### Confounded in dative alternation

### -different semantic mappings

- Pass the cup to the lion  $\rightarrow$  theme + recipient
- Pass the lion the cup  $\rightarrow$  recipient + theme
- -different syntactic forms
  - Pass the cup to the lion  $\rightarrow$  V + NP + PP
  - Pass the lion the cup  $\rightarrow$  V + NP+ NP

#### But not in locative alternation

## -different semantic mappings

- Load the hay onto the truck  $\rightarrow$  theme + location
- Load the truck with the hay  $\rightarrow$  location + theme
- single syntactic form
  - Load the hay onto the truck  $\rightarrow$  V + NP + PP
  - Load the truck with the hay  $\rightarrow$  V + NP + PP

# Locative-to-Dative Predictions

- If surface syntax is primed
  - Both locatives should prime PO datives (both have NP+PP structure)
- If semantic mappings are primed
  - Theme-first locative will prime PO dative (theme first)
  - Location-first locative will prime DO dative (recipients and locations are both goals)

# Dative priming in 4 yr olds


# Comprehension priming depends on thematic mappings



# Young children have abstract structural representations

Give me

a break!



### Priming persists across different tasks

Paradigm primes syntaxsemantics mappings The critical features of adult language processing are in place by 3 years of age

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# But young children differ from adults...

- Poor use of top-down cues
  - Referential context, plausibility
  - Due to slower processing speed? (ala Dell, 1986)
  - Less predictive and more reactive processing?
- Failure to override incorrect analyses
  - Phonosemantic errors, perseveration prosody
  - Immature executive functions? (Novick, Kan, Trueswell, Thompson-Schill, 2009; January et al., 2009; Mazuka, et al., 2009)
  - Limited experience?

# **New Questions**

- Using the tools to study disorders
  - Prosody in autism
  - Top-down cues schizophrenia
- Different languages, different cues
  - Comprehension of case marking in Turkish

# How do children with autism interpret prosodic accents?







### Eun Kyung Lee



Becky Nappa



## Communicative deficits in autism



## Autism with, and without, language impairment



Kjelgaard & Tager-Flusberg (2001)

## Communicative deficits in autism







#### Prosody affects syntactic analysis (actions)



Typically-developing Children Children with Autism 8-17 years (block 1) 8-17 years (block 1) 1 1 Instrument Prosody 0,9 ent Actions Modifier Prosody 0.8 0.7 ofInstrum 0.6 0.5 0.4 0.3 0.2 0.1 0.1 0 0 Typically Developing Autism

#### Eye movements demonstrate rapid use of prosody



### Joshua Diehl Notre Dame

Diehl, Friedberg, Paul & Snedeker (under review) Typically-developing children do not perseverate but children with ASD do (until 13)



Children with Autism



- A: How was your parents' visit?
- B: OK.My dad bought a BB gun for Oscar.

What should A say next?

- A: How was your parents' visit?
- B: OK.

My dad bought a BB gun for **\*Oscar\***.

But <u>he's</u> only six! Was <u>his brother</u> jealous?

- A: How was your parents' visit?
- B: OK.

My dad bought a \***BB gun\*** for Oscar.

Why did he buy <u>that</u>? What are you going to do with <u>it</u>?

- A: How was your parents' visit?
- B: OK.
  - My \*dad\* bought a BB gun for Oscar.

How is <u>he</u> doing? What did your <u>mom</u> say?

## • Hypothesis 1: accent signal new referent

- Explains some cases
  - "Put the candle on the square. Put the CANDY/candle...."
- But not others

"Click on the orange house. Now click on the RED house"

- Hypothesis 2: accent invokes a contrast set (Rooth, 1992)
  - Accent marks a variable
  - Replace variable with alternate values
  - To get set of alternatives under consideration

## "Put the candle on the square. Now..."



## Typical kids use accent as cue to novelty



Nappa & Snedeker (in prep); see also Arnold (2008)

## Kids with ASD do too



Nappa & Snedeker (in prep)

## "Click on the yellow house. Now..."



## Typical kids use accent to identify contrast



Nappa & Snedeker (in prep); see also Ito et al. (2011)

## Kids with ASD have the opposite response!



Nappa & Snedeker (in prep)



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