Slide 1

Conspiracies
in
Language Acquisition

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1

Slide 2

Child language seems weird (but is it, really?..)

- Several processes observed in child language are not attested in adult languages; e.g.
  - Major PoA consonant harmony (duck > 'guck')
  - Velar fronting (go > 'do')
- Analyzing these processes is rather challenging:
  - Some look at the statistical properties of the input (e.g. Levelt, Demuth, Lleó)
  - Some investigate the issues from a formal perspective (e.g. Bernhardt, Stemberger, Dinnsen, Gierut, Goad, Rose, Freitas, Pater, Fikkert, Levelt, …)
  - Some think that we simply shouldn't bother (esp. Hale & Reiss 1998)

2

Slide 3

Can any of these approaches be validated?

An example: the statistical approach

3

Slide 4

Statistical approaches: Foundational work

- **Infant speech perception:**
  Statistical and probabilistic approaches provide appealing / convinging explanations for:
  - Discrimination of sound sequences
  - Perception and development of ling. categories
  - Development of the mental lexicon (Work by, e.g. Aslin, Gerken, Jusczyk, Maye, Morgan, Newport, Saffran, Tees, Werker, …)
- (Other factors such segmental, co-articulatory and supra-segmental information also play a role in language learning) (e.g. Curtin, Werker)

4

Slide 5

Statistical approaches: Some proposals

- **Child early productions:**
  - **Levelt, Schiller & Levelt (2000):**
    The order of acquisition of syllable types in young Dutch learners **corresponds to the relative frequency** of these syllable types in the ambient language
  - **Demuth & Johnson (2003):**
    Syllable truncations resulting in CV forms in French **correlate with the high frequency** of CV syllables in this language

5

Slide 6

Statistical approaches: Predictions

- The order of acquisition (of syllable types, word shapes, phones, etc.) correspond to their frequencies in the ambient language:

  - **Most frequent** units acquired **first**

  - **Least frequent** units acquired **later**

  - Units with **comparable frequencies** acquired during the **same period**

6

Levelt, Schiller & Levelt (2000)

Group A: **CVCC > VCC > CCV > CCVC**

CV > CVC > V > VC   **CCVCC**

Group B: **CCV > CCVC > CVCC > VCC**
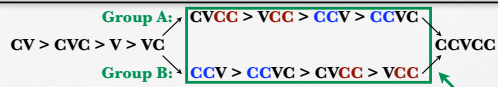
- The development sequences correspond to the frequencies observed in the language
- **Variation** between groups A and B: syllable types with **comparable frequencies**
  CV > CVC > VC > V > {CVCC ≈ CCVC ≈ CCV ≈ VCC} > CCVCC

<u>Their conclusion</u>: acquisition paths can be predicted through input frequency from ambient language

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Frequency versus complexity

- Does the frequency approach make any better predictions than more traditional approaches based on complexity (e.g. of phonological representations)?

- Order of acquisition predicted by complexity:
  Less complex >> more complex

- In most cases, predictions are identical:
  Complexity and frequency are in correlation
  (**Less complex** = **more frequent** = **acquired early**)

Frequency versus complexity

- Back to groups A and B in Dutch data:
  - Group A: **Final** CC sequences before **initial** ones:
    CVCC >> VCC >> CCV >> CCVC
  - Group B: **Initial** CC sequences before **final** ones:
    CCV >> CCVC >> CVCC >> VCC
- Non-attested patterns (there are 22 of these):
  * **CVCC >> CCV >> VCC >> CCVC**;
  * **CCV >> CVCC >> CCVC >> VCC**;
  (i.e. all cases where **#CC** and **CC#** are mixed)
- <u>However</u>:
  The non-occurrence of these unattested patterns is predicted by a complexity-based approach

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Frequency versus complexity

- Complexity-based approach:
  - The structures are independent
    - Finnish, Klamath: **CVCC** but not ***CCV**
    - Mazateco, Sedang: **CCV** but not ***CVCC**
- Groups A and B in Dutch (again!):
  - Group A: **Final** CC sequences before **initial** ones:
    CVCC >> VCC   **CCV >> CCVC**
  - Group B: **Initial** CC sequences before **final** ones:
    CCV >> CCVC   **CVCC >> VCC**
- Group A: **final** structure acquired first
- Group B: **initial** structure acquired first
- <u>Conclusion</u>: only possible grammars are attested

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In the larger context…

- Emerging processes:
  - Consonant harmony (e.g. *duck* > **[gʌk]**)
  - Velar fronting (e.g. *kick* > **[tɪk]**)
  - Segmental substitution (e.g. *fit* > **[sɪt]**)
  - Syllable truncation (e.g. *elephant* > **[ifa]**)
  - Syllable reduplication (e.g. *ami* > **[mimi]**)
  - …
- Why do children produce patterns that cannot be directly induced by statistics of the input, or even predicted by phonological theory in general?

Proposal

The spoken chain

Grammar

Articulation

Perception

Acoustic signal
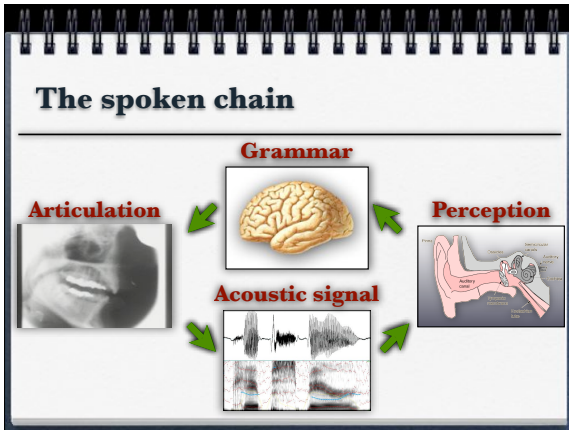
13

General approach

- The learning path is governed by the **child's grammatical analysis** of his/her language
  - Intuition expressed in the acquisition literature of the 1970s and 1980s (e.g. Goad & Ingram 1987)
  - Approach explicit in work on distributional learning (e.g. Pinker, Slobin, …)
  - Also e.g. Dresher and v.d. Hulst on learnability
- The child's analysis is **influenced by both grammatical and non-grammatical factors**
  - Non-grammatical factors can also influence productions independently of child's analysis

14

What kinds of factors?

Ambient language

Grammar

Analyses

Inferences

Now what?

Child speech
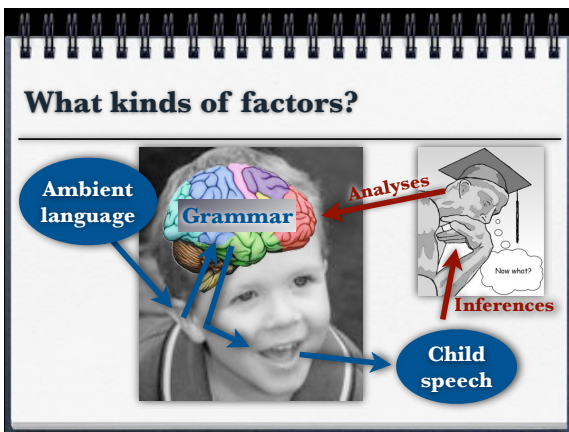
15

Methodological implications

- Consider a wide variety of cross-linguistic child production data in their larger context
- Interpret these data based on:
  - Property of the input (ambient language)
    - Its phonetics and phonology
    - Other factors such as input frequency

  Today's focus:
  - **Phonetics (perception, articulation)**
  - **Phonology (representations, categories)**
  - Morpho-syntax
    - Derivations, inflections, word order, systems
  - Larger context (social, pragmatic, …)

16

Some examples and illustrations

17

Perceptual effects

- Erroneous representations due to incorrect perception of speech input (Smith 1973)
  - *puzzle* /pʌzəł/ → [pʌdəł] -- /z/ → [d]
  - *puddle* /pʌdəł/ → [pʌgəł] -- /d/ → [g] (*[d])

- If the child can produce [d] in *puzzle*, then the non-production of [d] in *puddle* cannot be caused by a grammatical problem
- The word *puddle* is represented with a /g/ in the child's mind ⇒ there is no real 'process' involved (Blaine 1976, Macken 1980)

18

Perceptual effects

- Merger of acoustically-similar sounds
  - Acquisition of the /θ/ ~ /f/ contrast in English:

    /f/ → [f]   (e.g. *fin* → [fɪn])

    /θ/ → [f]   (e.g. *thin* → [fɪn])

  - /θ/ and /f/ are acoustically extremely similar and often confused at the perceptual level
    (e.g. Levitt et al. 1987; Borden et al. 2004)
  - If the child perceives and represents /θ/ as [f], then there is no way that *thin* will be produced as such

Articulatory effects: vocal tract
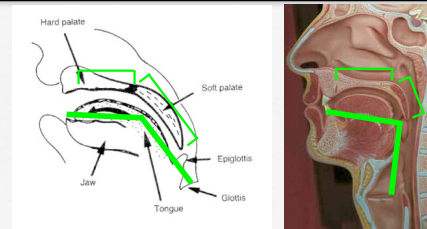
Adult forms and proportions are attained between ages 6 and 10 (Crelin 1987; Ménard 2002)

Articulatory effects: motor control

- The tongue is a unique muscle in the human body
  - Muscular hydrostat
  - Two functional sections (root, tip)

- Motor control is imperfect in young children
  - Full motor control for tongue shape is acquired fairly late in development (e.g. Kent 1992)
  - Tongue movements in early speech are ballistic (lack refined control)
    - Especially in positions requiring strong articulations
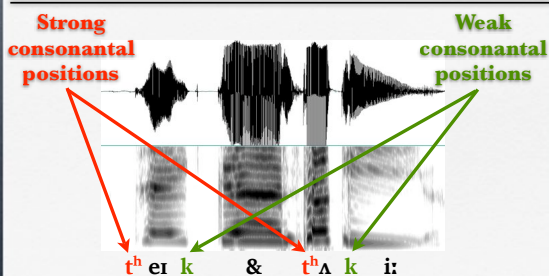   (e.g. Studdert-Kennedy & Goodell 1992)

Speech patterns

'Strong' positions (e.g. initial, stressed): k/g → t/d

cake	[t]ake
cookie	[t]ookie

'Weak' positions (e.g. medial unstr'd; final): OK

ca**k**e	ca[k]e
coo**k**ie	coo[k]ie

'Take and tookie'
'Sagwa is a tat'

Acoustic correlates

Strong consonantal positions

Weak consonantal positions

tʰ eɪ k   &   tʰ ʌ k   iː

Hypothesis (Inkelas and Rose 2008)

- The child perceives the grammatical contrast between strong and weak consonants
- The immature shape of the vocal tract and the imperfect control of the tongue prevent an accurate rendition of this contrast, such that:
  - Extended contact of the tongue body on the palate brings closure into front area of the palate
  - At release, the consonant sounds like a [t, d]
- Conclusions:
  - The child is phonetically inaccurate, but:
  - The child is grammatically accurate

Further proof of grammaticality: Positional lateral neutralization

- Different process; same contextualization
  - Target /l/:
    - Pronounced as [j] in strong positions
    - Pronounced as [w] in weak positions
- This pattern cannot be driven by lingual articulations only
- Cannot be fully explained by adult distributions of 'dark' versus 'clear' /l/
  - The patterns follows the same contextualization as positional velar fronting

Speech patterns
(prosodically strong positions)

- Word-initial primary-stressed syllable onset

[jæmp]	'lamp'	1;10.0
[jʊks jɑjk ø jɪŋkən jɑg]	'Looks like a Lincoln log!'	2;9.9

- Word-initial unstressed

[jjivan]	'Livan'	2;8.19

- Word-medial primary-stressed syllable onset

[ha'jow]	'hello'	1;10.0
[vajə'jɪn]	'violin'	2;5.29

- Word-medial secondary stressed syllable

['gɔwjijɔks]	'Goldilocks'	2;4.2
['pædjɔk]	'Padlocks'	2;4.9

Speech patterns
(prosodically weak positions)

- Intervocalic unstressed syllable onset

[hæwətʰʌəkɚ]	'helicopter'	1;11.10
[æwədɛɾɚ]	'alligator'	2;1.18

- Word-medial coda

[mow mi]	'hold me'	1;10.25
[hiwdə]	'Hilda'	1;11.10

- Word-final

[bejgu]	'bagel'	1;9.24
[fɛw]	'fell'	2;0.19

The discrepancy between PLN and the distribution of /l/ in English

	Word-initial	Unstressed medial onset	Stressed medial onset	Coda, word-final
Adult	Lightest ([l]) ←—————————→ Darkest ([ɫ])			
E	[j]	[w]	[j]	[w]

Contexts for: **[velar fronting]** vs **[no velar fronting]**

Conclusion:
The child grammaticalized two pronunciation rules (for velar and laterals) based on the same prosodic categories

Conspiracy between perception and articulation

- 'Chain shift' phenomena: problematic for strictly grammatical approaches to productions
  - (Hale & Reiss 1998; Bernhardt & Stemberger 1998)
- /θ/ → [f] (*thick* /θɪk/ → [fɪk])
- /s/ → [θ] (*sick* /sɪk/ → [θɪk])
- Why not /θ/ → [θ] if [θ] is possible in outputs?
- Explanation:
  - /θ/ → [f]: perceptual effect
    - Thus: [θ] = [f] in mental representations
  - /s/ → [θ]: frontal lisp-like articulatory problem

Other types of grammatical influences

- Phonological classes prevail
  - The consonant [ʁ] in French is phonetically a fricative but phonologically a liquid
  - In French acquisition, it patterns like a liquid
- Further proof from bilingual development
  - Portuguese codas: /s, l, r/
  - Portuguese coda acquisition: s >> l, r
  - Monolingual acq. in French: all codas at once
  - Acq. of French codas by Portuguese (dominant) - French bilingual learner: s >> l, ʁ >> other codas
  - (Almeida, in prep.)

Discussion

Summary

- Mono-factorial approaches to child language:
  - Do not provide many useful explanations
  - Sometimes complicate the explanations of observed phenomena
- An understanding of developmental production patterns requires a multi-faceted analysis incorporating:
  - Perceptual and articulatory factors
  - Grammatical properties of the target language
  - Cognitively-informed analytical framework
- These components interact with one another

Some further questions

- What should analyses of child language phonological patterns really give us?
  - A grammar in the traditional sense of the term?
  - Insight into a more general system?
- Should constraints that represent physiological or motor issues be part of the grammar at all?
  - Cf. Pater's (1997) child-specific constraints
- The answer to this question should probably be NO, *if we want a theory of grammar*
- This calls for a more modular system with interacting parts and interfaces between them

If all this makes sense…

… we have to maintain a formal distinction between phonetics and phonology

Phonology → • Representations
• Constraints

Phonetics → • Rules of phonetic implementation

[Output]
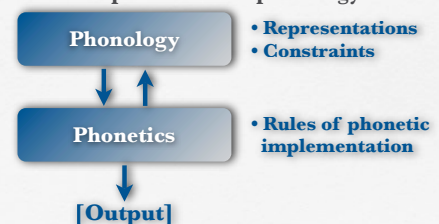
Conclusion

- Child language is entirely compatible with current theoretical issues that pertain to phonetics and phonology as a system of constraint interaction
- The peculiarities of child language offer a nice workbench for the elaboration and testing of current formal models
- This work raises fundamental questions about the very definition of what should be our object of study and how we should approach these objects, both empirically and formally

Thanks for your attention!

Feedback?
Questions?
PDF version?

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