Acquisition of Local and Non-Adjacent Syntactic Dependencies in 7- and 16-Month-Old Infants

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ICIS 2008 – Vancouver, Canada

1. Background

Adults are able to discriminate syllable strings generated by a finite state grammar (FSG) from those generated by a phrase structure grammar (PSG) in an artificial grammar learning (AGL) task [1,2]. Infants have been shown to learn local as well as non-adjacent dependencies presented in an artificial language [3,4]. The capacity of learning local dependencies is sufficient for acquiring a FSG whereas the capacity to detect non-adjacent dependencies should enable them to learn a simple PSG.

Given infants' sensitivity to various cues we expected them to show learning effects for both grammar types – similar to adults. However, considering young infants' limited processing capacity it seems conceivable to find differences in comparison to adults. Our research questions are:

- **Can infants discriminate two types of grammars?**
- **Does the familiarisation grammar play a role?**
- **Does age affect performance?**

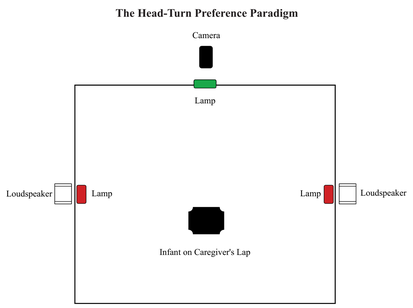
2. Participants

2 age groups of 152 infants (74 girls, 78 boys):

- 7 months (N=100): Ø 7;12 (m;d) min 6;28 max 8;00
- 16 months (N=52): Ø 16;14 min 15;17 max 17;01

3. Procedure

Headturn Preference Procedure [5]:



Presentation:

- Familiarisation in one of 3 groups:
  - FSG group (N=62): 32 FSG strings (≈ 2 min)
  - PSG group (N=65): 32 PSG strings (≈ 2 min)
  - No familiarisation (N=25, Experiment 2)
- Test Phase: Per grammar 7 blocks of 4 strings
  - Max. duration: 3 min 40 sec
  - All strings are new

Dependent variable:

- Orientation Time (OT) towards the side of the stimulus

4. Materials

Types of grammars with strings of 4 or 6 syllables:

FSG	$(AB)^n$	ABAB	*ti za fi pa*
		ABABAB	*ni la zi pa ki va*
PSG	A^nB^n	AABB	*ri ni la ma*
		AAABBB	*ni pi li ka la za*

Dependencies exist between *categories* of different syllables:

- 8 different syllables per category
- 120 possible syllable transitions
- mean transition probability $< .25$
- Thus: an abstraction from specific syllables is required

Catetegory marking by either (between-subject):

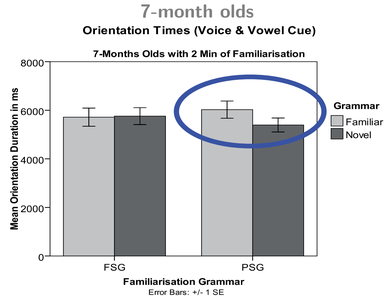
- Voice: A = female, B = male, or
- Vowel: A = /i:/, B = /a:/

5. Results

Experiment 1

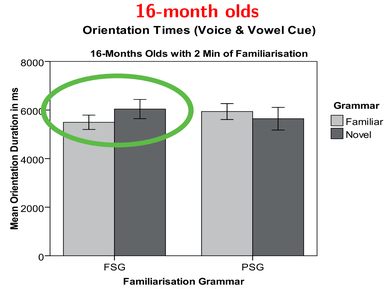
- Analysis for both age groups separately
- Collapsed over cue types, no differences between voices and vowels

7-month olds



- FSG-Group (N=36): No effect of grammar $t_{35} < 1$, n.s.
- PSG-Group (N=39): **Familiarity effect** $t_{38} = 2.243$, $p < .05$
  - Effect present in 69% of the infants of the group

16-month olds



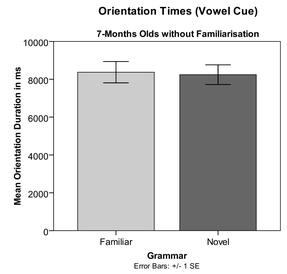
- FSG-Group (N=26): Tendency of a **Novelty effect** $t_{25} = 1.634$, $p = .115$
  - Effect present in 58% of the infants of the group
- PSG-Group (N=26): No effect of grammar $t_{25} < 1$, n.s.

6. Explanation

Behaviour due to experiment-external preferences? Exp.2 → No

Experiment 2

- No familiarisation
- Only 7-month olds (N=25)
- No preference for one of the grammars $t_{24} < 1$, n.s.



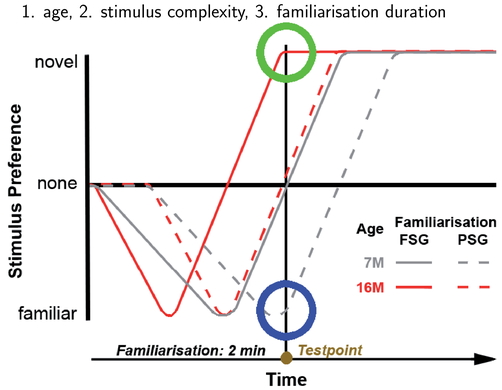
Facts to be explained

- 7-month-old infants able to distinguish both grammars but only if familiarised with the more complex grammar
- The opposite behaviour in the older group, i.e. discrimination tendency only when familiarised with the simpler grammar type
- The older infants do not show more effects/learning

These effects might be explained in terms of the following model

Hunter & Ames' Multifactor Model [6]

- Preferences depend on 3 factors:
  1. age, 2. stimulus complexity, 3. familiarisation duration



- No preferences without familiarisation (Exp.2)
- A novelty preference is interpreted as the result of a full representation for familiar strings (that's why they become uninteresting)
- Different preference patterns in both age groups depending on the familiarisation grammar
  - 16M infants learn quicker: their curves are further left
  - 7M (FSG group) have learnt the FSG
  - 7M (PSG group) have a partial representation for PSG
  - 16M (FSG group) have a complete representation for the FSG
  - 16M (PSG group) have learnt the PSG
- According to the model, both age groups have learnt both grammars – at least in parts
- It takes longer to learn the PSG compared to the FSG

7. Conclusion

Infants as young as 7 months are able to distinguish FSG from PSG strings. In this way, they behave like adults in a judgement task using the voice-cue stimuli [7]. Preferences cannot be attributed to extra-experimental factors since without familiarisation there were none.

These findings suggest that the infants tested did learn some characteristics of their familiarisation grammar (FSG or PSG), even though they could not rely on statistical cues like transition probabilities. Furthermore, the fact that the cue type (voice or vowel) had no influence suggests that they abstracted away from surface structure and processed syllables as categories.

This interpretation depends on the model of Hunter & Ames, which also takes into account the factors age and stimulus complexity and predicts null-effects exactly where we observed them. Although PSG strings include non-adjacent dependencies there is no direct evidence that infants did learn these dependencies. Nevertheless, the distribution of effects suggests that the rules underlying the PSG strings were harder to learn than those underlying the FSG strings. This asymmetry has also been found in studies with adults [7,8]. Identifying PSG strings thus requires more than just the detection of local well-formedness that is enough for FSG strings.

The type of representation that infants build as well as further predictions of Hunter & Ames' model have to be assessed in the future.

8. References

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This work was funded by the European Union:
NEST Pathfinder Initiative:
What it means to be human
CHLaSC Project: *Characterizing Human Language by Structural Complexity* (028395)