

# **Rapid recognition at 10 months as a predictor of language development**

-CarolineJunge  
-ValescaKooijman  
-PeterHagoort  
-AnneCutler

Instructor : Amitabha Mukherjee

Presentation by : Pratyush Sinha

# INTRODUCTION

- Vocabulary construction requires identifying both concepts and spoken forms.
- One of the best-documented early lexical phenomena is toddlers' rapid vocabulary explosion once they have laboriously acquired their first words.
- At this stage they are capable of '*fast mapping*': acquiring the meaning of a novel word after only a single brief or incidental exposure

# INTRODUCTION

- Basic elements of vocabulary construction that should be in place by this point:
  - The ability to identify concepts,
  - The ability to map a concept to a spoken form,
  - The ability to create a memory representation of a spoken form.

# INTRODUCTION

- The present study investigates whether infants at 10 months of age can create such a word-form memory after hearing a form for the first time.
- Infants' ability at 10 months to discriminate familiar words heard in:
  - Isolation (to test memory) *or*
  - In a sentence (to test segmentation ability)are compared with the infants' language skills at the age of 12 months and 24 months.

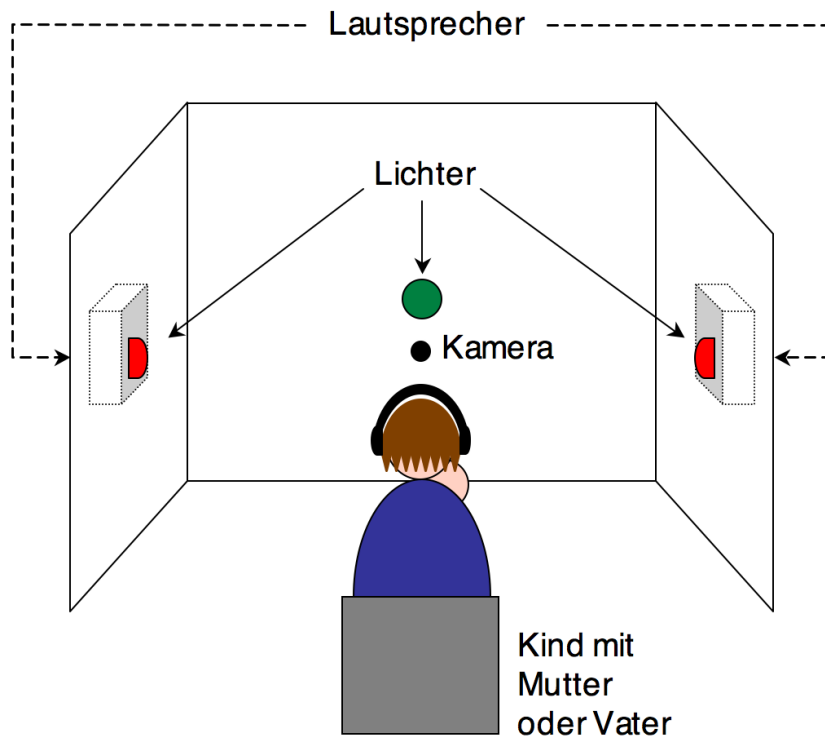
# PREDICTIONS

- Based on previous findings by Kooijman et al. (2005,2009) :
  - ERPs will be more negative for familiarized words than for unfamiliarized words, regardless of the type of familiarization prior to the test phase.
  - Left frontal negativity for the segmentation condition.
- Based on previous findings by Junge et al.(2010)
  - Infants with better segmentation skill, in the form of a larger negative ERP effect of familiarity, will outscore their peers on subsequent language tests.

# METHOD

Techniques used :

## 1. Headturn Preference Procedure (HPP) :



# METHOD

Techniques used :

1. Headturn Preference Procedure (HPP)
2. Event Related Potential (ERP)

*Infant Brain Cap*



# METHOD

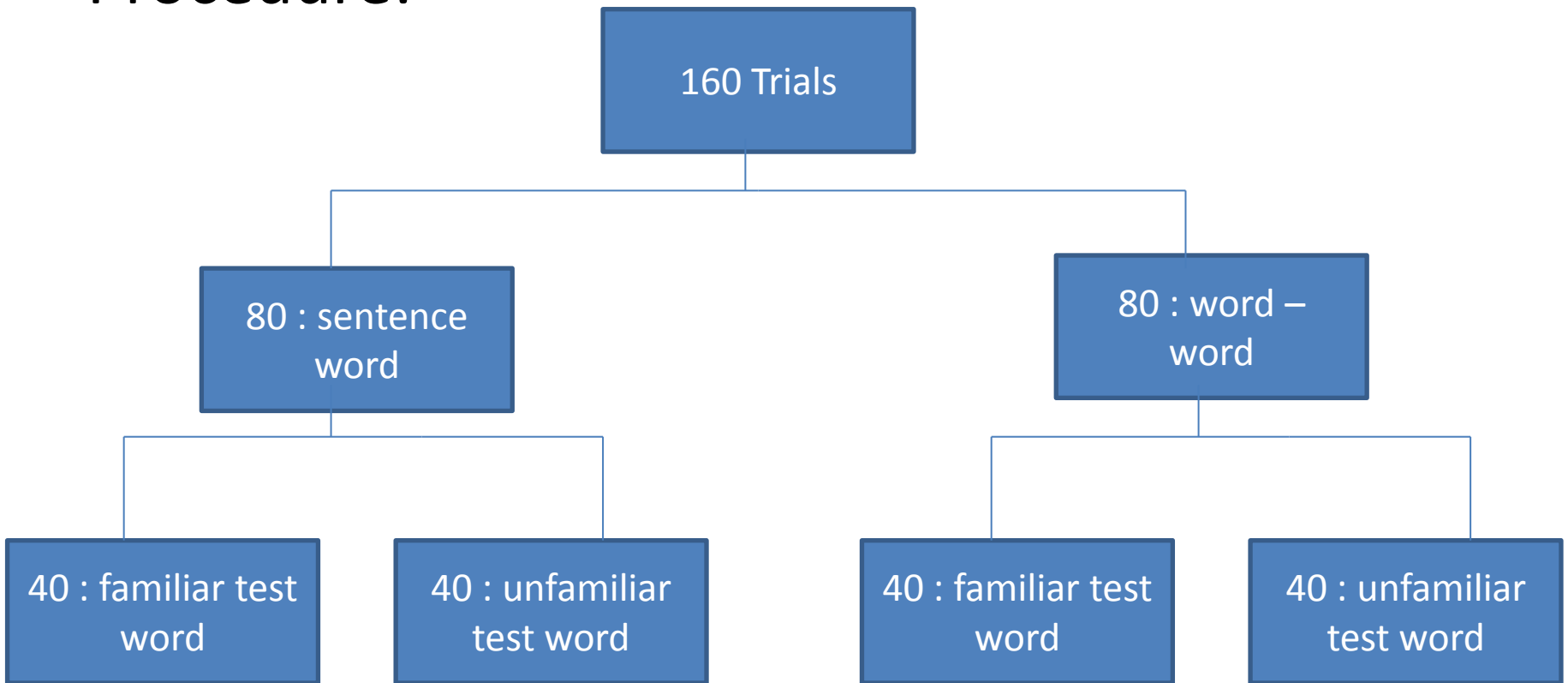
## Participants :

- 28 infants
- Dutch monolinguals
- 10-month-olds (mean age = 307 days, range 293–318 days; 13 girls)



# METHOD

## Procedure:



# METHOD

- 40 pairs of unrelated Dutch bisyllables with trochaic stress were selected. E.g. homm<sub>i</sub>mel ‘bumblebee’, mammo<sub>i</sub>et ‘mammoth’

Condition	Familiar		Unfamiliar	
	Familiarization phase	Test phase	Familiarization phase	Test phase
<i>Group A Memory Segmentation</i>	<b>mammo<sub>i</sub>et<sub>i</sub></b> (mammoth) Een kleine <b>homm<sub>i</sub>el<sub>i</sub></b> zit op het gordijn (A small bumblebee sits on the curtains)	<b>mammo<sub>i</sub>et<sub>j</sub></b> (mammoth) <b>homm<sub>i</sub>el<sub>j</sub></b> (bumblebee)	<b>mammo<sub>i</sub>et</b> (mammoth) Het is een oude <b>homm<sub>i</sub>el</b> met gele strepen (It is an old bumblebee with yellow stripes)	<b>homm<sub>i</sub>el</b> (bumblebee) <b>mammo<sub>i</sub>et</b> (mammoth)
<i>Group B Memory Segmentation</i>	<b>homm<sub>i</sub>el<sub>i</sub></b> (bumblebee) Die kleine <b>mammo<sub>i</sub>et<sub>i</sub></b> zwemt in de rivier (That small mammoth is swimming in the river)	<b>homm<sub>i</sub>el<sub>j</sub></b> (bumblebee) <b>mammo<sub>i</sub>et<sub>j</sub></b> (mammoth)	<b>homm<sub>i</sub>el</b> (bumblebee) Er is een oude <b>mammo<sub>i</sub>et</b> in het museum(There is an old mammoth in the museum)	<b>mammo<sub>i</sub>et</b> (mammoth) <b>homm<sub>i</sub>el</b> (bumblebee)

# METHOD

- Infants could receive in one condition an ‘unfamiliarized’ word that they had actually heard before as a ‘familiarized’ item in the other condition.
- Average no. of trials between such use = 39.4 (SD 15.7)
- Average time between such use of word = 244.1 seconds (SD 98.8)

# METHOD

Utterance durations:

- Mean sentence duration = 3463 ms (SD 615).
- Mean target word duration = 937 ms (SD 265) in isolation.
- Mean target word duration = 714 ms (SD 134) in sentences.

# METHOD

## Intervals:

- Sentence-word tests
  - Intra-trial = 300 ms
  - Inter-trial = 1500 ms
- Word-word tests
  - Mean Intra-trial = 1956 ms
  - Mean Inter-trial = 2517 ms

# METHOD

For 12 months:

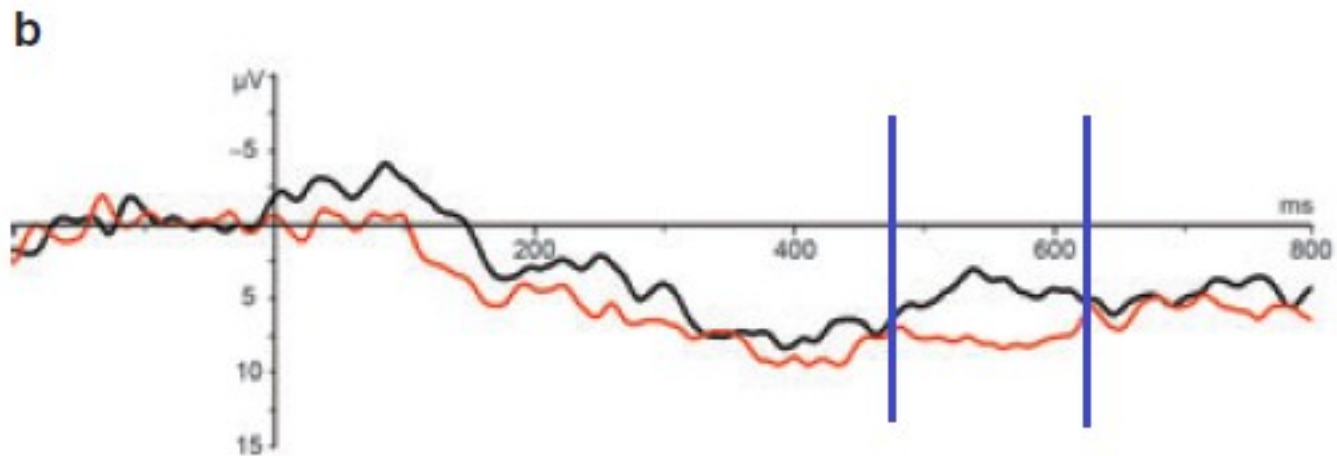
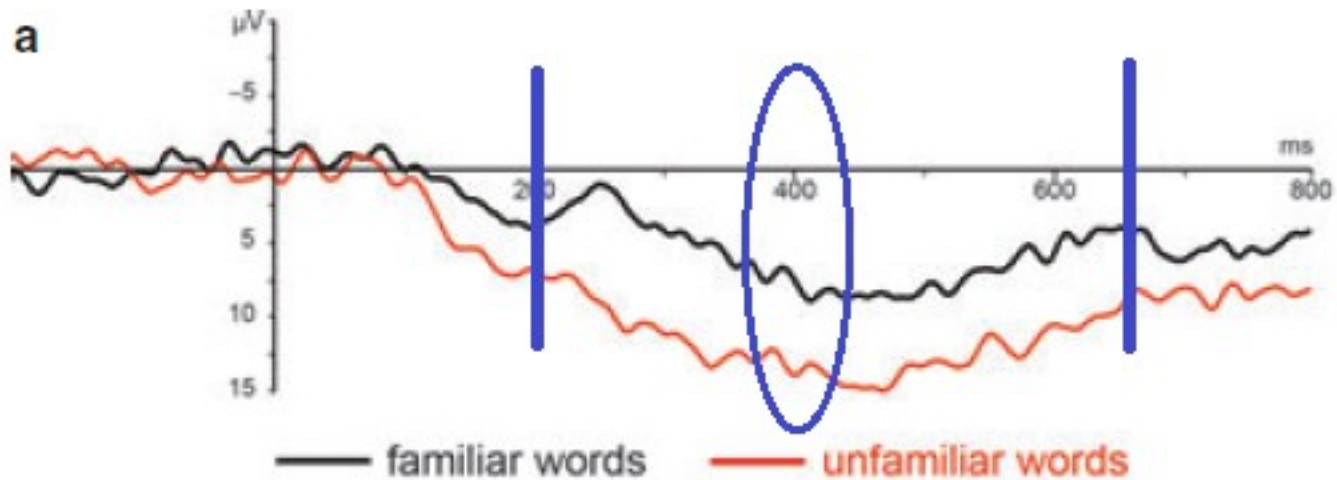
- Infant-CDI,
- Tests comprehension and production of
  - 31 typical utterances and 434 words
  - In 19 semantic categories

# METHOD

For 24 months:

- Toddler-CDI,
- Tests comprehension and production of
  - 702 words
  - In 22 semantic categories

# RESULTS



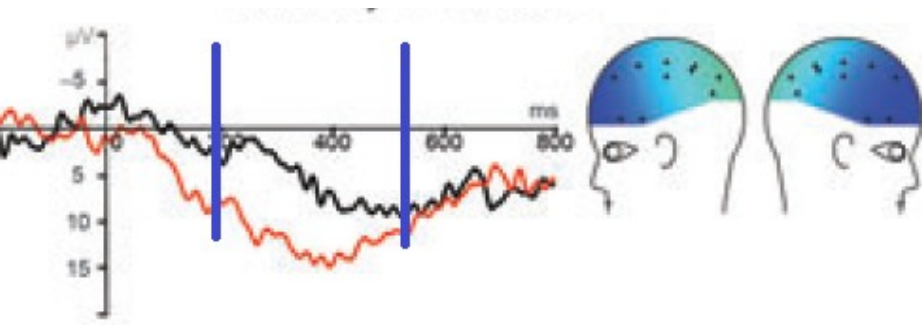


# RESULTS

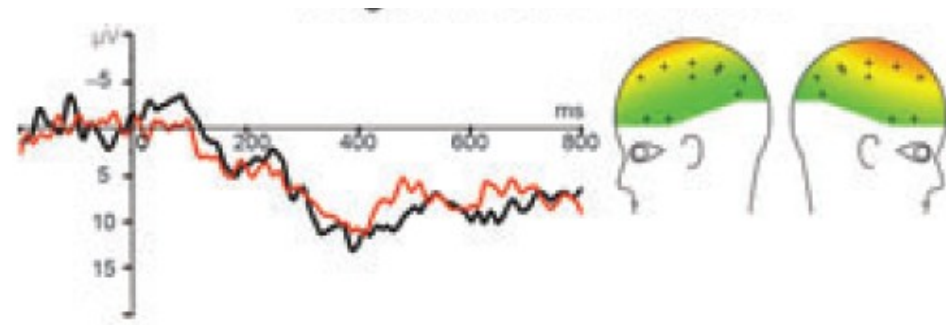
- At 12 months, the infants were divided into 2 subgroups along a median split of vocabulary size:
  - Lower Vocabulary (LV) group :  
Comprehended on average 40 words and utterances (range 2–68; six girls)
  - Higher Vocabulary (HV) group :  
Comprehended on average 146 words and utterances (range 71–264; seven girls)

# RESULTS

- ERP response of the LV group



**Memory Condition**

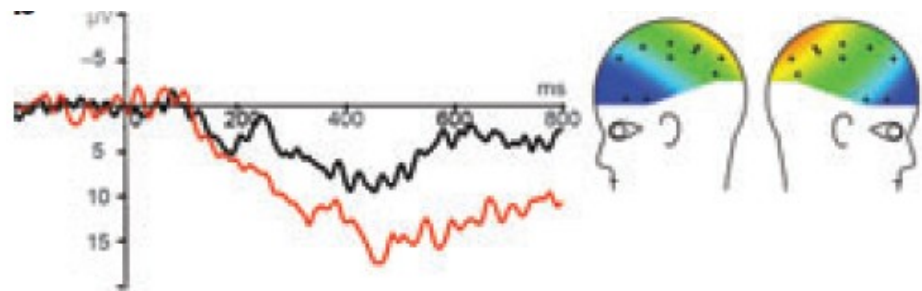


**Segmentation Condition**

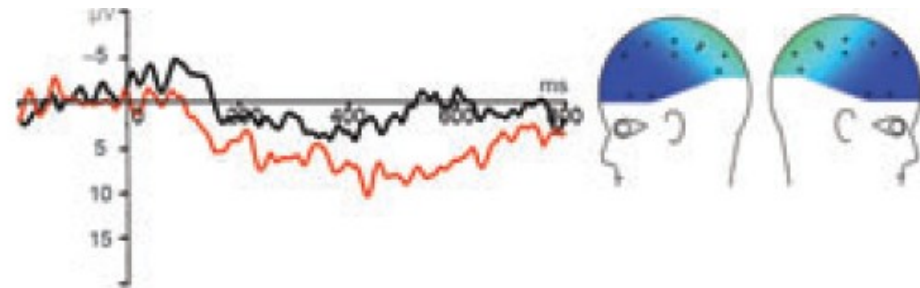


# RESULTS

- ERP response of the LV group



**Memory Condition**



**Segmentation Condition**

# RESULTS

Age	Measure	1.	2.	3.	4.	5.	6.	7.
10 months	0. Segmentation ability (-1.7 $\mu$ V, [-24.0, +17.9])	-.036	-.564 **	-.588***	-.551**	-.151	-.518**	-.383*
	1. Memory ability (-3.8 $\mu$ V, [-19.8, +7.1])		+.076	-.017	+.086	+.024	-.142	-.108
12 months	2. Items understood (93.0, [2–264])			+.875***	+.998***	+.308	+.585***	+.426*
	3. Phrases understood (14.9, [2–31])				+.845***	+.323	+.741***	+.608***
	4. Words understood (78.1, [0–233])					+.301	+.556**	+.396*
	5. Words produced (5.5, [0–39])						+.361	+.375*
24 months	6. Words understood (416.5, [149 – 681])							+.861***
	7. Words produced (326.4, [28 – 676])							

Correlation coefficients matrix for speech segmentation ability (and memory ability) at 10 months, and subsequent language scores for CDI subscales at 12 and 24 months.

# RESULTS

At 12 months:

- The larger the ERP difference, the more items the infant understands
- Speech production correlates neither with the ERP index of speech segmentation ability nor with the receptive language scales

At 24 months:

- The larger infants' ERP difference at 10 months, the larger their comprehension vocabulary.

# DISCUSSION & CONCLUSION

- 10 month olds can recognize a word after a single exposure when it re-occurs
- Some of them can also recognize words that were part of a sentence.
- There is a significant correlation between the receptive vocabulary scores at 12 months and 24 months and the speech segmentation skills at 10 months both statistically and at an individual level.

# DISCUSSION & CONCLUSION

- Word production in infants this young is not a stable measure for language proficiency, since the variability in productive vocabulary size in infants under 13 months is not equivalent to the variability in receptive vocabulary size.

# DISCUSSION & CONCLUSION

- The authors propose that in the study the negativity arises from the familiarity of word forms, and hence reflects the segmentation that has made the recognition response possible.
- According to Mills, Plunkett, Prat and Schafer (2005) that for 20-month-olds this negativity is sensitive to word meaning rather than to word familiarity.
- It is plausible that at an earlier stage the same recognition mechanism is involved in detecting word-form repetition.



# DISCUSSION & CONCLUSION

- A similar effect of negativity around 400 ms is shown by adults learning artificial language.
- This contrasts with the finding that word repetition in adults is generally coupled with a positive amplitude.
- Again, it is likely that the infant familiarity effect for familiarized versus unfamiliar word forms shares task characteristics with the learning of nonsense word forms from continuous speech by adults.

# DISCUSSION & CONCLUSION

- Infants with lower vocabulary sizes display a familiarity effect in the memory condition that starts earlier but also ends earlier (200-500ms).
- Moreover, their familiarity effect is more broadly distributed compared to their peers with greater vocabularies.
- Infants with greater vocabularies show a focal effect restricted to left frontal electrode during the memory test.

# DISCUSSION & CONCLUSION

- Infants with lower vocabulary sizes might detect word repetition faster, but use more resources to do so.
- Infants with higher vocabulary sizes require fewer resources to do this, but show an extended recognition response (200-650 ms).
- Possible hypothesis : After an initial recognition response infants from the HV group then continue to update the memory trace further or start a search for this word in their lexicon.

# DISCUSSION & CONCLUSION

In case of segmentation test:

- The familiarity effect is more broadly distributed.
- This makes sense if we assume that a broader distribution of the familiarity effect reflects allocation of more resources for a more difficult case.

# DISCUSSION & CONCLUSION

How may the relationship between segmentation ability and later language skills arise ?

- Adult listeners use a variety of speech segmentation cues in combination, including both absolute cues and probabilistic cues such as:
  - phonotactic rules such as distribution of stress patterns
  - phonetic transitional probability, and
  - Frequency of occurrence.
- The infants in the HV group could be capable of achieving such a combination and applying it to segmentation.

# POSSIBLE INTERPRETATION

- that segmentation skill itself, in the form of exploitation of whatever cues the speech signals offer to enable word boundaries to be found, is the functional link to later vocabulary growth.

THANK YOU!

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