From Babble to Words: Perspectives from Research in Early Language Development

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Background

- Motor behaviour (cf. hand opening/closing and kicking)
- Onset of canonical babble ~8-10 months
- Oller & Eilers (1988)

Background

Oller & Eilers (1988)

- Recorded babbling of 21 hearing and 9 deaf infants
- All infants babbled
- Deaf infants started babbling canonically later and babbled less. and 6/9 never reached canonical babble criteria.
- 3 deaf infants who did reach criteria were the only deaf subjects to develop speech

Background

Current research suggests that:

- Maternal responsiveness is central to the shift from babble to words
- Contingent responses → more ‘speech-like’ babble
- Vowel quality + CV transition

Goldstein & Schwade, 2008; Gros-Louis et al., 2014; Wu & Gros-Louis, 2014

Background

- Consonants produced in babble are prominent in early words (McCune & Vihman, 2001)
- **Articulatory filter**: Infant 'tuned in' to own production (Vihman, 1993)
- **Vocal Motor Schemes** (**VMS**): "well-practiced and longitudinally stable vocal productions" (McCune & Vihman, 2001)

(DePaolis et al., 2011; Majorano et al., 2014; McGillion et al., 2017)

Our Main Questions

→Does having a VMS affect how a baby responds to input speech?

→Does the VMS itself affect which consonants a baby responds to?

Terminology

- For a given baby, do they have stable consonants?

Yes: withVMS baby

No: noVMS baby

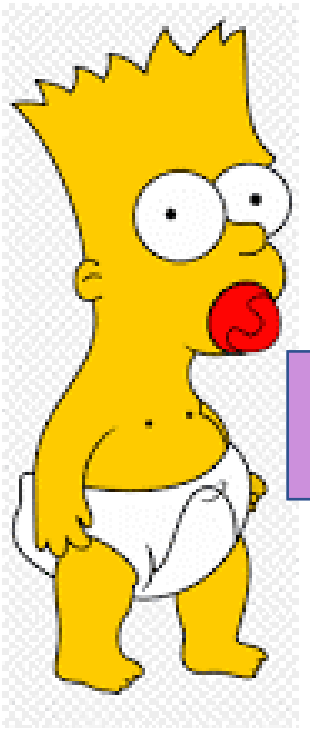
Terminology

My vms:
/t,d/

da da da da…
ma na ba ba…

withVMS
baby

ba ba ta ga…



noVMS
baby

Terminology

- For a given baby, do they have stable consonants?

Yes: withVMS baby

No: noVMS baby

- For a given consonant production (CP) by an infant:
  - is it in that child's VMS repertoire?

Yes: INREP consonants

No: OUTREP consonants

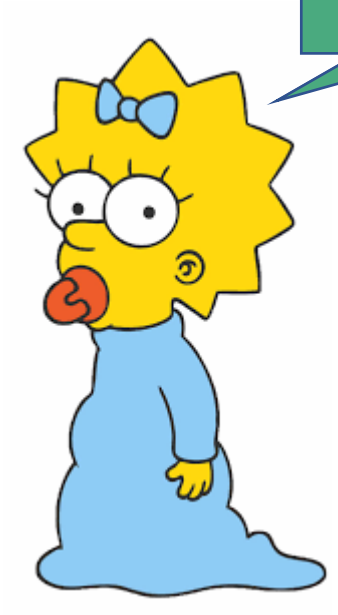
Terminology

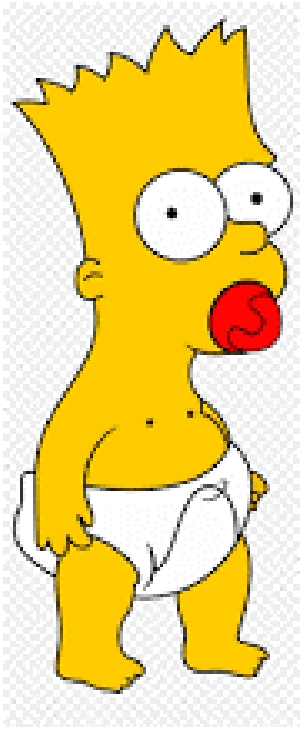
All CPs are outREP for noVMS babies

My vms: /t,d/

da da da da…
ma na ba ba…

ba ba ta ga…





withVMS baby

INREP consonants

OUTREP consonants

noVMS baby

Terminology

- For a given baby, do they have stable consonants?

Yes: withVMS baby

No: noVMS baby

- For a given consonant production (CP) by an infant:
  - is it in that child's VMS inventory?

Yes: INREP consonants

No: OUTREP consonants

  - Does it match something in their input??

Yes: input-congruent

No: input-incongruent

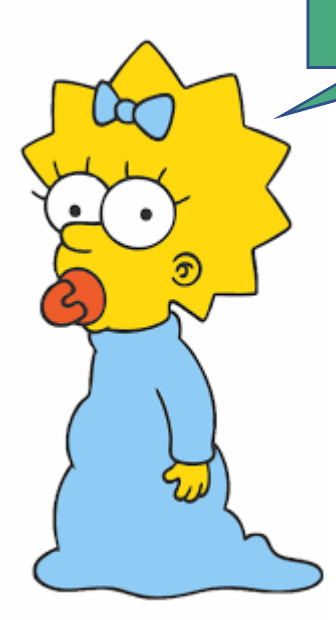
Terminology

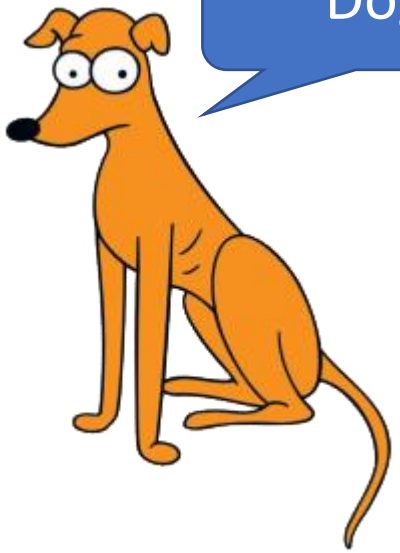
input-congruent

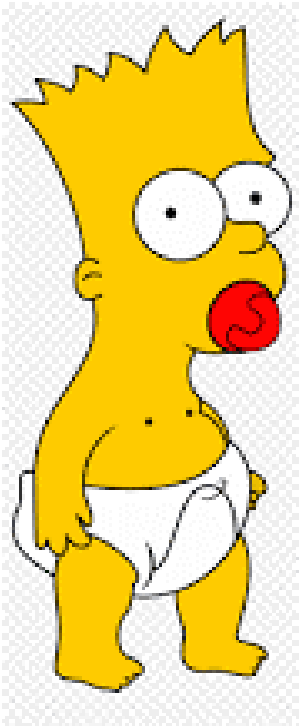
input-incongruent

My vms: /t,d/

withVMS baby







noVMS baby

Terminology

- For a given baby, do they have stable consonants?

Yes: withVMS baby

No: noVMS baby

- For a given consonant production (CP) by an infant:
  - is it in that child's VMS inventory?

Yes: INREP consonants

No: OUTREP consonants

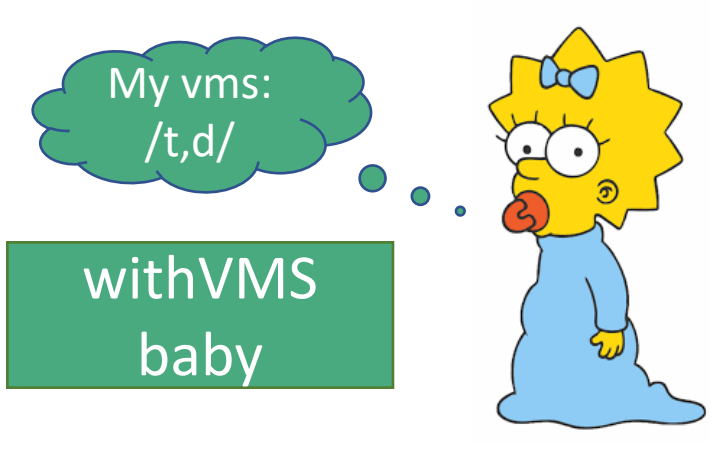
  - Does it match something they are **attending to** during production??

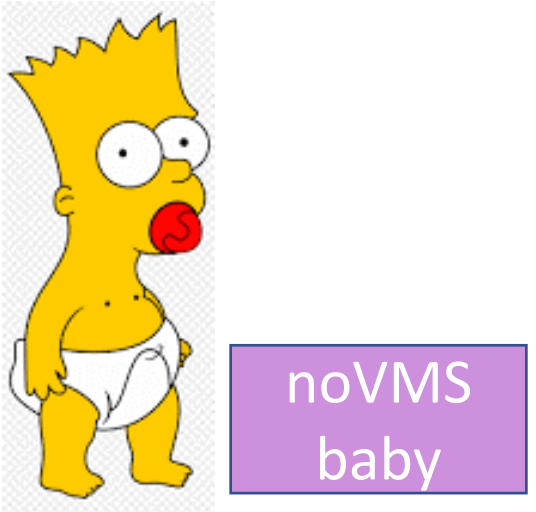
Yes: input-congruent

No: input-incongruent

Research Questions

1. Do infants with stable vocal motor schema (withVMS) produce more consonants that are **congruent with input** than noVMS infants?
2. Are **input-congruent consonants** more often inREP than outREP?





The SEEDLingS Corpus (Bergelson, 2016)

44 infants recorded at home, monthly, from age 6-17 months

Present study: Audio & Video recordings, age 10/11 months

Recorded on **different days**

1. Determine VMS from top 30 minutes of day-long audio: withVMS or noVMS?
2. Annotate all child consonant productions from hour-long video
3. Annotate caregiver input during consonant production (CP) in video

Caregiver input = most salient word produced in preceding 15s

- Coder agreement: 85% (Cohen's kappa=.83, z=39.8)
- 49% of all CPs
- **Did input match infant's CP?**

Example, from DePaolis et al. 2009

MOT: Mamm:y

MOT: From next time [undec.]…
MOT: like a **beast** [?] sitting down

CHI: **/bə…bə…bə/** (waving)

MOT: ta ta:::

DePaolis et al., 2009

Coding input stimuli

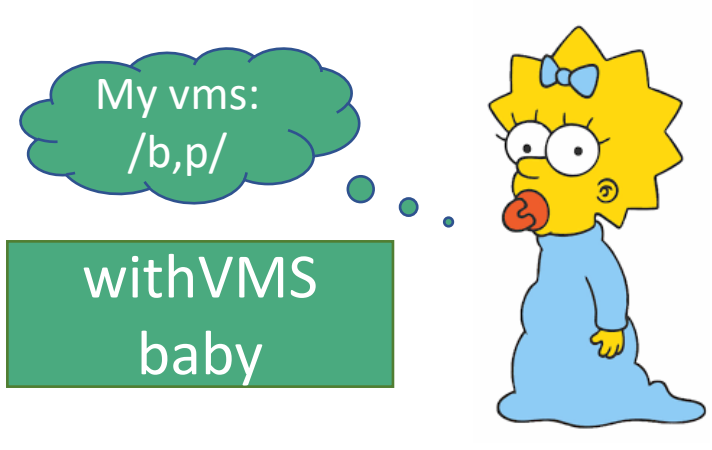
For each consonant produced in babble:

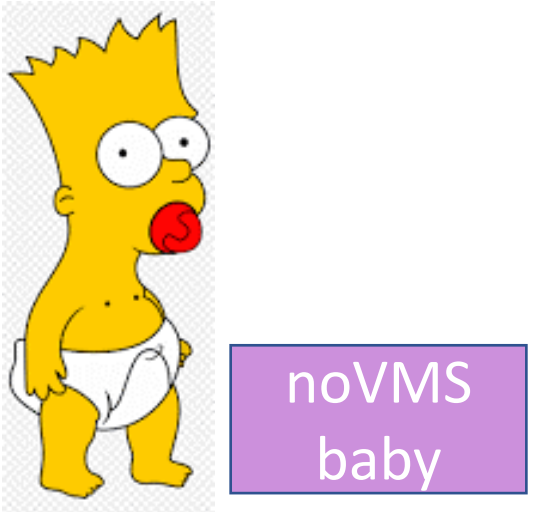
- Is it congruent with caregiver's input?
- Is it inREP or outREP?

Comparison with scrambled input dataset

Research Questions

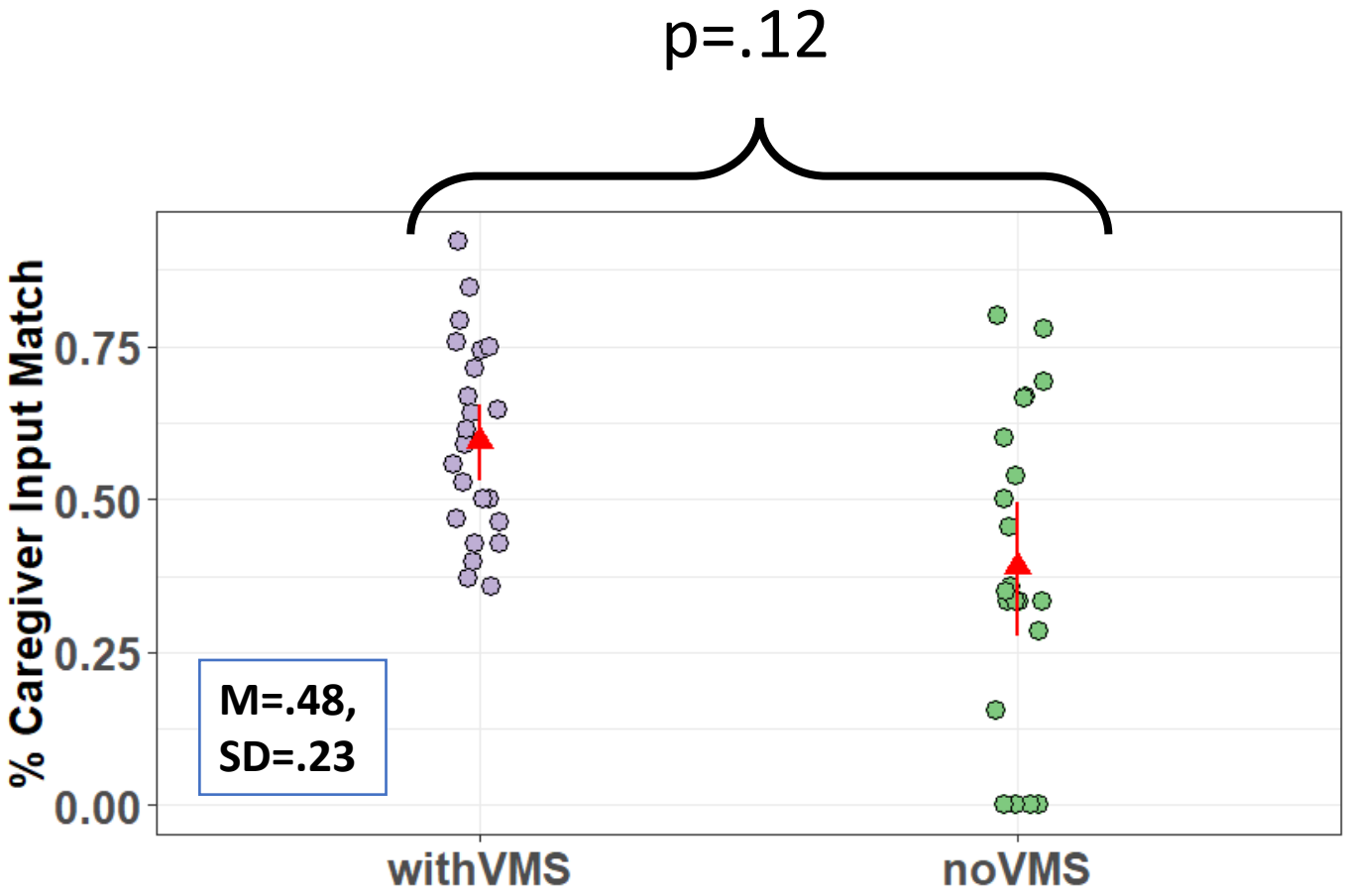
1. Do withVMS infants produce more consonants that are **congruent with caregiver input** than noVMS infants?
2. Are **input-congruent consonants** more often inREP than outREP?





Video data

Results: Infants Match Caregiver Input



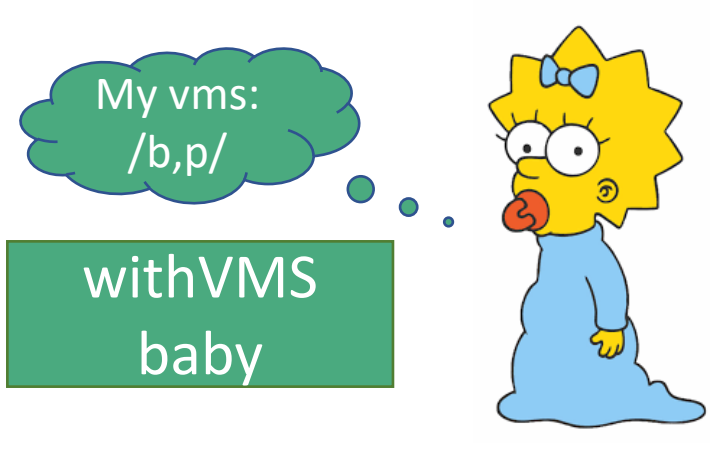
- Both withVMS and noVMS infants' CPs **matched caregiver input** above chance, i.e. vs. scrambled data (ps<.05, Wilcoxon test)
- withVMS infants matched CG input equally to noVMS infants

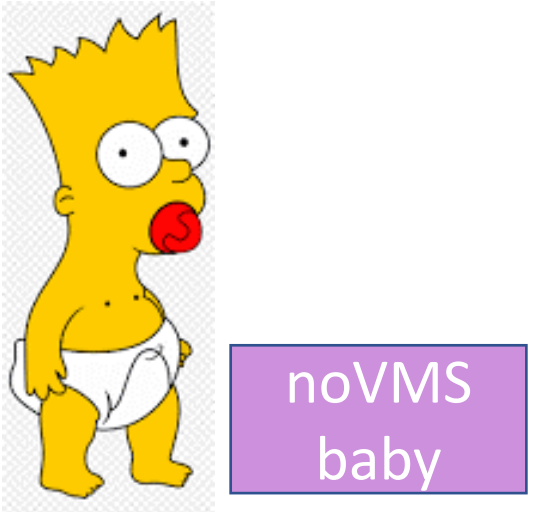
Research Questions

1. Do withVMS infants produce more consonants that are **congruent with caregiver input** than noVMS infants?

   Not really – both groups do it in equal measure!

2. Are **input-congruent consonants** more often inREP than outREP?

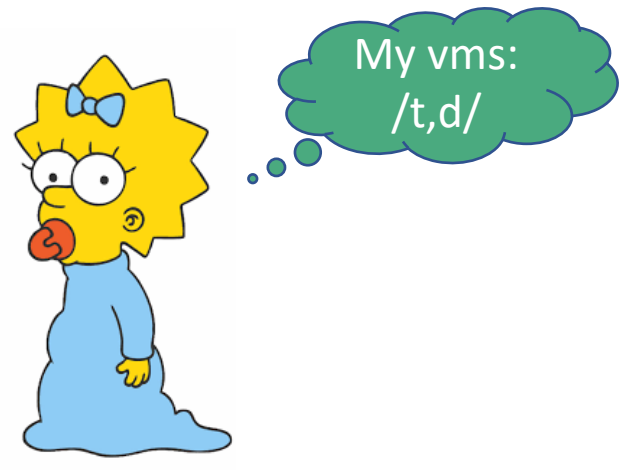


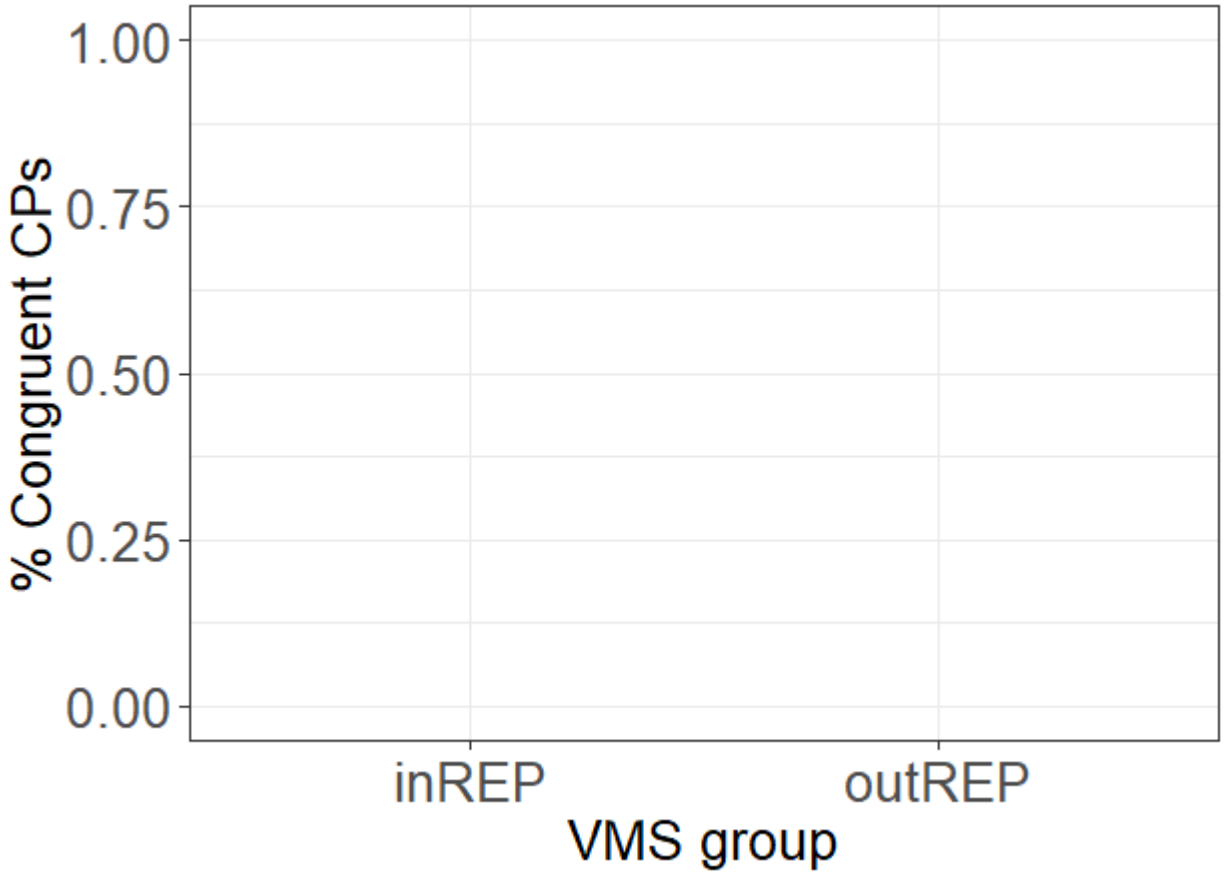


Video data

Results: withVMS infants match Caregiver Input **more** when the word matches their VMS inventory

withVMS infants only





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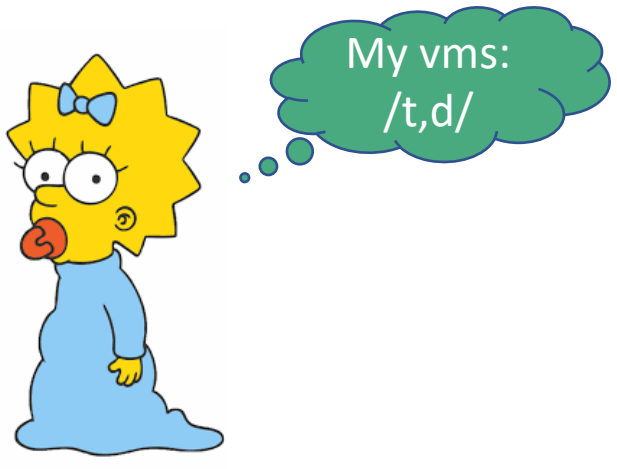

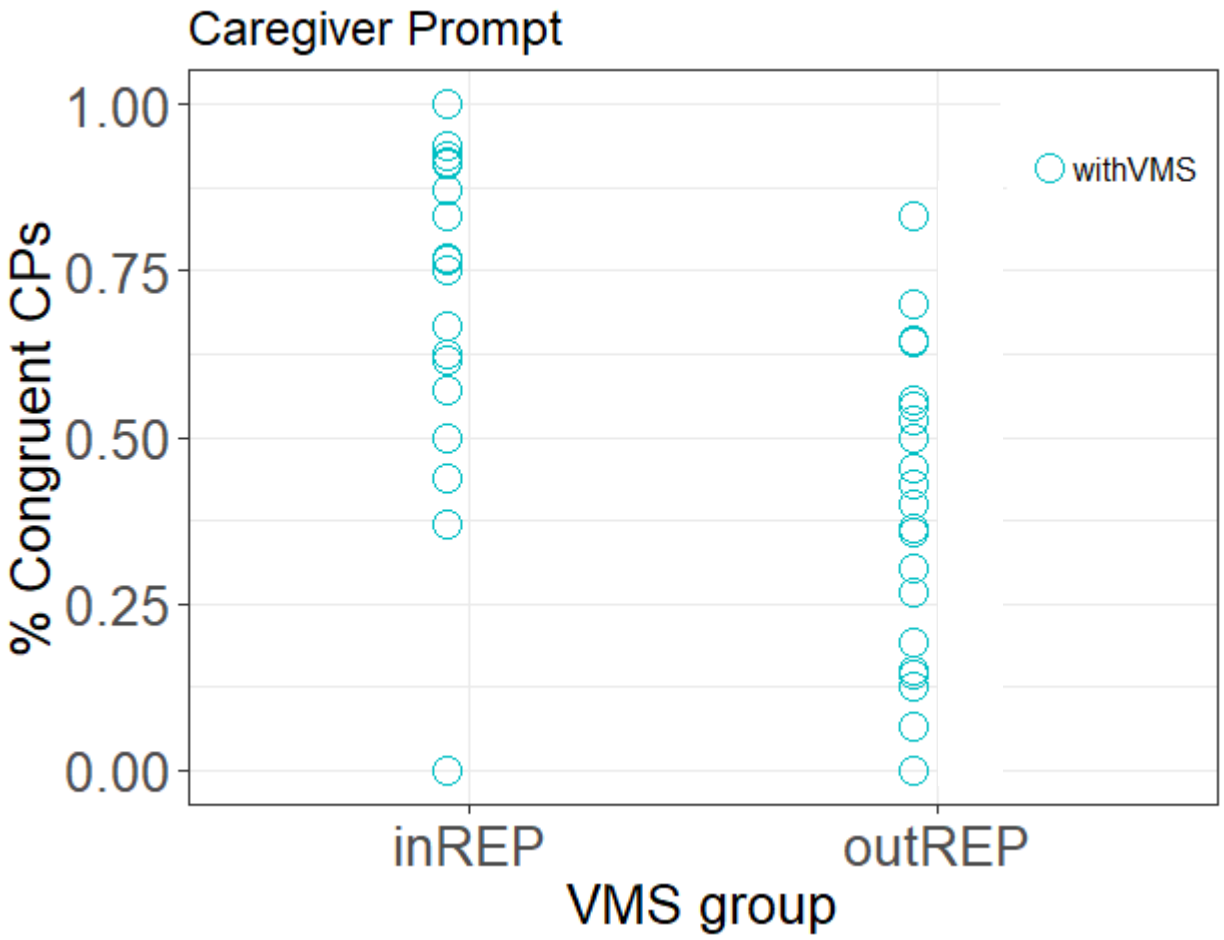

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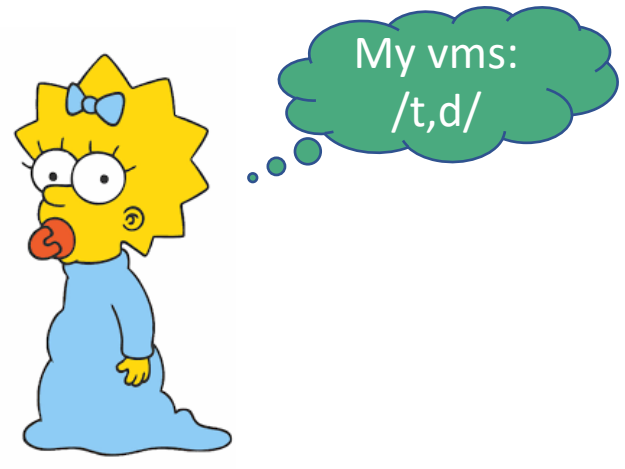

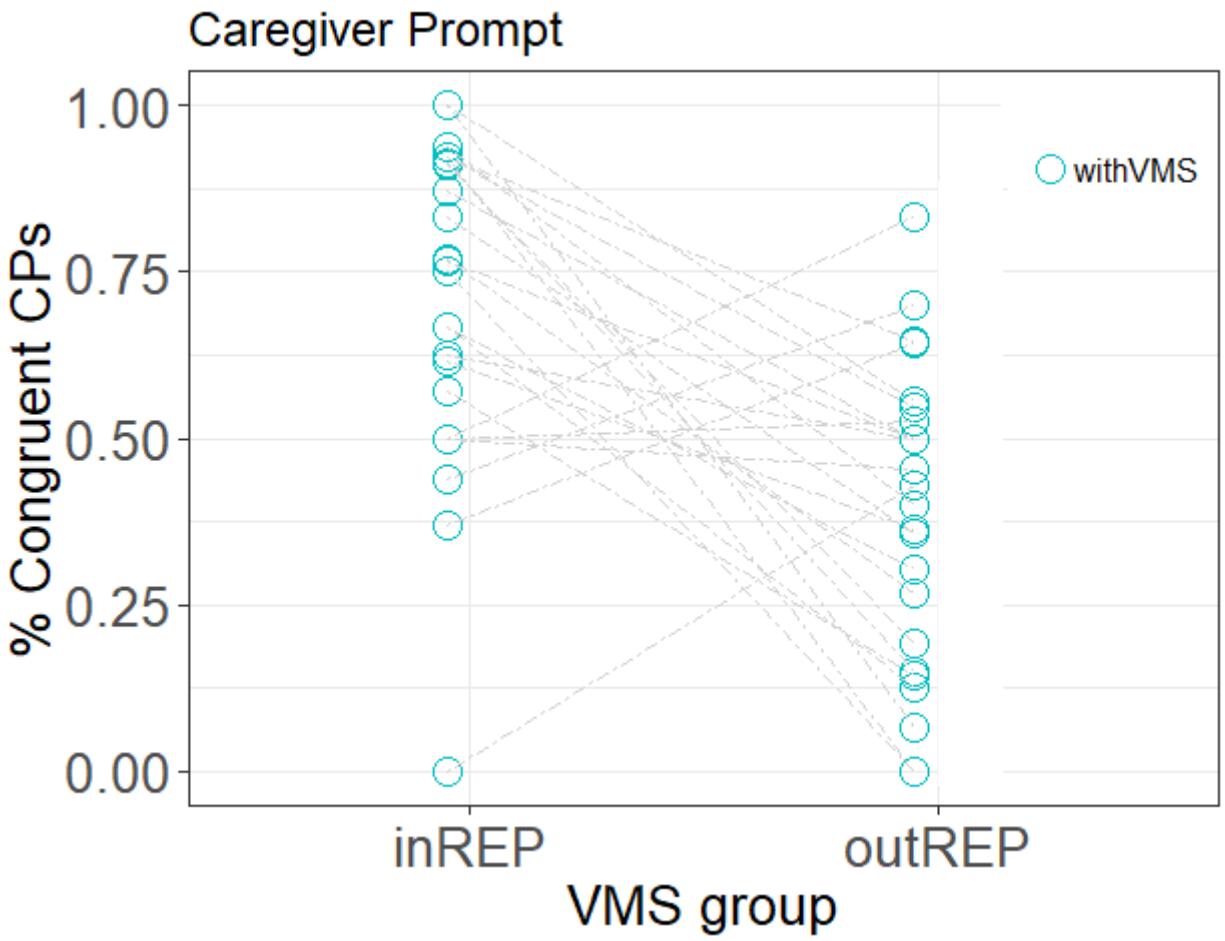

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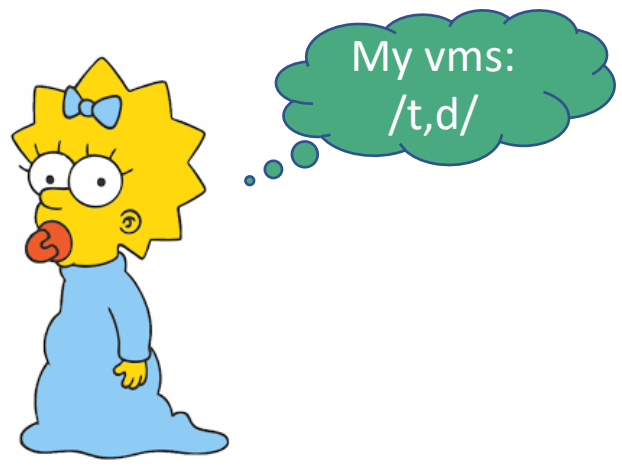
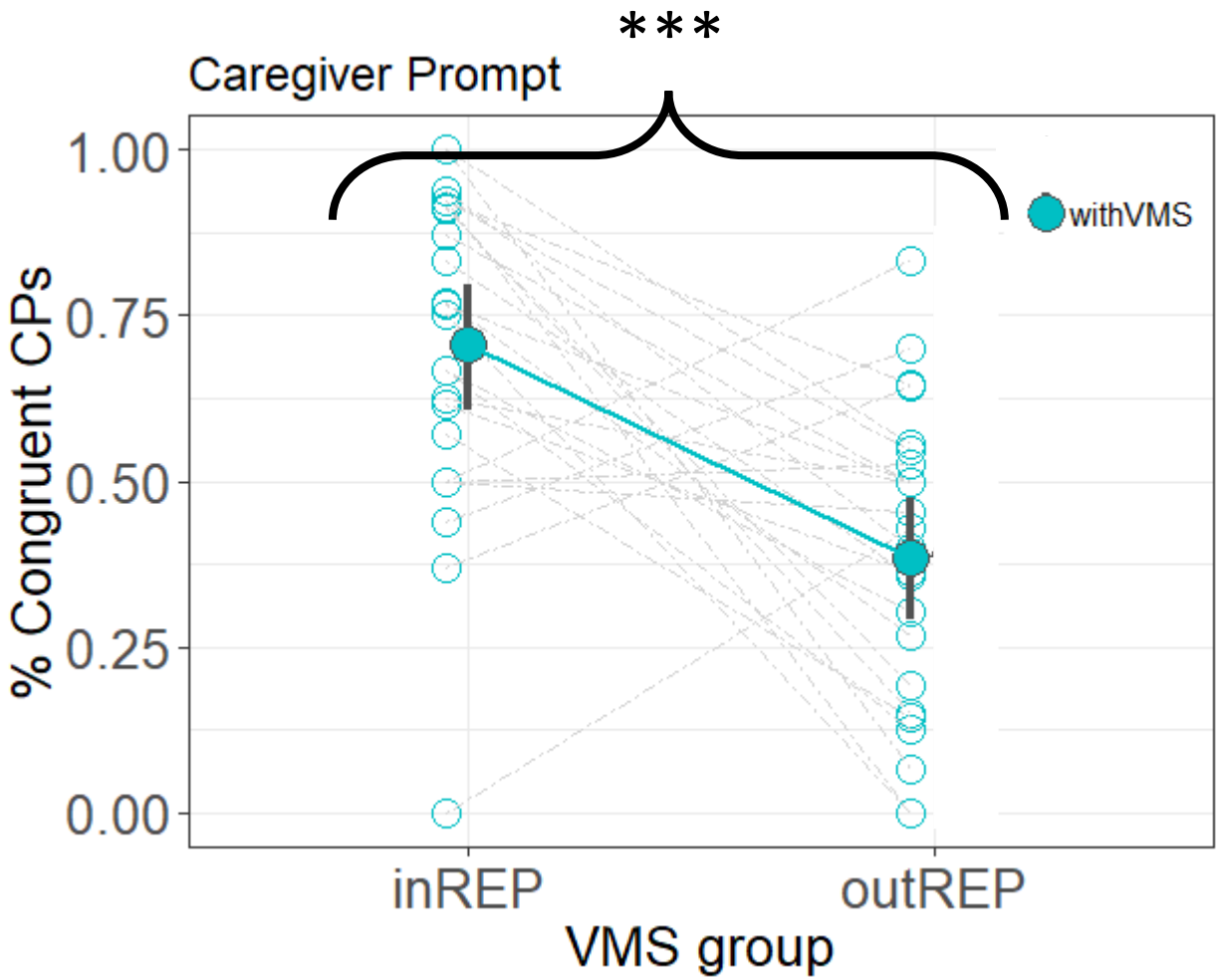




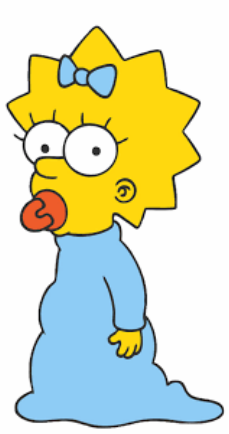
t(23)=4.13, p<.001***

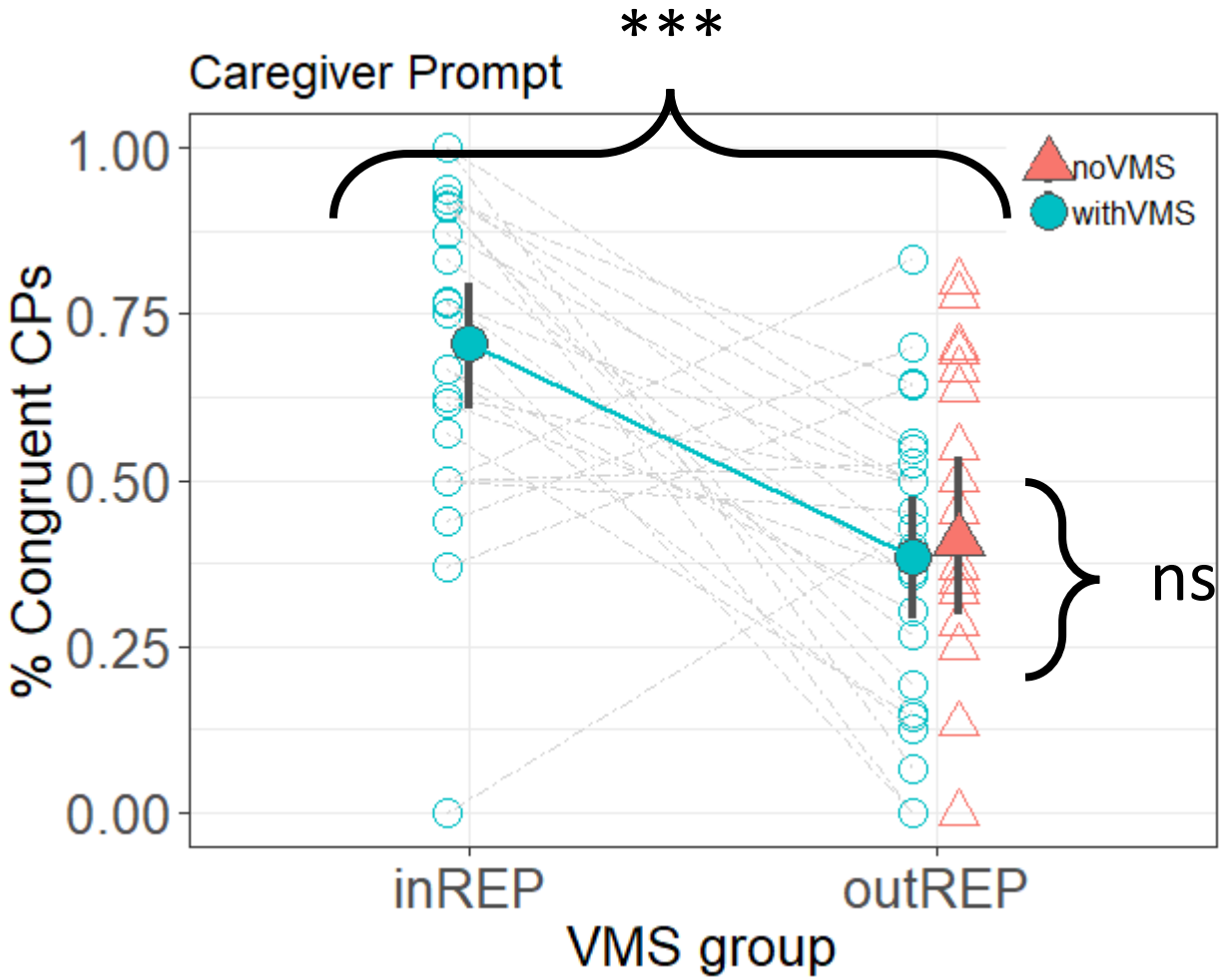
Video data

Results: withVMS infants match Caregiver Input **more** when the word matches their VMS inventory

All infants

All CPs are outREP for infants who have no VMS to begin with





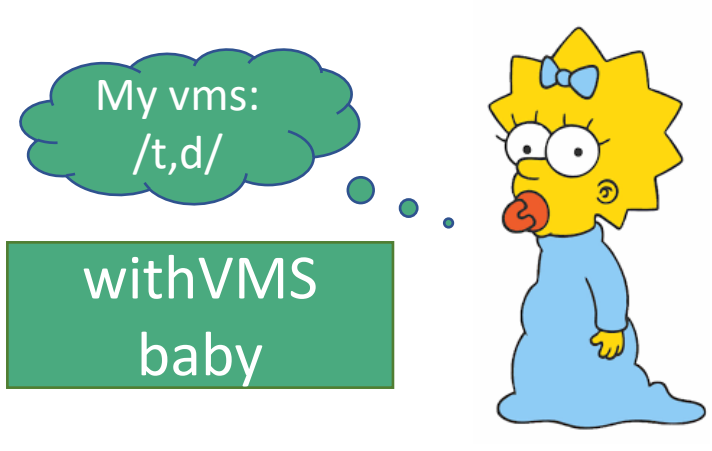
Research Questions

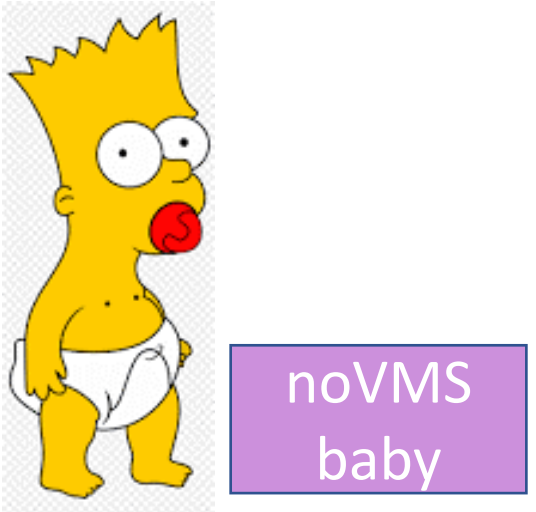
1. Do withVMS infants produce more consonants that are **congruent with caregiver input** than noVMS infants?

Not really – both groups do it in equal measure!

2. Are **input-congruent consonants** more often inREP than outREP?

YES! Evidence for the articulatory filter: infants are attuned to the consonants that they can produce themselves.





In summary

- Previous research tested **perception** of VMS; we show that this also mediates **production,** from as young as 0;10
- No group differences → matching of input + output comes online earlier than expected; prerequisite to VMS?
- Perhaps responsiveness isn't so important? (cf. Goldstein & Schwade)
- Spoiler: VMS matters when it comes to babble + object pairings
- Focusing on what infants <u>can already produce</u> presents new evidence for role of input in shaping infants' phonological development

(cf. Albert et al., 2017)

Thank you!

- SEEDLingS & BLAB Staff: Koorathota, Tor, Schneider, Amatuni, Dailey, Garrison & small army of RAs!
- RAs at Cardiff University: Langner, Miccalef, Raffil
- NIH Early Independence Award
- Digging Into Data NEH Award
- 44 SEEDLingS and their families!

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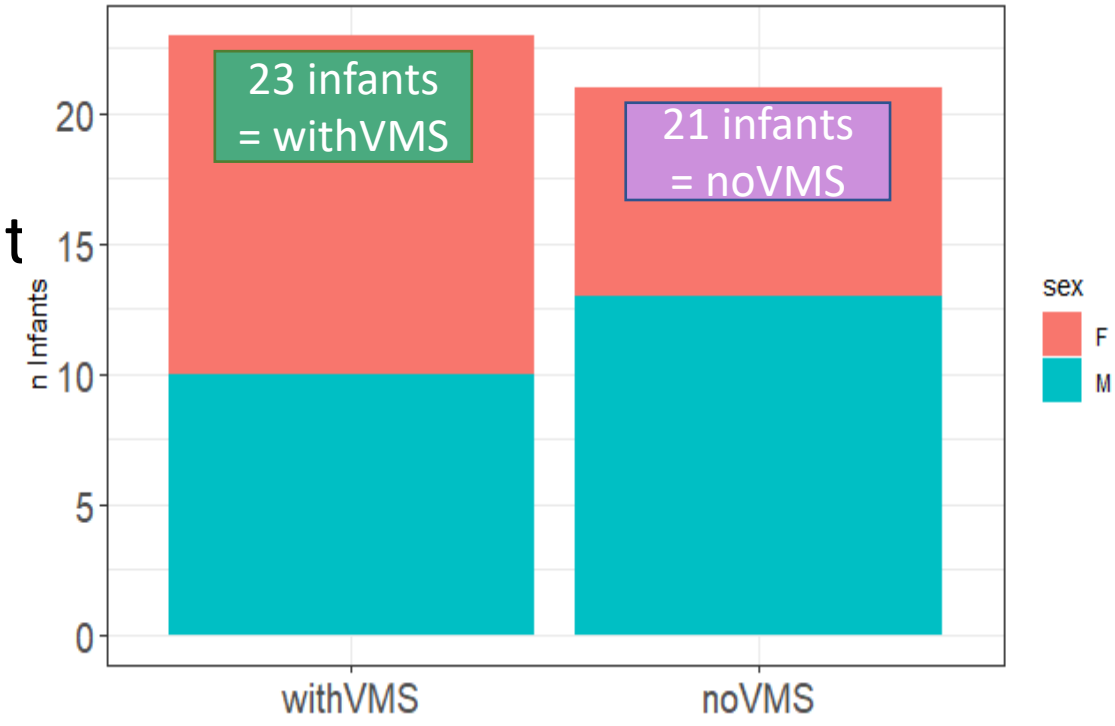
Step 1: determining each infant's VMS

- Audio data from LENA recordings
- 30 minutes of highest-talk-volume infant productions (Child Vocalization Counts)
  - 2/3 of top 30 minutes were baby alone!
- Every CP counted for each infant
- VMS: ≥50 of any single CP during 30min segment
  - Ignoring voicing distinction (p=b)
- Coder reliability: 100%



Audio data

Consonant Production: withVMS babies produce more tokens

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