The facilitative effect of phonetic context variability on early word learning: A habituation study with 14-month-old children

Tom Fritzsche, Natalie Boll-Avetisyan, Elisabeth Markmann, Adamantios Gafos & Barbara Höhle

Background

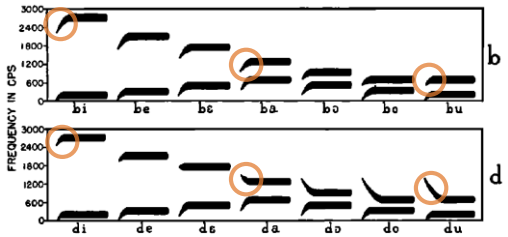
Children at the age of 14 months have difficulties learning **similar sounding** novel **words**, e.g. *dih* vs. *bih* [1].

These difficulties can be overcome by including **input variability**, e.g. different speakers [2] or variable syllabic contexts [3].

This study explores which type of **phonetic context** variability is helpful when learning the novel word *buk* vs. *duk*.

Design & Participants

The relevant acoustic cue for the place-of-articulation contrast /b/ vs. /d/ is the **second formant transition** (F_2) which varies with the following vowel [4].



We expected **vowel variability** (one speaker) to highlight the place-of-articulation contrast and lead to successful learning of buk vs. duk whereas consonant variability would not.

Children were assigned to one of **3 familiarisation conditions**:

Initial C	Vowel	Final C (in progress)
Familiarisation (20 tokens, 40s)		
puk/tuk, fuk/luk, nuk/muk, buk/duk	*bak/dak, bek/dek, bik/dik, bok/dok, buk/duk*	*bup/dup, but/dut, bun/dun, bum/dum, buk/duk*
Participants		
18 children (8 girls/10 boys) 13.7 months (13.2 – 15.0)	18 children (12 girls/6 boys) 14.2 months (13.2 – 15.0)	6 children (2 girls/4 boys) 13.5 months (12.8 – 14.9)
Habituation duration		
88s (39 – 145) 10.8 trials (6 – 20)	110s (55 – 315) 10.5 trials (7 – 21)	172s (46 – 448) 12.0 trials (5 – 21)

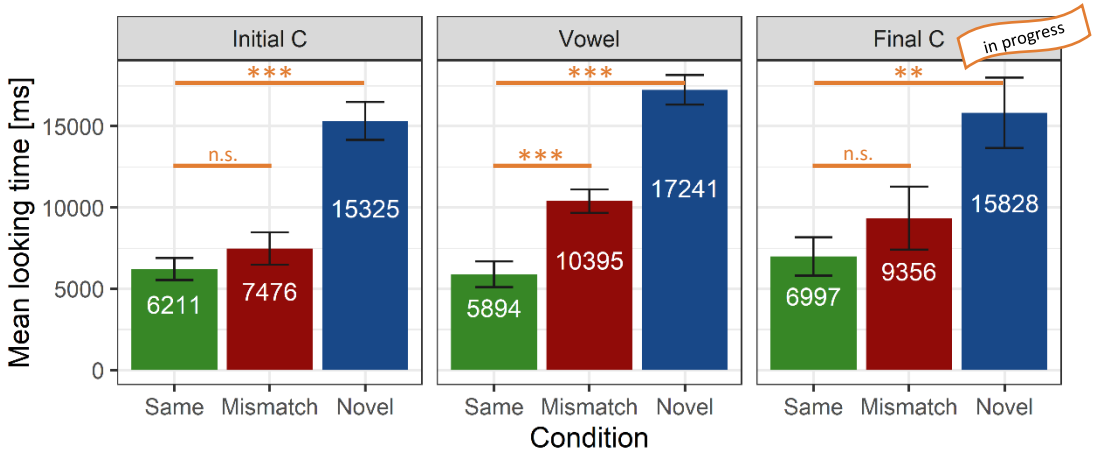
Procedure

Habituation word-learning paradigm following Thiessen [3], implemented in Habit [5].

Three experimental phases:

1. Fixed auditory familiarisation (checkerboard).
2. Infant-controlled habituation (word/object pairs).
3. Test phase with 3 Same, 3 Mismatch and 1 Novel trial.

Results



The **novelty effect** (Novel vs. Same trials) is significant in all groups (all t's > 4, p's < .01).

The **mismatch effect** (Mismatch vs. Same trials) is significant only in the Vowel group (t = 5.07, p < .001), not in the Initial C group (t = 1.58, p = .13) or in the Final C group (t = 1.61, p = .17).

Mean **habituation durations** do not differ between the vowel and the two consonant groups (both t's < 1.5, p's > .16).

A **correlation** between **mismatch** effect and **vocabulary** score (CDI) was not significant across all children (*rho* = .001, p = .995)

Discussion

A short (40s) exposure to varying vowel contexts is sufficient to boost learning.

Neither variability in itself is sufficient nor is the presence of different speakers necessary to achieve this facilitative effect.

We are currently exploring the potential relation of these findings to a general consonantal bias in word learning which has not been shown for German yet.

Variability is beneficial for learning minimally different words – but only if the variability contains linguistically relevant information.

References

[1] Stager, C. L., & Werker, J. F. (1997). Infants listen for more phonetic detail in speech perception than in word-learning tasks. *Nature*, *388*, 381–382. **[2]** Rost, G. C., & McMurray, B. (2009). Speaker variability augments phonological processing in early word learning. *Developmental Science*, *12*(2), 339–349. **[3]** Thiessen, E. D. (2011). When variability matters more than meaning: The effect of lexical forms on use of phonemic contrasts. *Developmental Psychology*, *47*(5), 1448–1458. **[4]** Delattre, P. C., Liberman, A. M., & Cooper, F. S. (1955). Acoustic Loci and Transitional Cues for Consonants. *The Journal of the Acoustical Society of America*, *27*(4), 769–773. **[5]** Oakes, L. M., Sperka, D., DeBolt, M. C., & Cantrell, L. M. (2019). Habit2: A stand-alone software solution for presenting stimuli and recording infant looking times to study infant development. *Behavior Research Methods*.

Thanks & Links

Thanks to parents and children!

Contact:
tom.fritzsche@uni-potsdam.de