

# How brief exposure to varying phonetic contexts can enhance minimal pair word learning in 14-month-old children

Tom Fritzsche, Natalie Boll-Avetisyan, Marc A. Hullebus, Adamantios I. Gafos & Barbara Höhle



## Background

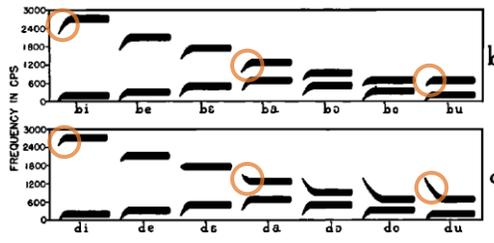
Children at the age of 14 months have difficulties learning **similar sounding novel words**, e.g. *dih* vs. *bih* [1].

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

One of the major acoustic cues 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 token from a single 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
Familiarisation (20 tokens for 40s)		
<i>puk/tuk, fuk/luk, nuk/muk, buk/duk</i>	<i>bak/dak, bek/dek, bik/dik, bok/dok, buk/duk</i>	<i>bup/dup, but/dut, bun/dun, bum/dum, buk/duk</i>
Participants		
21 children (8 girls/13 boys) 13.7 months (13.2 – 15.0)	20 children (12 girls/8 boys) 14.1 months (13.1 – 15.0)	19 children (9 girls/10 boys) 14.1 months (13.2 – 15.0)
Habituation duration		
86s (39 – 145) / ~10.9 trials 10.9 trials (6 – 20)	105s (45 – 315) / ~10.0 trials 10.0 trials (5 – 21)	119s (46 – 448) / ~11.1 trials 12.0 trials (5 – 21)

## Procedure

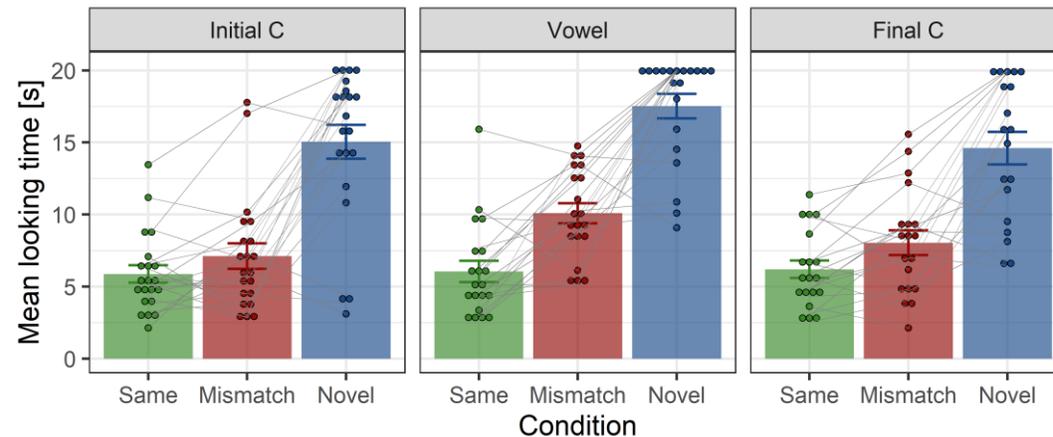
**Habituation word-learning** paradigm following Thiessen [3], implemented in Habit [5].

Three phases:

1. Fixed auditory familiarisation (checkerboard).
2. Infant-controlled habituation (*buk*/object1).
3. Test phase: 3 **Same** trials (*buk*/object1), 3 **Mismatch** trials (*duk*/object1) and 1 **Novel** trial (*loek*/object2).



## Results



The **novelty effect** (Novel vs. Same trials) is significant across all three groups ( $t > 14$ ) and does not interact with group ( $t < 1.9$ ).

The **mismatch effect** (Mismatch vs. Same trials) is present across all groups ( $t > 4.8$ ) but does interact with group. Follow-up analyses show that it is not significant in the Initial C group ( $t < 1.6$ ) but present in the Vowel group ( $t > 4.7$ ) as well as in the Final C group ( $t > 2.1$ ). Crucially, the effect in the Vowel group is significantly larger compared to the Final C group ( $t > 2.3$ ).

The average **habituation durations** do not differ between groups (all  $t < .6$ ).

## Discussion

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

Phonetic context variability in itself (the initial consonant) is not sufficient and variability in the final consonant to a much lesser degree than variability in the vowels.

Variability is beneficial for learning minimal pairs as long it contains linguistically relevant information (vowels) or more tokens of the relevant /bu/ and /du/ contrast (Final C).

The difference between Initial vs. Final C suggests that children do not rely on a consonantal bias (i.e. learning /C-C/ templates).

## 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 & Contact

Thanks to parents and their children!

Contact:

tom.fritzsche@uni-potsdam.de

