No evidence of a high variability benefit in phonetic vowel training for children

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Background

High variability phonetic training (HVPT) is well-established in training L2 speech contrasts following seminal studies by Logan, Lively, & Pisoni (1991; 1993). Key to their success was high variability (HV) input with multiple talkers and contexts, rather than low variability (LV) input. HVPT has since been used effectively in many adult studies (e.g. Nishi & Kewley-Port, 2007), and more recently with children (e.g. Giannakopoulou, Uther, & Ylinen, 2013). However, so far only two studies to date (Evans & Martín-Alvarez, 2016; Giannakopoulou, Brown, Clayards, & Wonnacott, 2017) directly investigated the effect of input variability for training children, and they found mixed results.

Aim: to further investigate the effect of variability on phonetic training for children.

Research questions
1. Do child participants improve after phonetic training?
2. Does input variability affect their improvement?

Hypothesis
We expect improvement across the board, but expect a possible LV benefit in training, and an HV benefit at post-test.

Participants
Tested 109 Dutch children learning English as a second language.

Final sample: 89 children spread over 2 age groups
  – 50 7/8 year-olds   27 HV   23 LV
  – 39 11/12 year-olds   20 HV   19 LV

Some additional task-specific drop-out due to absence/data loss.

Stimuli
Monosyllabic CVC minimal pairs recorded by 6 SSBE speakers.

Corresponding clip art pictures for each item.

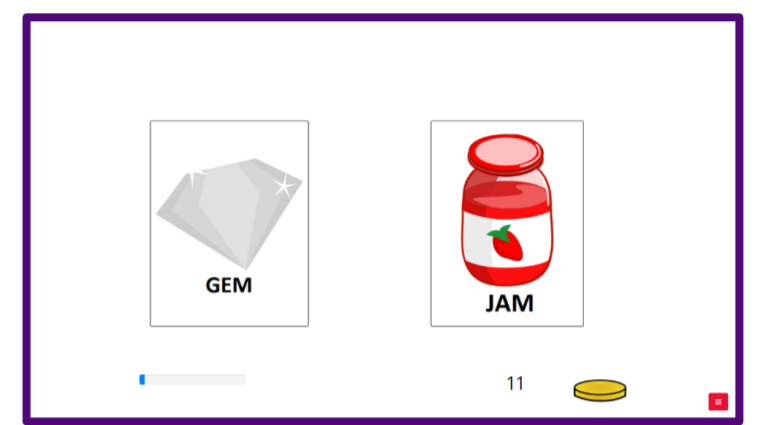| /e/-/æ/	/uː/-/ʊ/	/ʌ/-/ɒ/	/iː/-/ɔː/
bed-bad	fool-full	bus-boss	heel-hall
gem-jam	Luke-look	cut-cot	sheet-short
pen-pan	pool-pull	luck-lock	week-walk
vet-vat	suit-soot	shut-shot	wheel-wall

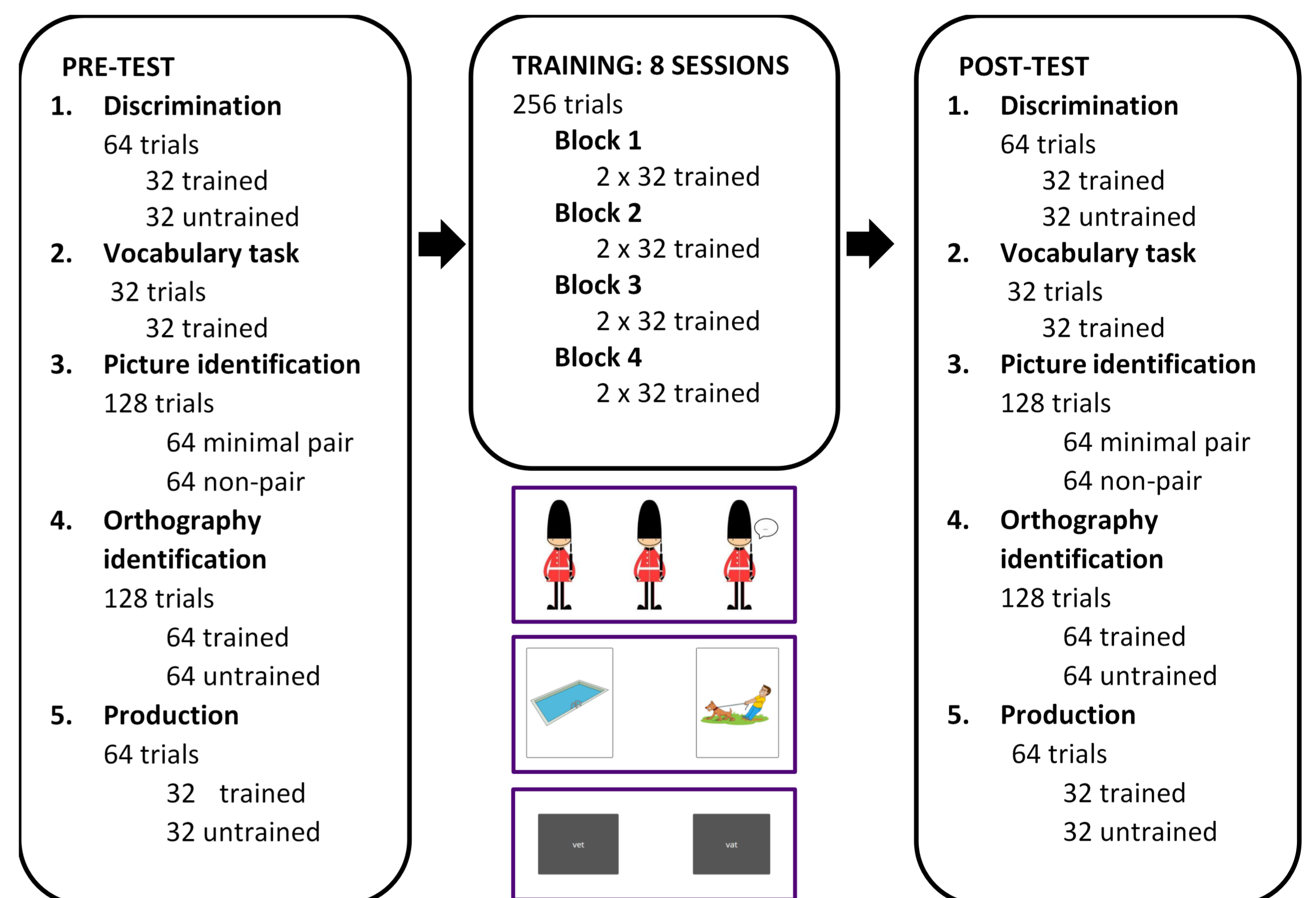Pre/post-tests included additional novel items not used in training.

Open science
Preregistration, stimuli, data, and analyses can be found on
https://osf.io/bgdxp/
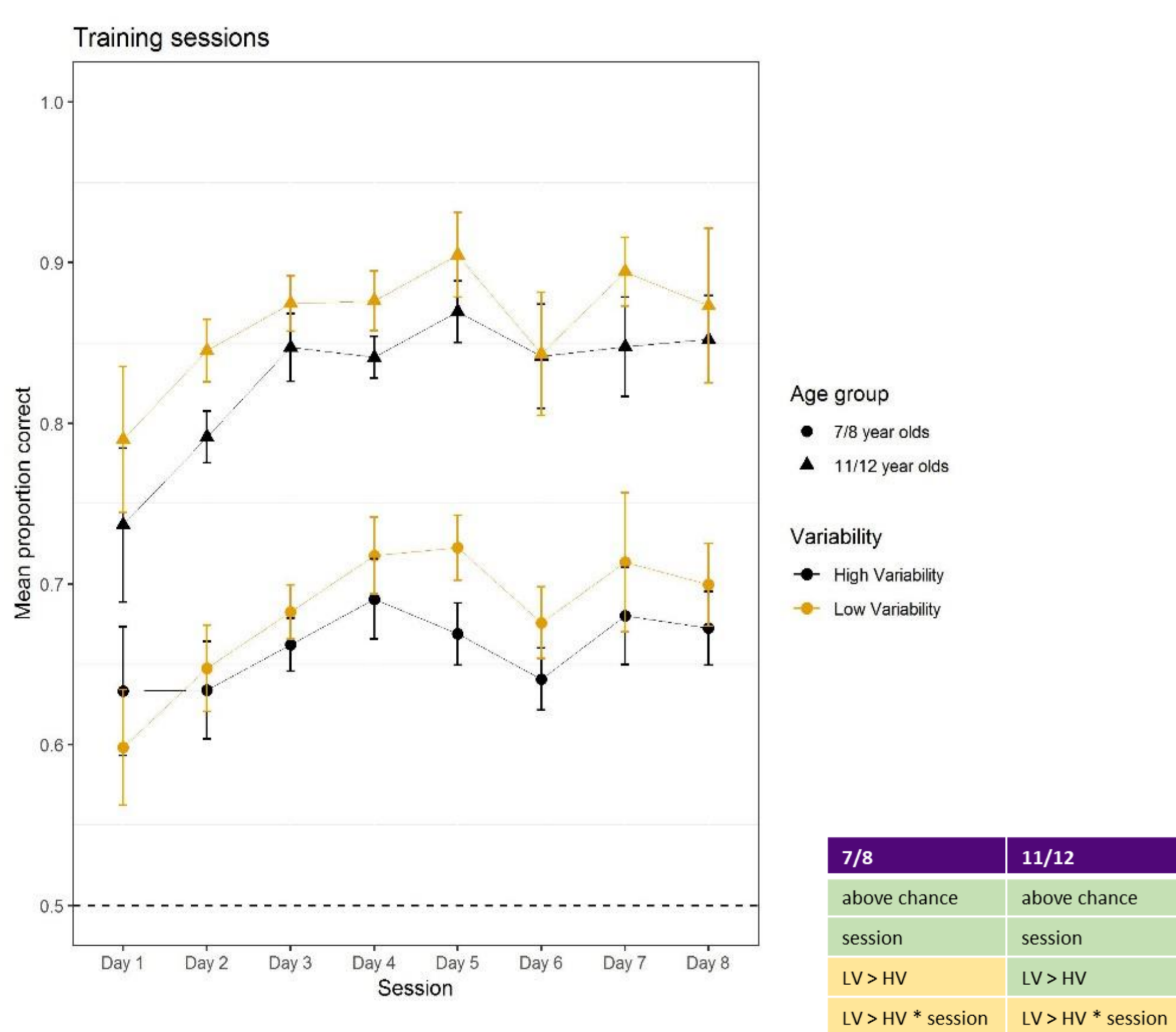
Procedure and design

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Training: HV (4 talkers) or LV (1 talkers)
Minimal pair 2 AFC task with trial-by-trial feedback.

Pre/post-tests: used 3 novel talkers not used in training.

PRE-TEST
1. Discrimination
   64 trials
      32 trained
      32 untrained
2. Vocabulary task
   32 trials
      32 trained
3. Picture identification
   128 trials
      64 minimal pair
      64 non-pair
4. Orthography identification
   128 trials
      64 trained
      64 untrained
5. Production
   64 trials
      32 trained
      32 untrained

TRAINING: 8 SESSIONS
256 trials
   Block 1
      2 x 32 trained
   Block 2
      2 x 32 trained
   Block 3
      2 x 32 trained
   Block 4
      2 x 32 trained

POST-TEST
1. Discrimination
   64 trials
      32 trained
      32 untrained
2. Vocabulary task
   32 trials
      32 trained
3. Picture identification
   128 trials
      64 minimal pair
      64 non-pair
4. Orthography identification
   128 trials
      64 trained
      64 untrained
5. Production
   64 trials
      32 trained
      32 untrained

Performance in training

7/8	11/12
above chance	above chance
session	session
LV > HV	LV > HV
LV > HV * session	LV > HV * session

Pre/Post performance with novel talkers

Picture identification task — 7/8-year-olds / 11/12-year-olds

7/8	11/12
above chance	above chance
session	session
HV > LV	HV > LV

Discrimination task — 7/8-year-olds / 11/12-year-olds

7/8	11/12
above chance	above chance
session	session
HV > LV	HV > LV
HV > LV on novel items	HV > LV on novel items

Orthography identification task — 7/8-year-olds / 11/12-year-olds

7/8	11/12
above chance	above chance
session	session
HV > LV	HV > LV
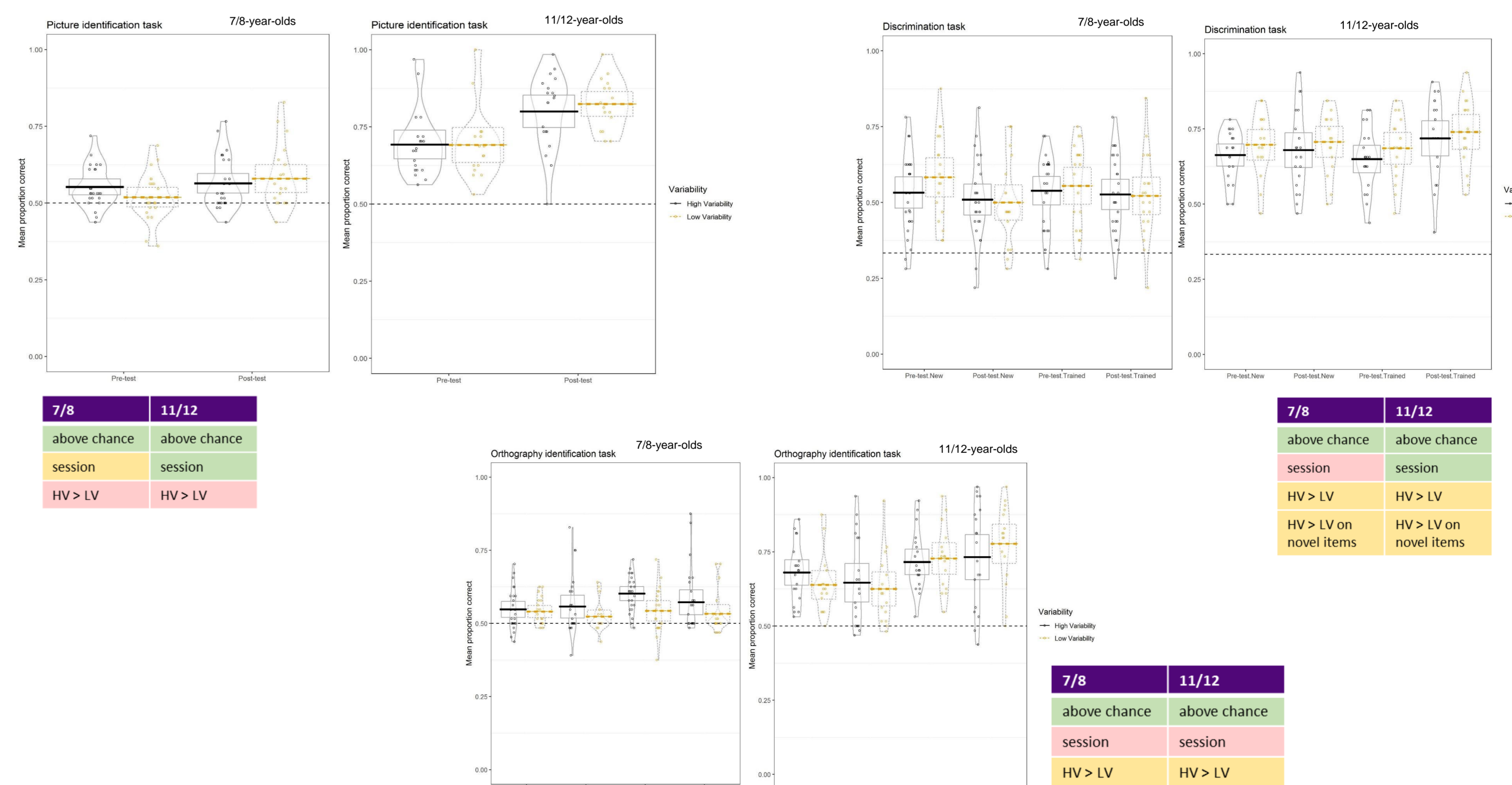
Do child participants improve after phonetic training?
As expected, both age groups improve over time during phonetic training. Younger children did not improve in any of the pre/post tasks, suggesting no generalisation to novel voices or items.

Older children improved on some but not all pre/post tasks, suggesting some evidence for generalization to novel voices and items.

Does input variability affect participants' improvement?
In training, LV outperforms HV as expected. No evidence for HV benefit is found in pre/post-test; in most cases Bayes Factors are ambiguous, in some there is even evidence against HV benefit.

This goes against some of the literature finding an HV training benefit on post-test results in adults (e.g. Lively et al. 1993, Sadakata & McQueen 2013), but is in line with Giannakopoulou et al. (2017) who found no such benefit either.

Implications
Trade-off between variability and complexity: HVPT might not be as beneficial for children as might be assumed based on adult literature.
This could have practical implications for the development of second and foreign language teaching methods.

References EVANS, B. G., & MARTÍN-ALVAREZ, L. (2016). Age-related differences in second-language learning? A comparison of high and low variability perceptual training for the acquisition of English /i/-/ɪ/ by Spanish adults and children. New Sounds. Aarhus, Denmark. GIANNAKOPOULOU, A., BROWN, H., CLAYARDS, M., & WONNACOTT, E. (2017). High or low? Comparing high and low-variability phonetic training in adult and child second language learners. PeerJ, 5, e3209. GIANNAKOPOULOU, A., UTHER, M., & YLINEN, S. (2013). Enhanced plasticity in spoken language acquisition for child learners: Evidence from phonetic training studies in child and adult learners of English. Child Language Teaching and Therapy, 29(2), 201–218. LIVELY, S. E., LOGAN, J. S., & PISONI, D. B. (1993). Training Japanese listeners to identify English /r/ and /l/. II: The role of phonetic environment and talker variability in learning new perceptual categories. The Journal of the Acoustical Society of America, 94(3 Pt 1), 1242–1255. LOGAN, J. S., LIVELY, S. E., & PISONI, D. B. (1991). Training Japanese listeners to identify English /r/ and /l/: a first report. The Journal of the Acoustical Society of America, 89(2), 874–886. NISHI, K., & KEWLEY-PORT, D. (2007). Training Japanese Listeners to Perceive American English Vowels: Influence of Training Sets. Journal of Speech Language and Hearing Research, 50(6), 1496. SADAKATA, M., & McQUEEN, J. M. (2013). High stimulus variability in nonnative speech learning supports formation of abstract categories: Evidence from Japanese geminates. The Journal of the Acoustical Society of America, 134(2), 1324–1335.