Neural and Behavioural Predictors of Successful Second Language Perception

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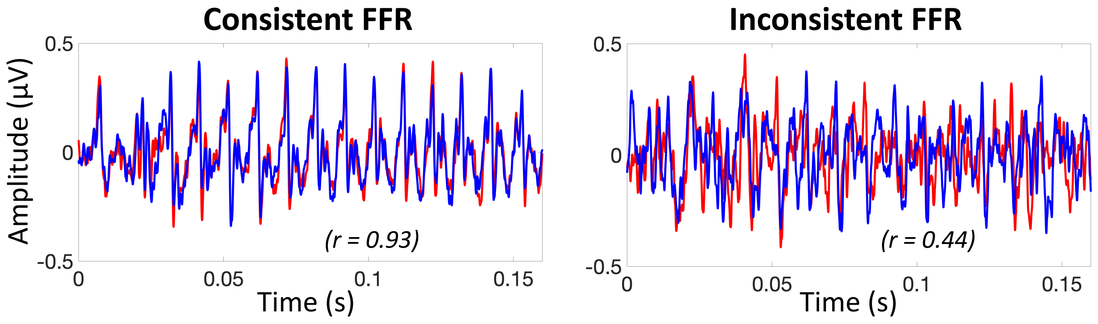
BACKGROUND

Individual differences among healthy young adults, in

- Native phonetic perception (e.g., on 2AFC and VAS tasks)[1,2]
- Non-native phonetic perception[3]
- Frequency-following response (FFR)[4]

Do these differences relate to each other? If so, how?



Hypotheses:

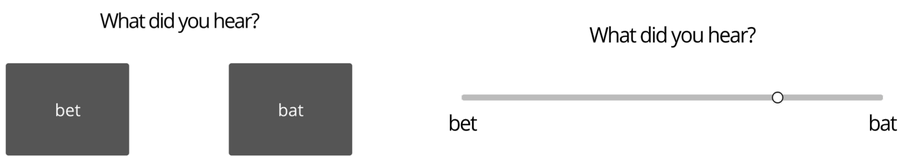
1. Different native perception tasks (2AFC and VAS) may measure different constructs but be related through consistency of responses.
2. More fine-tuned native perception may predict more accurate non-native perception.
3. A more consistent FFR may predict more fine-tuned native perception and more accurate non-native perception.

METHODS

Participants. 73 English monolinguals
(behavioural data for all, FFR data for 33)

Behavioural tasks.

Native perception: **2AFC** and **VAS** tasks *(stimuli: bet-bat and dear-tear continua, made by varying 2 acoustic cues)*



Non-native perception: **Oddity** task *(stimuli: German minimal pairs with ç /ʃ , yː /ʏ , and øː /œ)*

Control tasks: **AX-CPT** (attention) and **Backwards Digit Span** (memory)

FFR Recording. 150 ms **/da/** stimulus (F0 = 98 Hz) presented 4000 times in alternating polarities. Vertical electrode montage (Cz referenced against avg. mastoids). Bandpass filtering 80-2000 Hz; ±35 μV artifact rejection; segmentation from 0-160 ms post-stimulus onset.

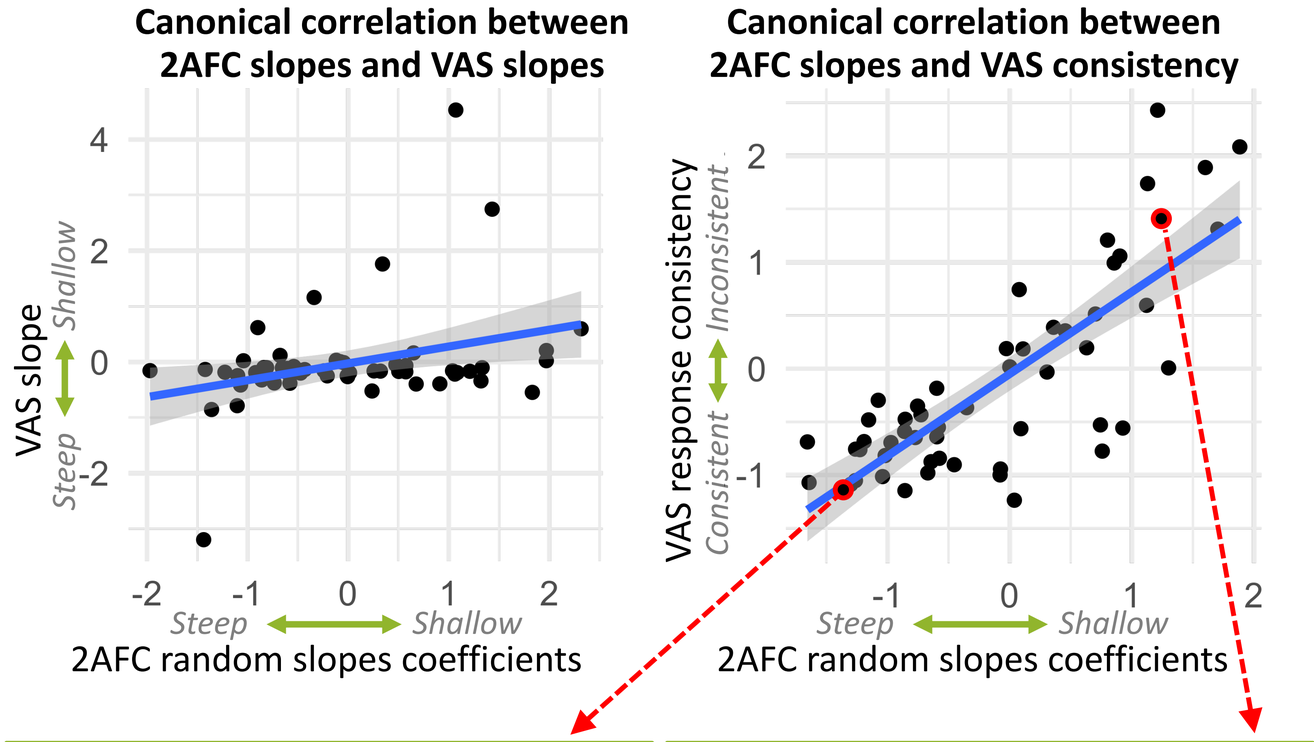
Measures. **2AFC**: random slopes from mixed-effects models. **VAS**: slope and consistency from rotated logistic[2]. **Oddity**: *A* sensitivity. **FFR**: response consistency (bootstrapping, 200 iterations)

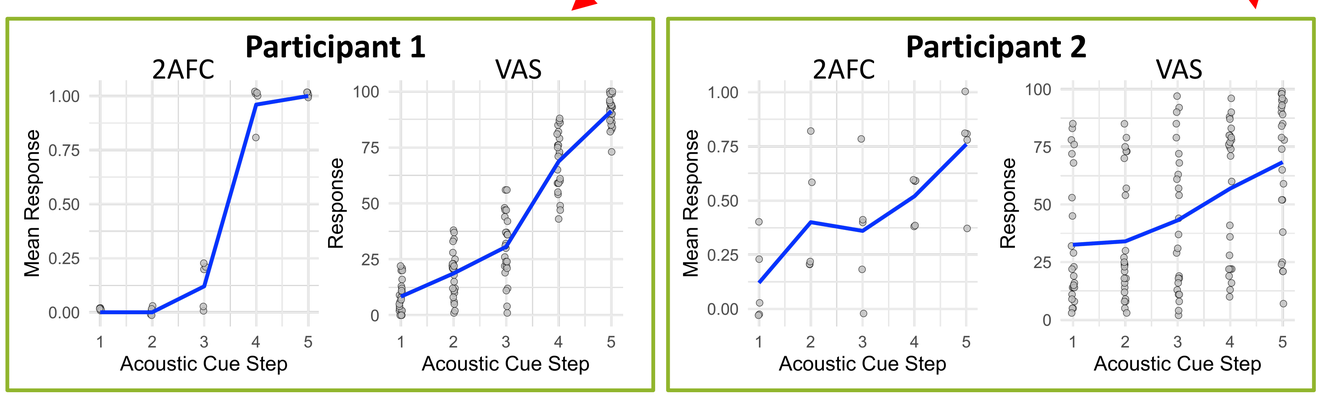
Analyses. Hypothesis **1**: canonical correlations & multivariate multiple regression. Hypothesis **2**: multiple regression. Hypothesis **3**: multiple regression and Pearson correlation.

RESULTS

Hypothesis 1: Supported. *(also corroborated by a larger dataset of 139 online participants)*

- Identification slopes on the 2AFC task were not predicted by VAS slopes, but were predicted by consistency of VAS responses to dear-tear *(p = .004)*



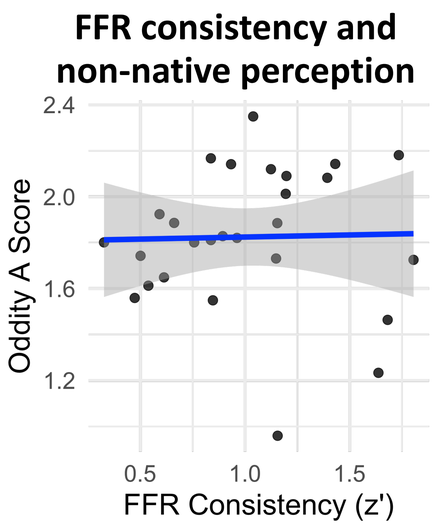


Hypothesis 2: Partially supported.

- Performance on one native perception task (2AFC) predicted non-native perception *(p = 0.005)*

Hypothesis 3: Not supported.

- FFR consistency was not related to native perception *(p > 0.1 for all predictors)* or non-native perception *(r = 0.02, p = 0.91)*



CONCLUSIONS

- Different phonetic perception tasks measure different constructs; shallow VAS slopes reflect gradient perception while shallow 2AFC slopes reflect inconsistency of responses
- The ability to clearly categorize native speech sounds seems to relate to better non-native perception; possible tool for identifying who would benefit from more support during language learning
- No evidence that neural consistency of sound encoding relates to behavioural consistency of phonetic perception; could be due to a variety of factors

REFERENCES

[1] Clayards, 2018. Differences in cue weights for speech perception are correlated for individuals within and across contrasts. J. Acoust. Soc. Am., 144(3), EL172-EL177. **[2]** Kapnoula et al., 2017. Evaluating the sources and functions of gradiency in phoneme categorization: An individual differences approach. J. Exp. Psychol. Hum. Percept. Perform., 43(9), 1594. **[3]** Mayr & Escudero, 2010. Explaining individual variation in L2 perception: Rounded vowels in English learners of German. Biling.: Lang. Cogn., 13(3), 279-297. **[4]** Coffey et al., 2016. Individual differences in the frequency-following response: relation to pitch perception. PloS one, 11(3), e0152374.