

# Lexical tone learning:

## The effect of incremental training and tonal experience

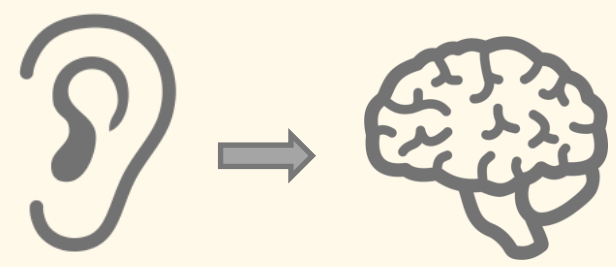


Yanyu Li, Laurence White & Ghada Khattab



Newcastle University

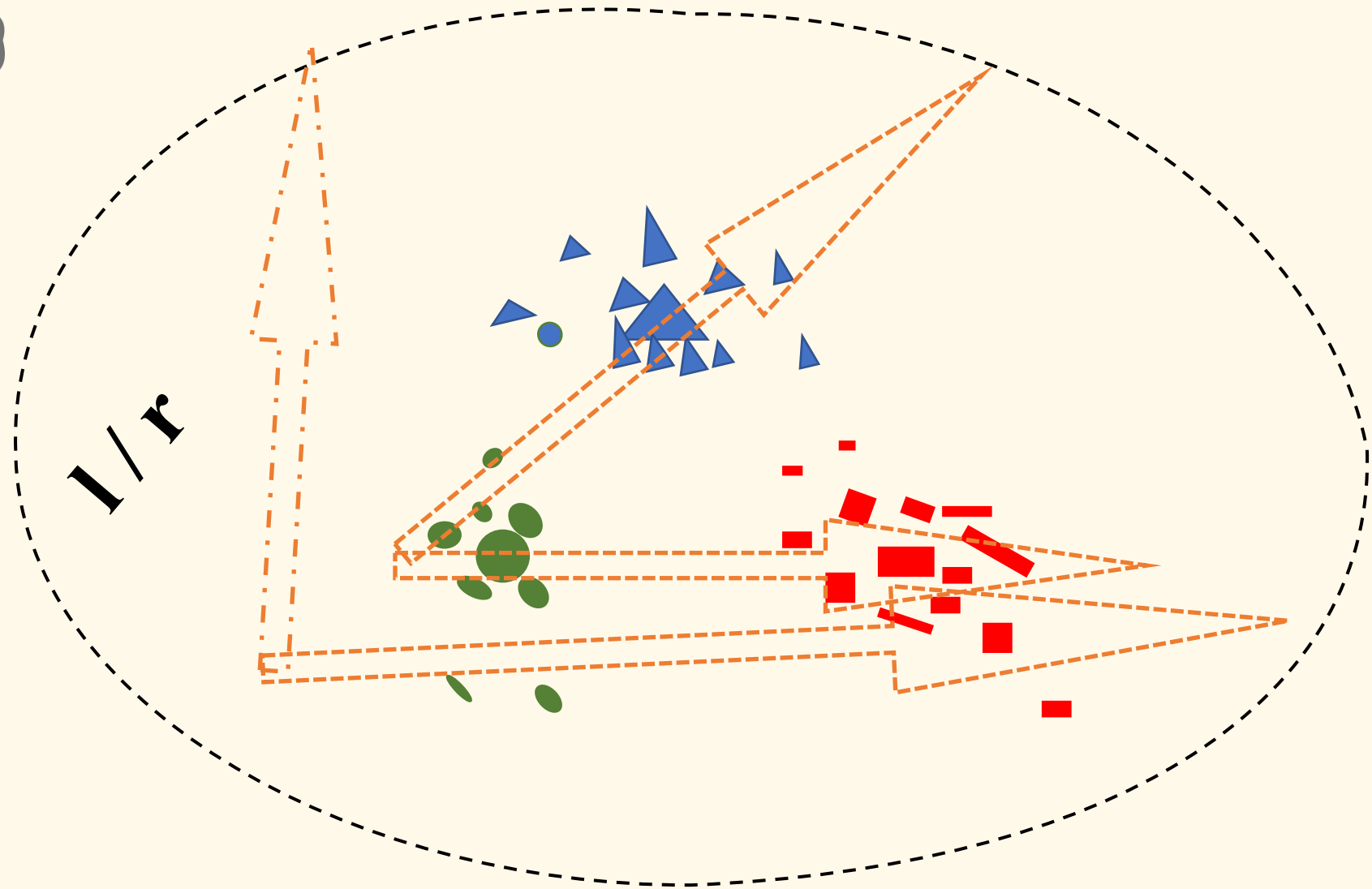
[y.li218@newcastle.ac.uk](mailto:y.li218@newcastle.ac.uk) | [laurence.white@newcastle.ac.uk](mailto:laurence.white@newcastle.ac.uk) | [ghada.khattab@newcastle.ac.uk](mailto:ghada.khattab@newcastle.ac.uk)



English

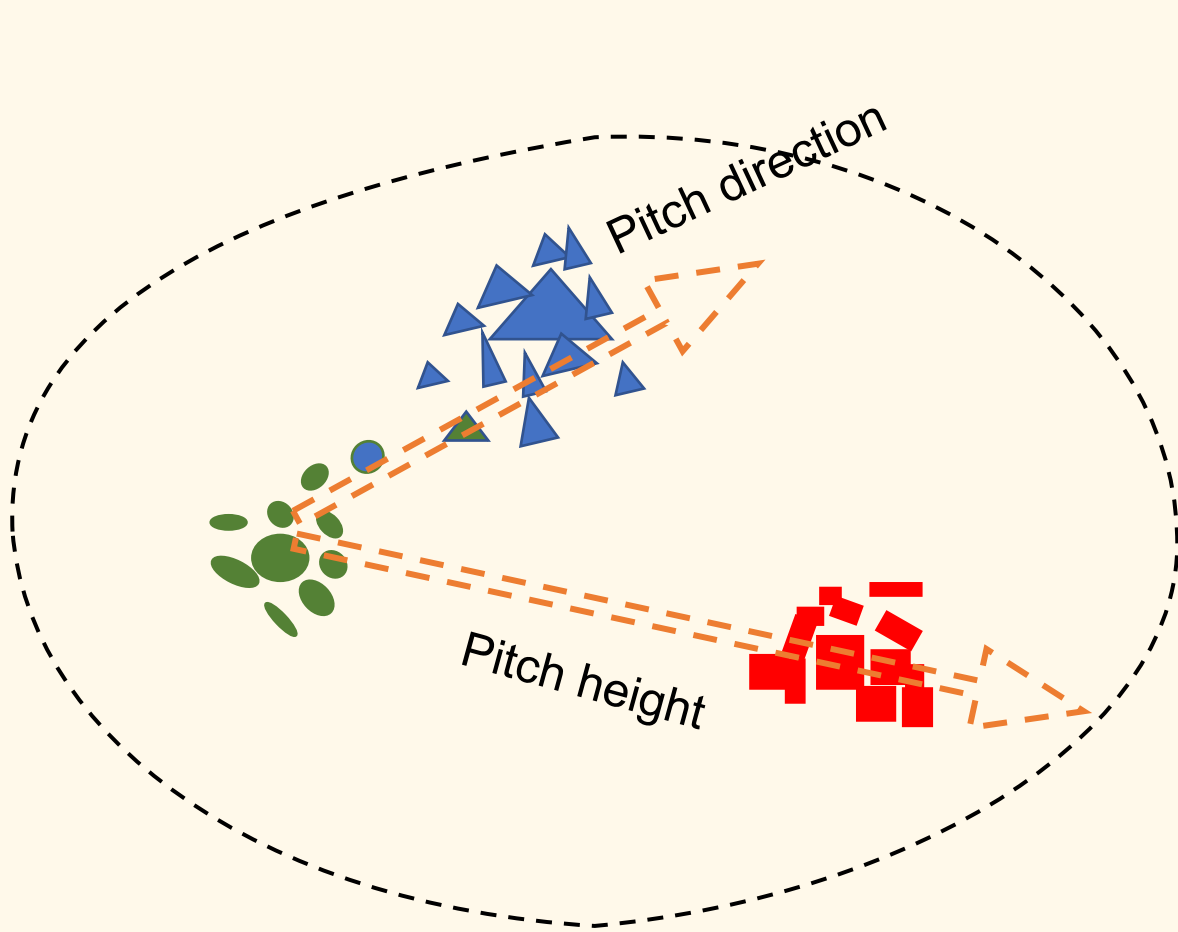
Japanese

l / r

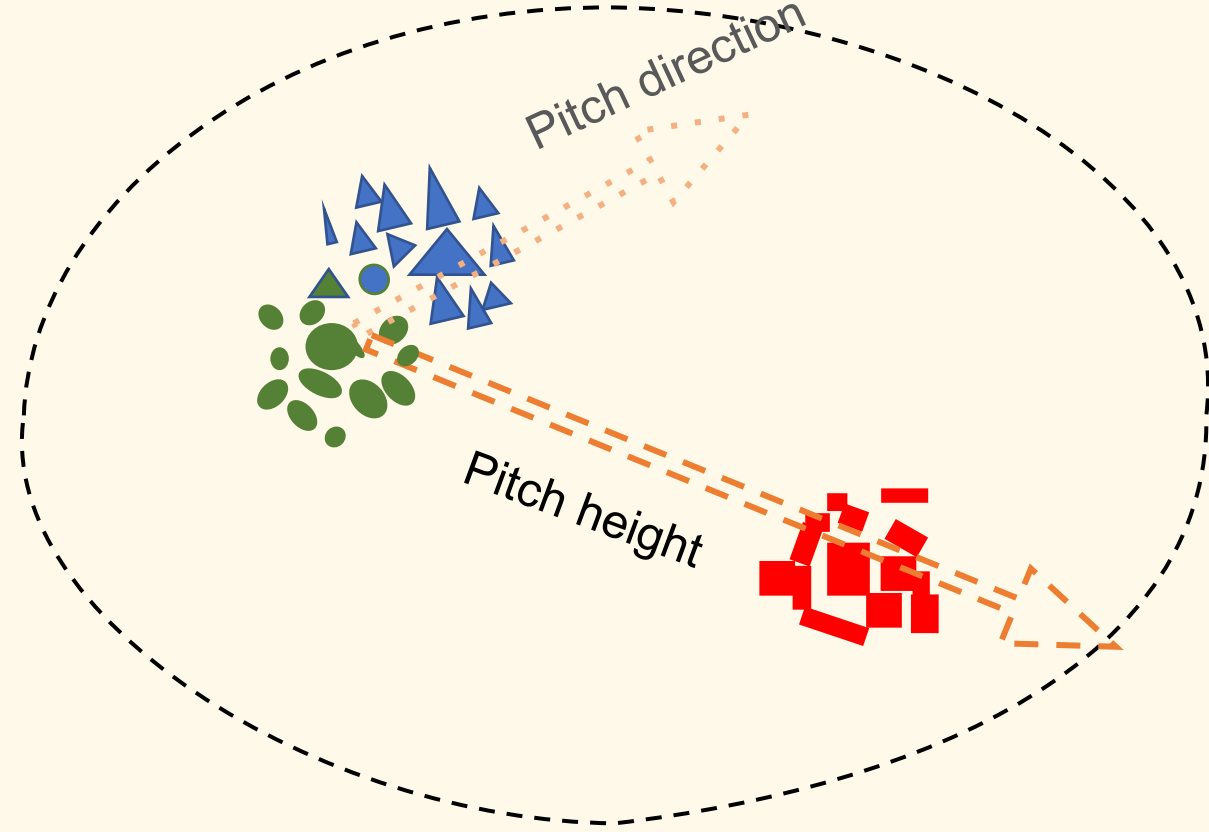




# Lexical tone?



**Tonal listeners**



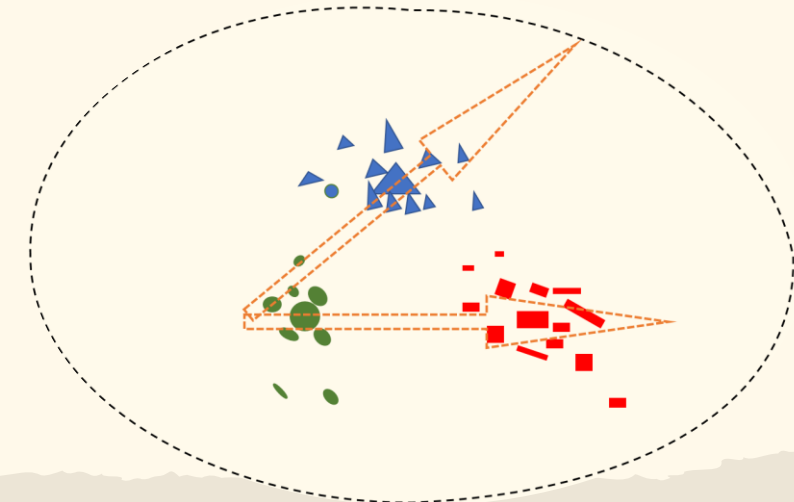
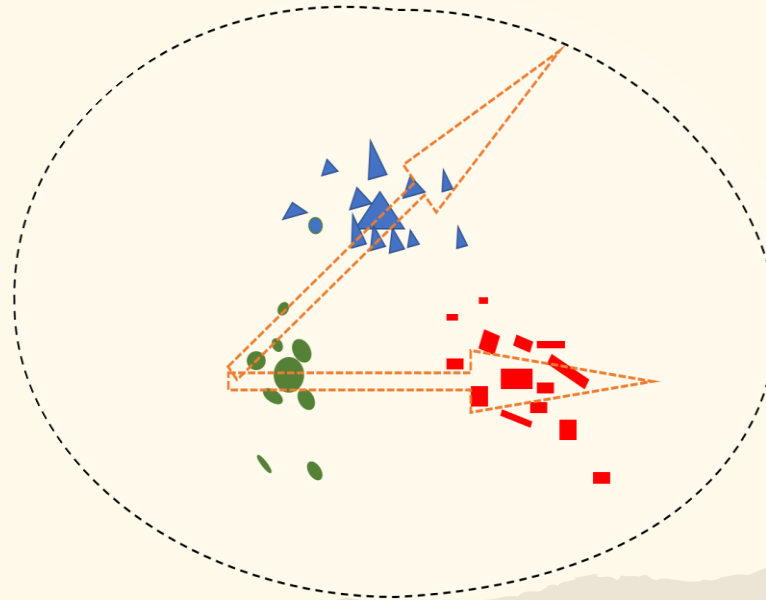
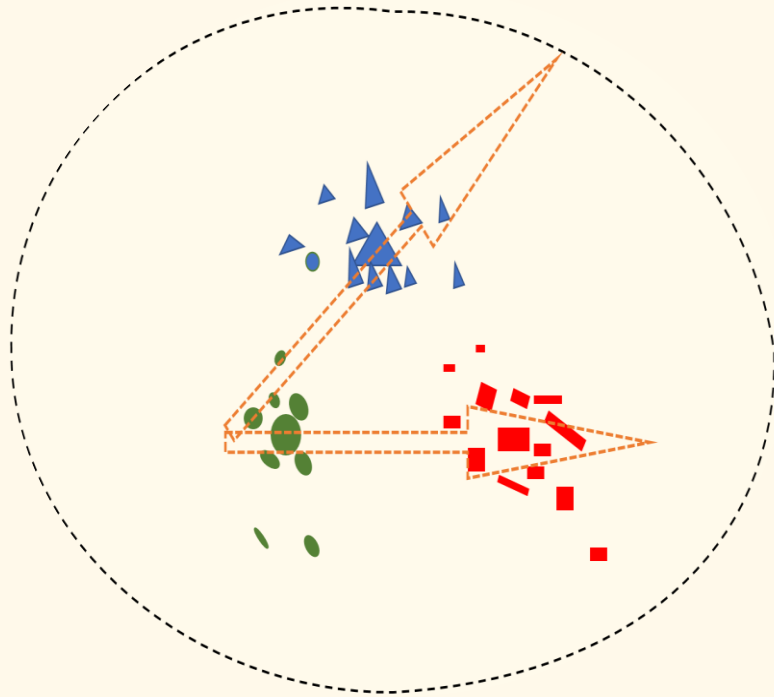
**Non-tonal listeners**

# Incremental training for L2 perception

Training 1  
(**Most** exaggerated)

Training 2  
(**Less** exaggerated)

Training 3  
(**No** exaggeration)





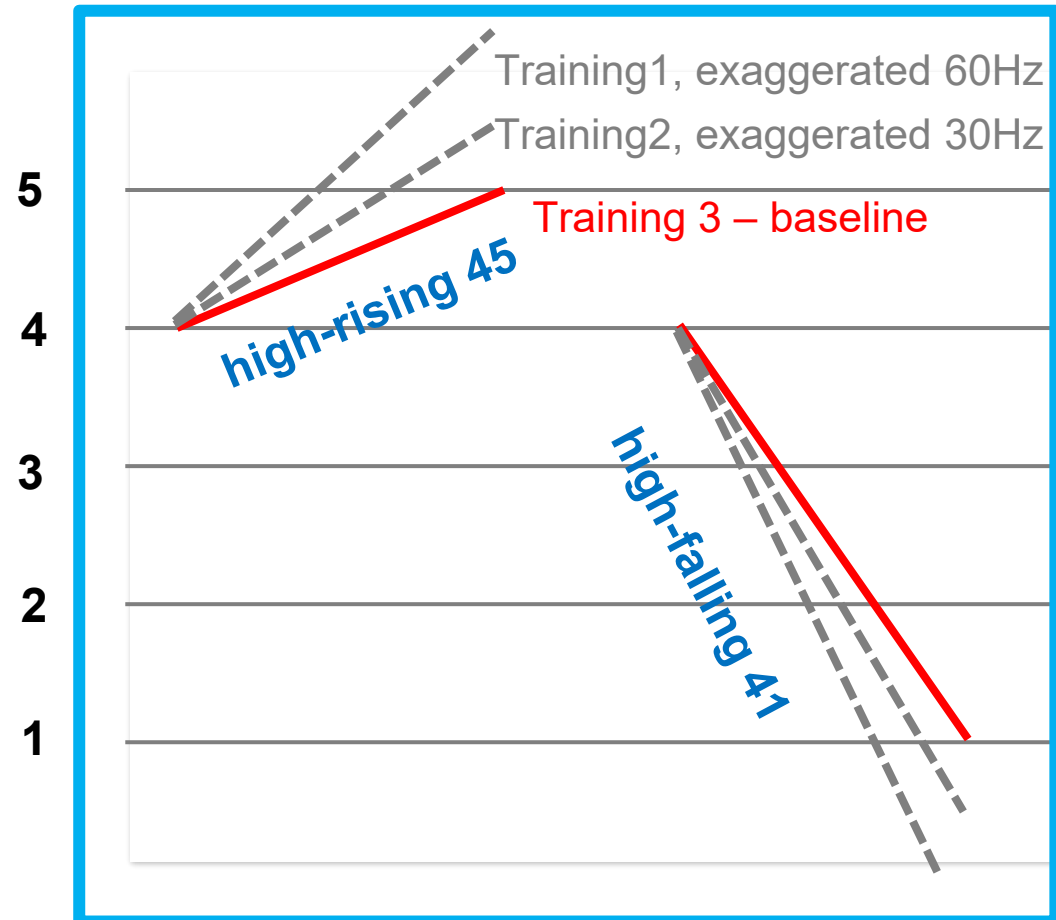
Is the incremental training  
method **effective** for non-  
tonal listeners...

## Experiment 1

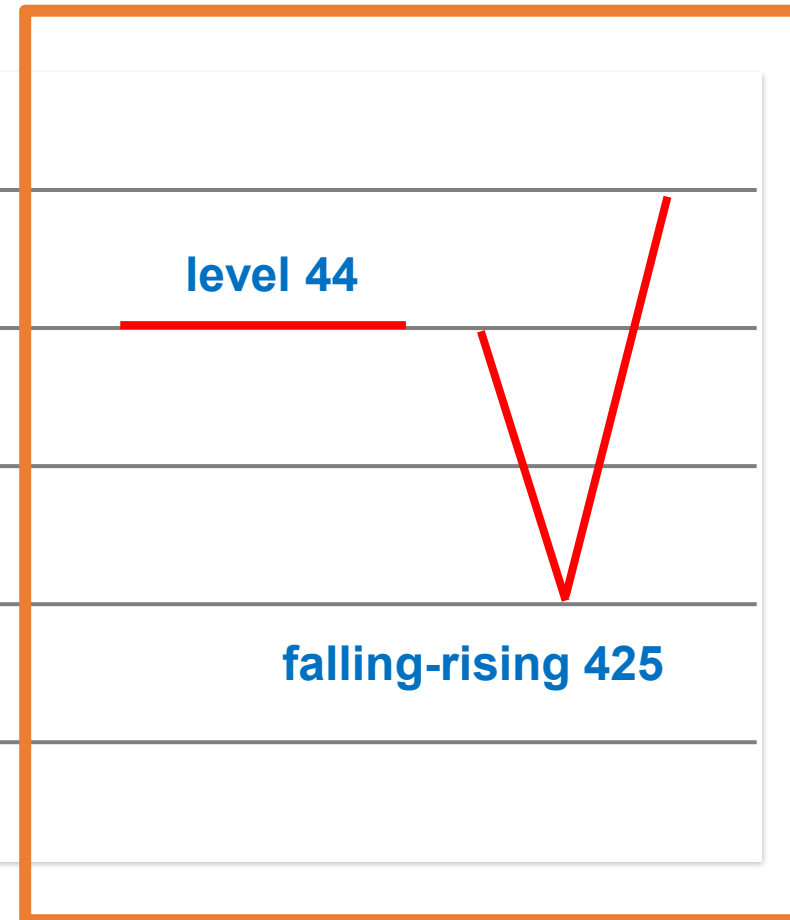
...given tonal contrasts  
varying on  
both height (attended)  
and trajectory (neglected)?



## Training



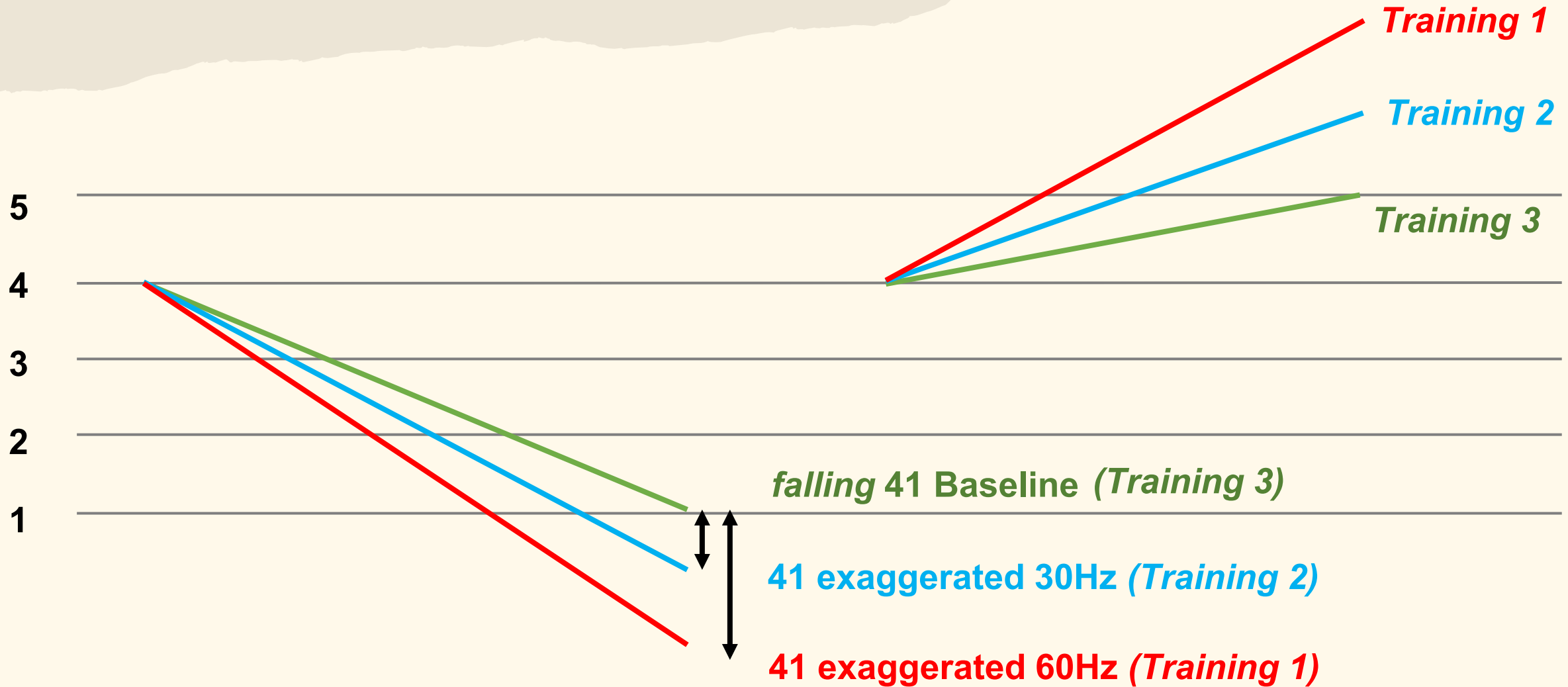
## Test



**9 Syllables:** /pa:/, /ta:/, /ka:/, /pi:/, /ti:/, /ki:/, /pu:/, /tu:/, and /ku:/



# Exaggerated stimuli



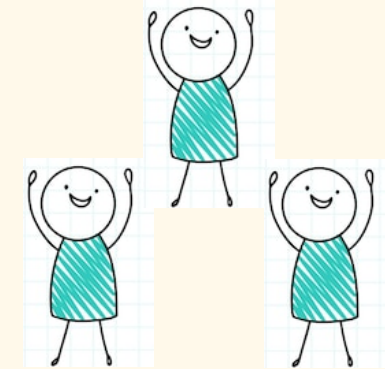


# Participants



**Incremental group: N=40**

*With **exaggerated** stimuli*



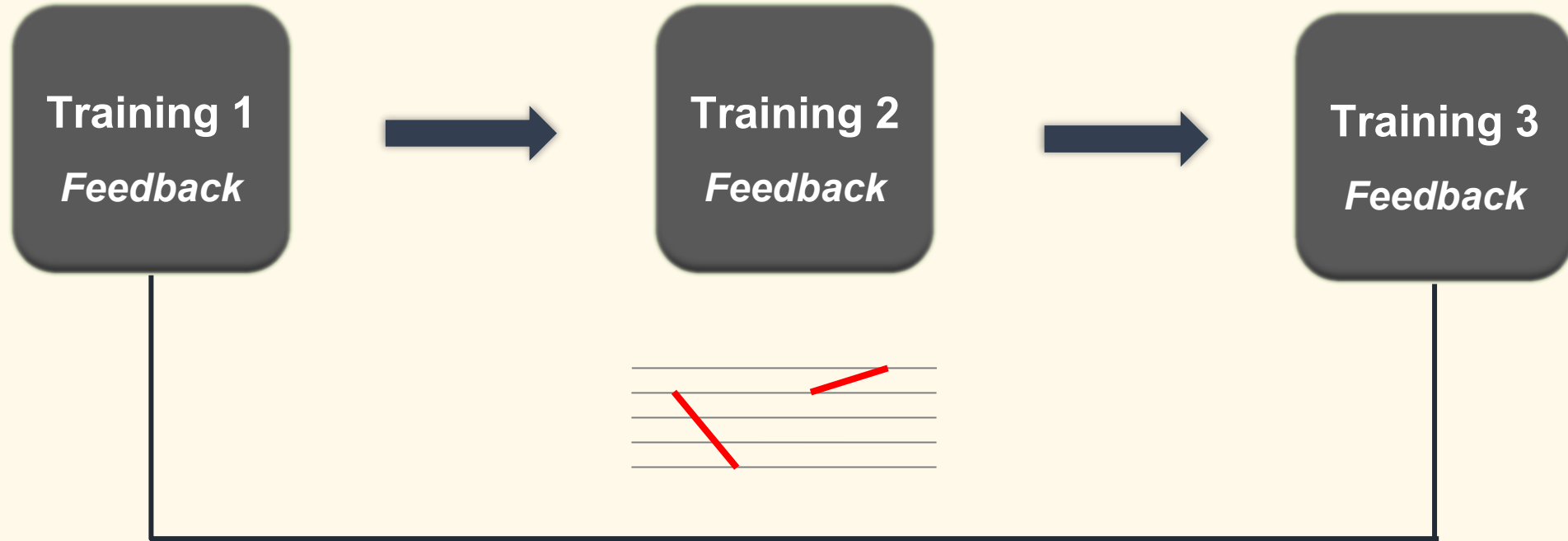
**Fixed group: N=46**

*With **baseline** stimuli*

Native English speakers without lexical tone experience.



ABX tasks



Exaggeration 60Hz

Exaggeration 30Hz

Baseline



Baseline

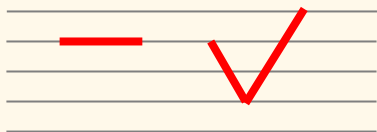
Baseline

Baseline



**44 vs 425**

*level vs. falling-rising*



**41 vs 45**

*high-falling vs high-rising*



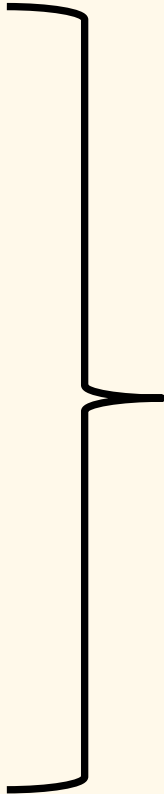
*Same as pre-test*





# Data Analysis

- ABX task:
  - **Accuracy** data
  - **Reaction time** data:
    - No interesting effects here:
      - Just quicker in post-test than pre-test



Separately for Test  
and Training blocks



# Accuracy data

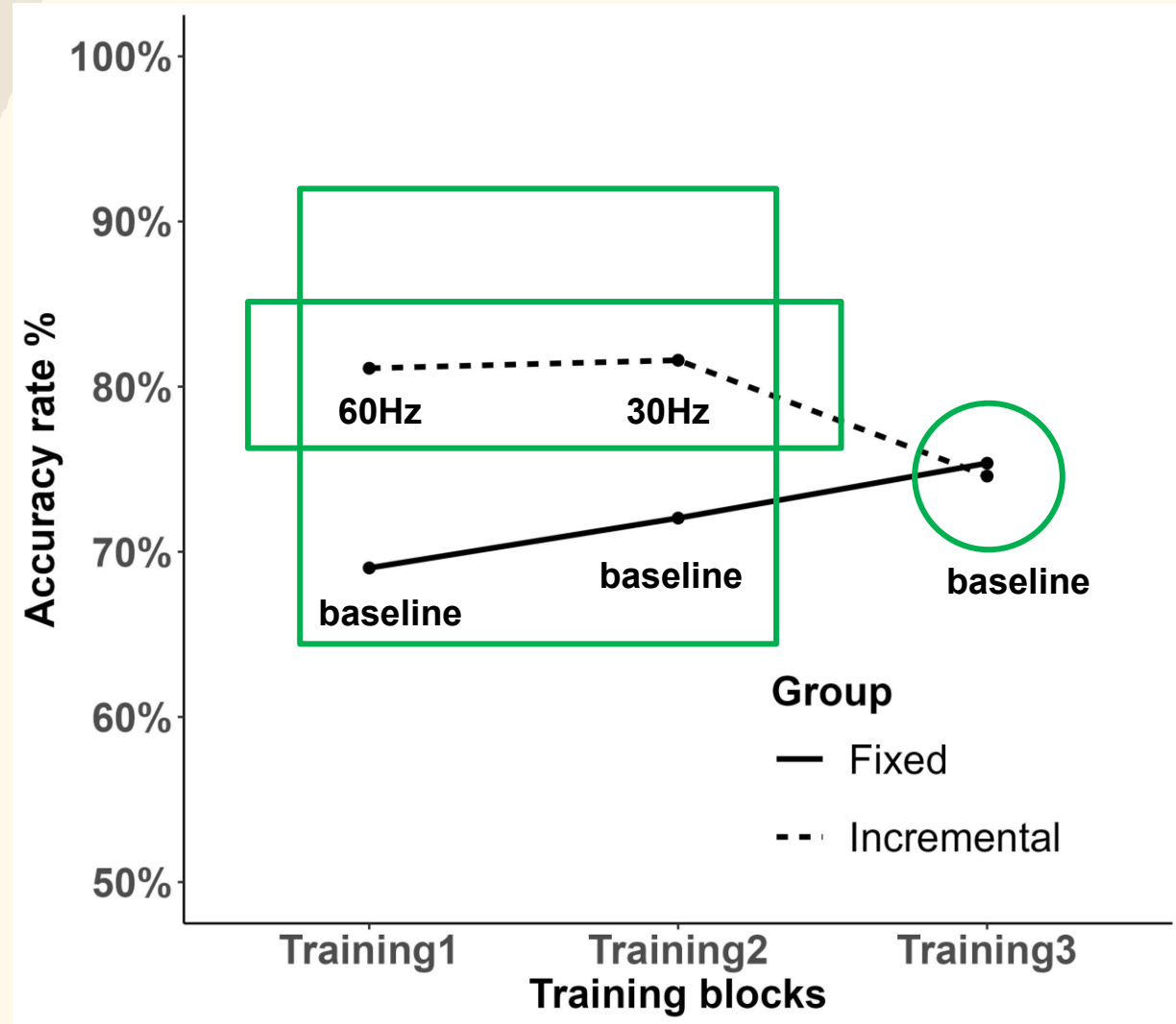
## *Logistic mixed-effect regression models*

- **Fixed effects:**
  - Group: Incremental vs Fixed
    - Block (Training): Training1 vs Training2 vs Training3
    - Block (Test): Pre-test vs Post-test
- **Random effects:**
  - Random intercepts: participant, syllable
  - Random slope: block-by-participant



# Accuracy training blocks

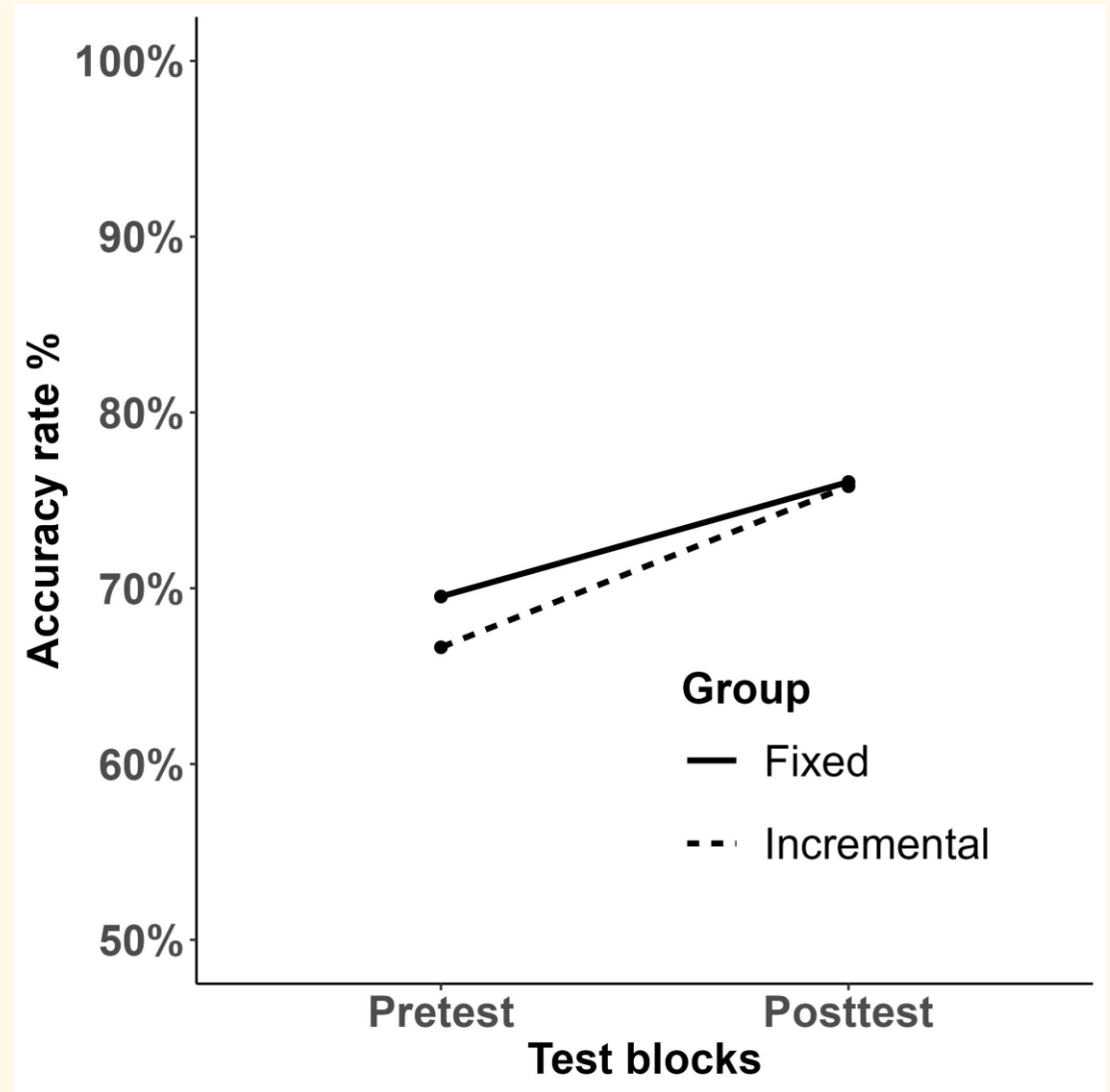
- **Group:**  $\chi^2(1) = 9.54$ ,  $p = .002$
- **Block:**  $\chi^2(2) = 10.56$ ,  $p = .005$
- **Group x Block:**  $\chi^2(2) = 20.10$ ,  $p < .001$





# Accuracy test blocks

- **Block:**  $\chi^2(1) = 31.96, p < .001$





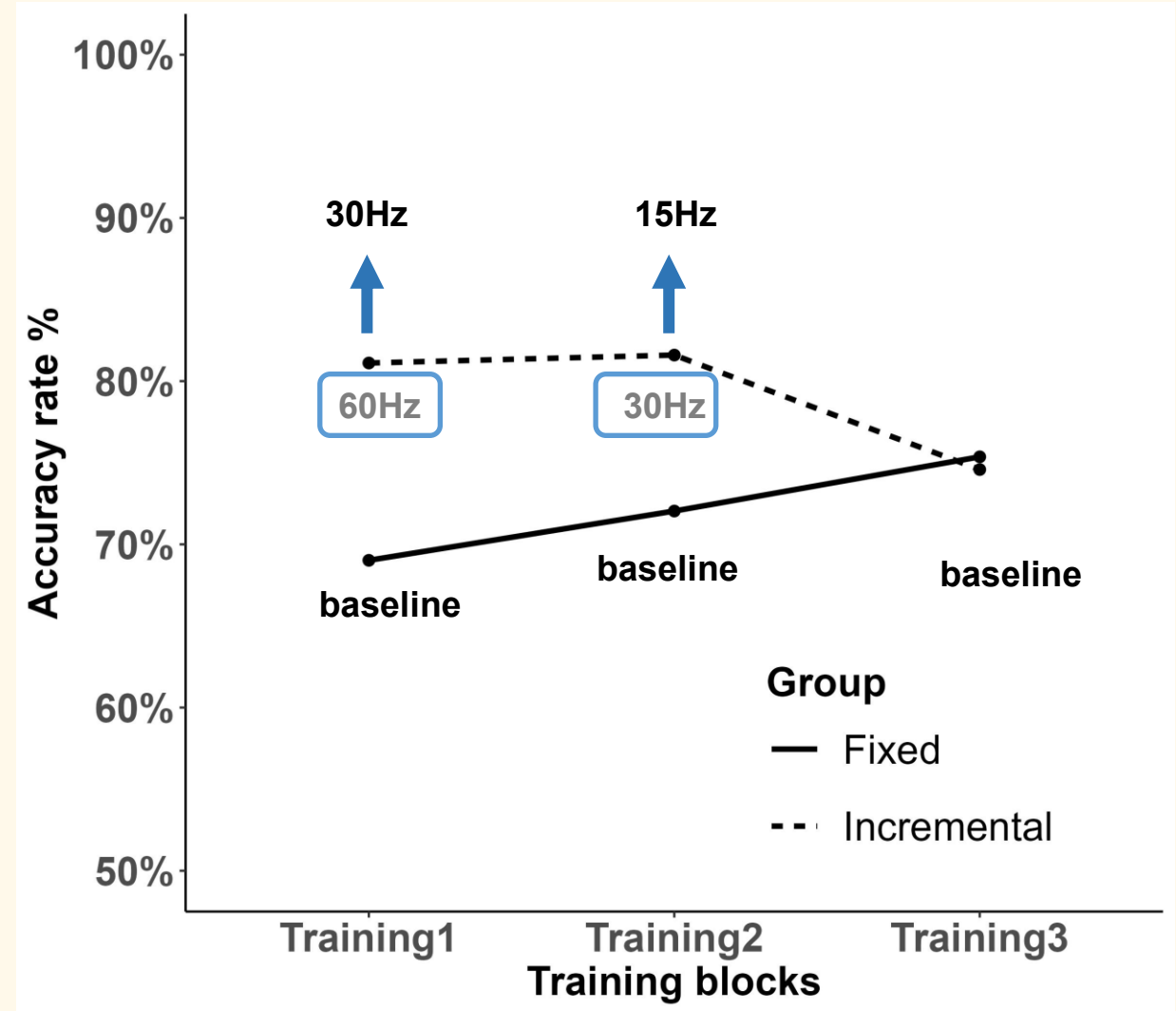
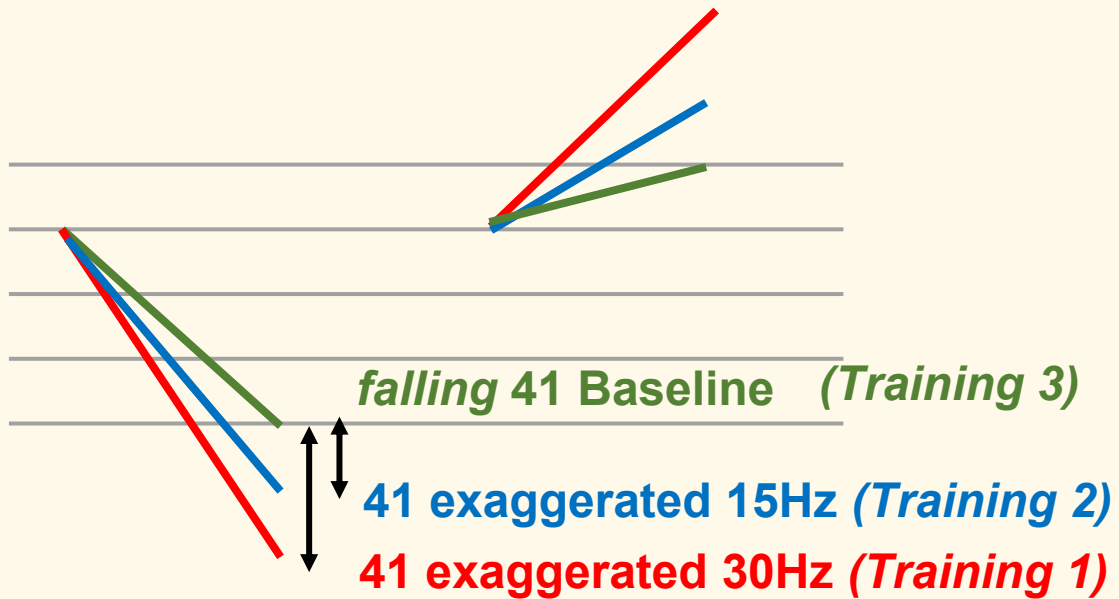
# Discussion

- Exaggerated stimuli **boost discrimination** (*Training1 and Training2*).
- Boost **not sustained** when exaggeration removed (*Training3*).
  
- Participants **improve** on **untrained** tonal contrast (*Test1 vs Test2*):
  - But **no difference in untrained contrasts** due to exaggerated training.



# Experiments 2 and 3

Reduced exaggeration step to 15Hz/block.

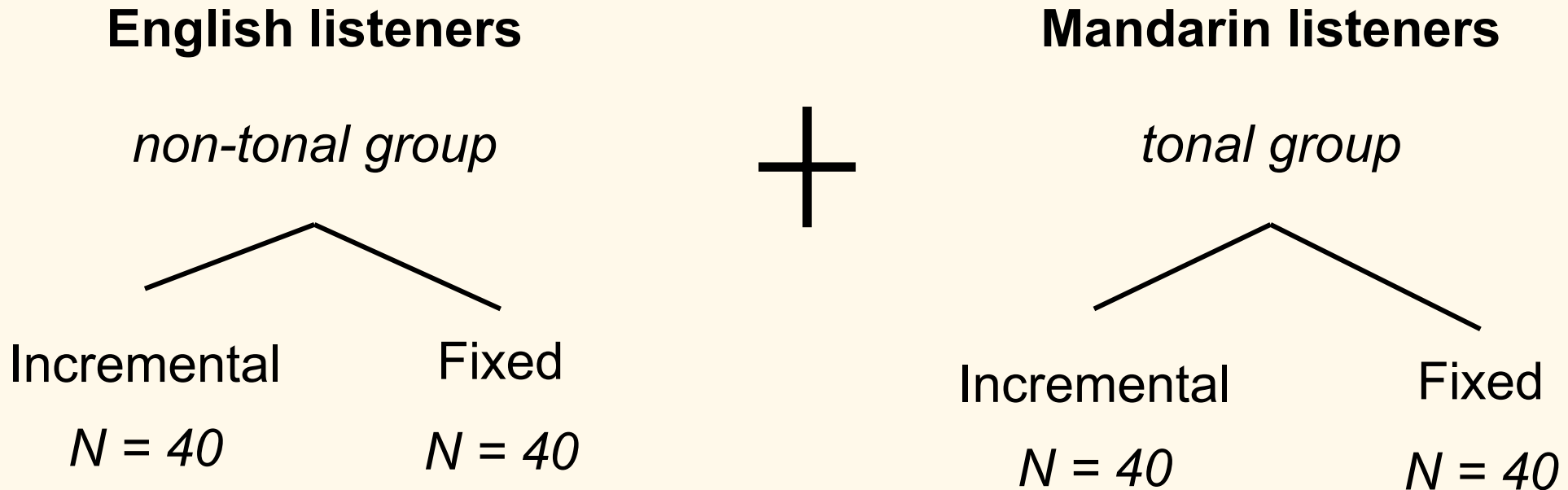




## Experiments 2 and 3

### Impact of tonal experience?

- In particular, on effect of exaggerated tonal contrasts.





# Data Analysis

- **Accuracy** data
- **Reaction time** data
- **Combined** data:
  - Experiment 2: L1 English listeners
  - Experiment 3: L1 Mandarin listeners
- **Separate** Test & Training blocks
- Regression model structure
  - As Experiment 1...
  - ...additional fixed effect of L1:
    - Mandarin vs English



# Accuracy training blocks

- **Language x Group:**

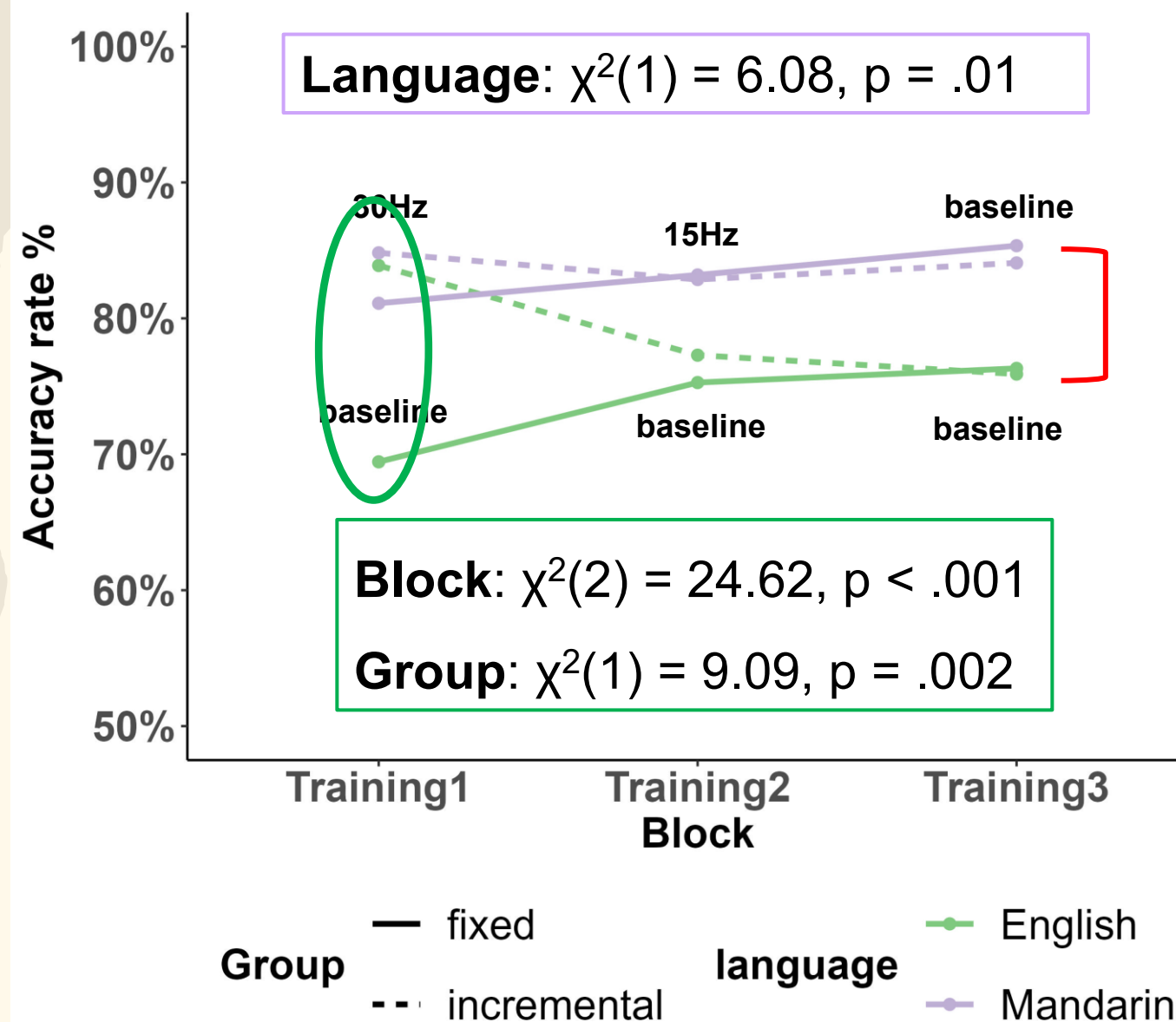
$$\chi^2(1) = 7.74, p < .001$$

- **Block x Group:**

$$\chi^2(2) = 41.67, p < .001$$

- **Block x Language x Group**

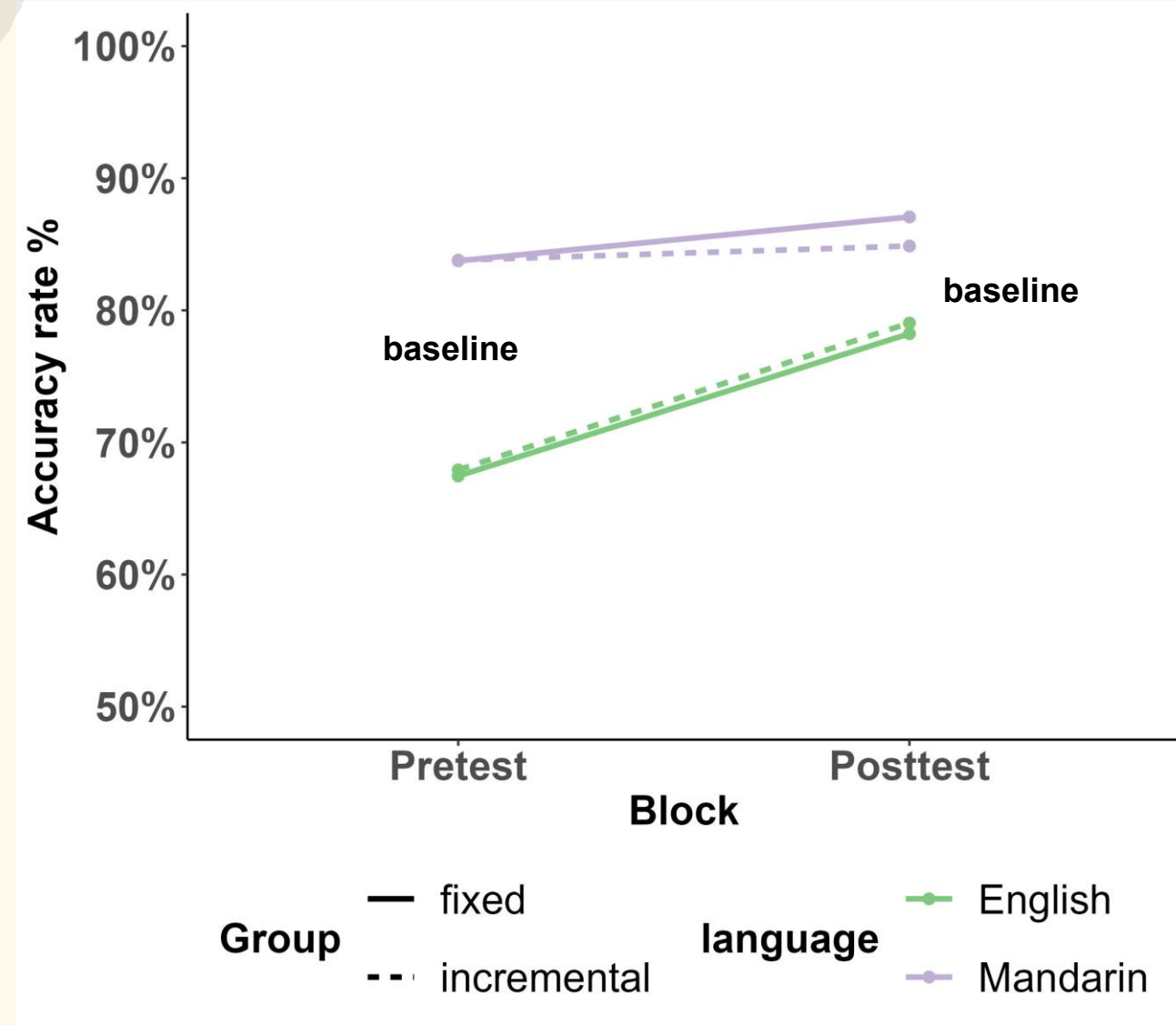
$$\chi^2(1) = 7.32, p = .03$$





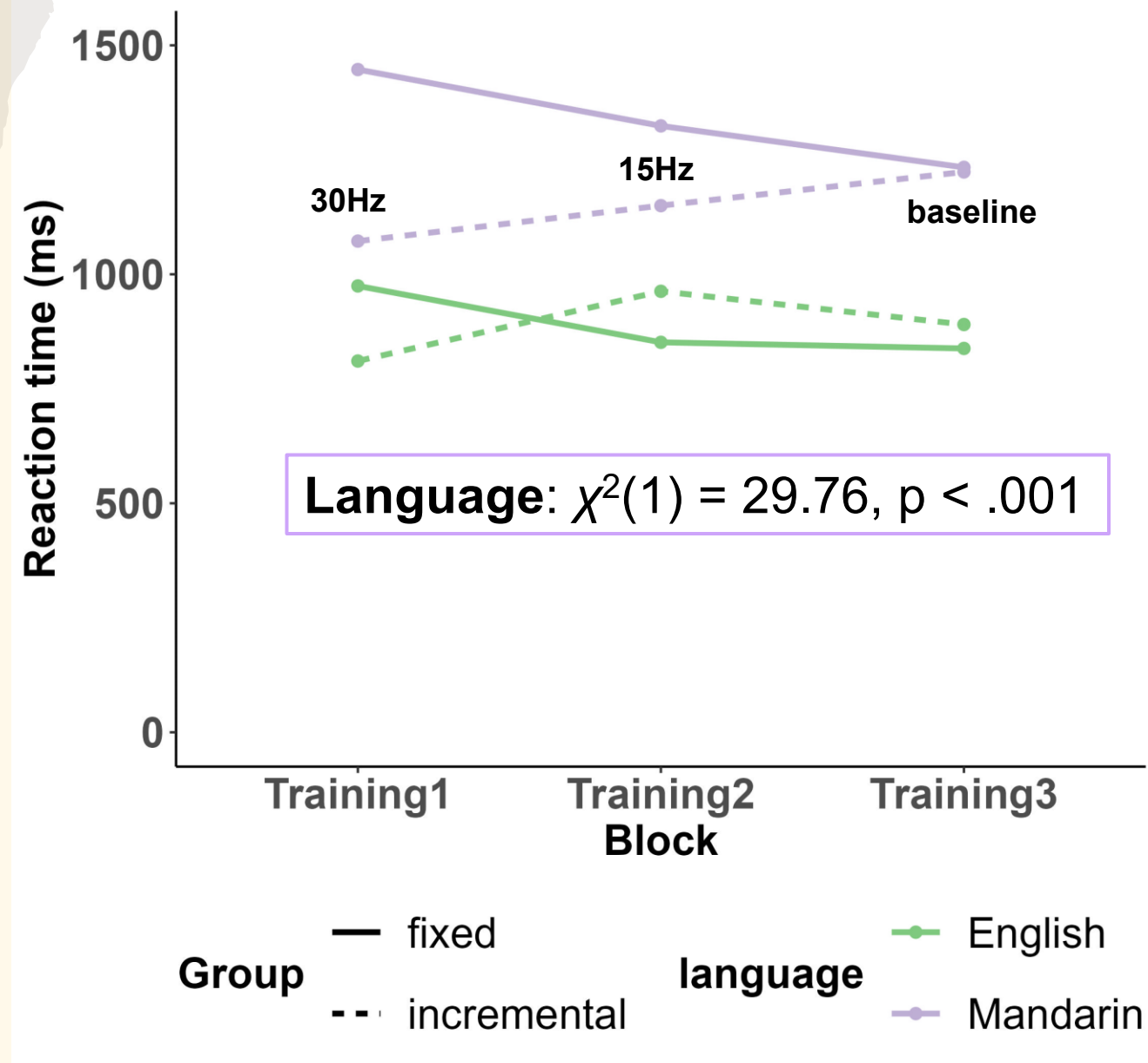
# Accuracy test blocks

- **Language:**  $\chi^2(1) = 41.01$ ,  $p < .001$
- **Block:**  $\chi^2(1) = 43.67$ ,  $p < .001$
- **Language x Block:**  $\chi^2(1) = 4.46$ ,  $p = .03$



# RT training blocks

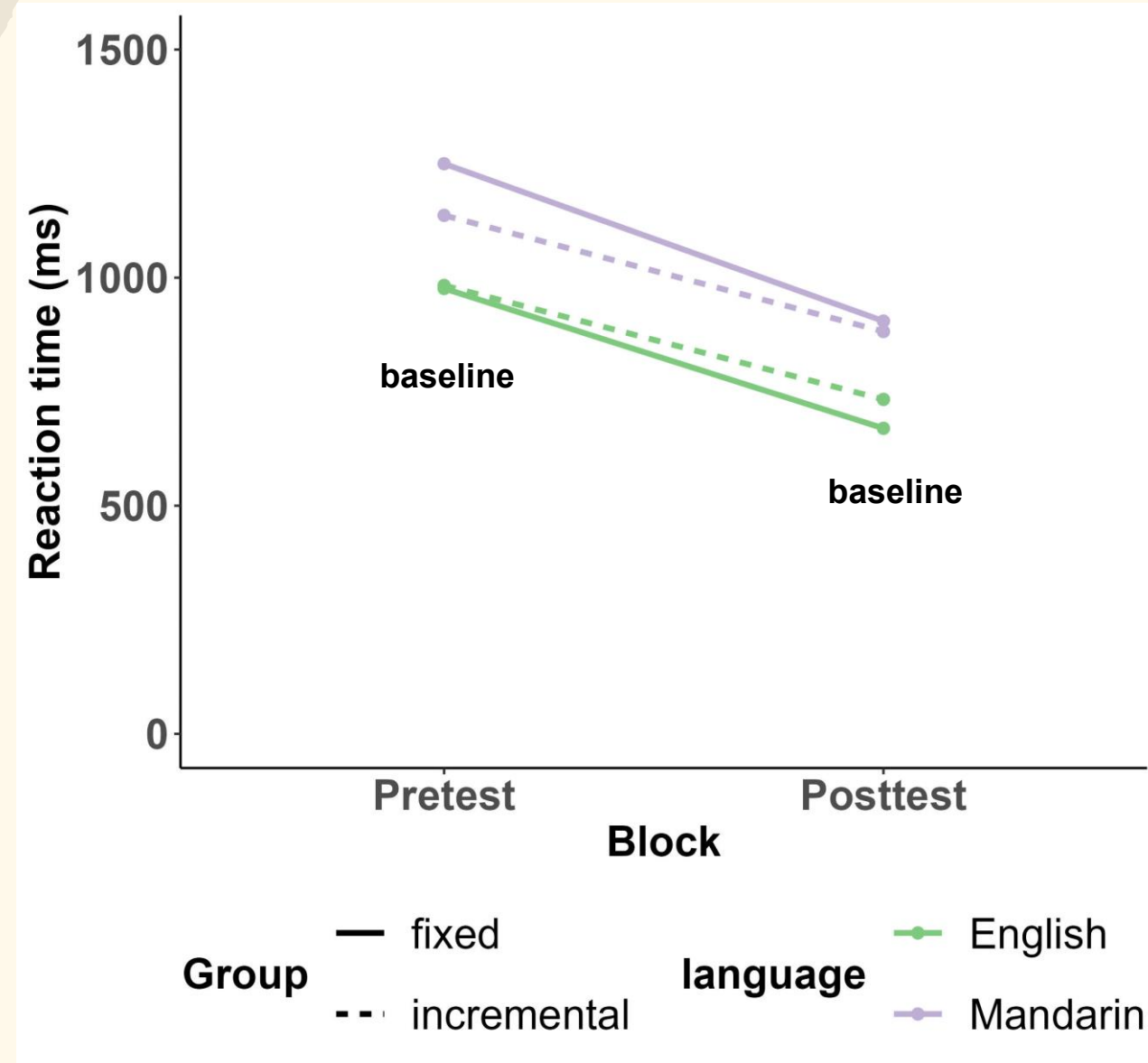
- **Block:**  $\chi^2(2) = 28.39$ ,  $p < .001$
- **Group:**  $\chi^2(1) = 6.52$ ,  $p = .01$
- **Group x Block:**  $\chi^2(2) = 26.75$ ,  $p < .001$





# RT test blocks

- **Block:**  $\chi^2(1) = 97.43$ ,  $p < .001$
- **Language:**  $\chi^2(1) = 16.40$ ,  $p < .001$



# Summary

- **Tonal experience:**
  - Mandarin L1 tonal listeners more accurate, but slower...
    - Due to small tonal dissimilarities between L1 and artificial stimuli?
- **Training effect:**
  - Exaggeration threshold for boosting effect:
    - Between 15Hz and 30Hz.
  - Again: no sustained impact of exaggerated stimuli.
    - Do we see incremental training effects over multiple sessions...?