

# Following and Opposing Responses to Perturbed Auditory Feedback

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## INTRODUCTION

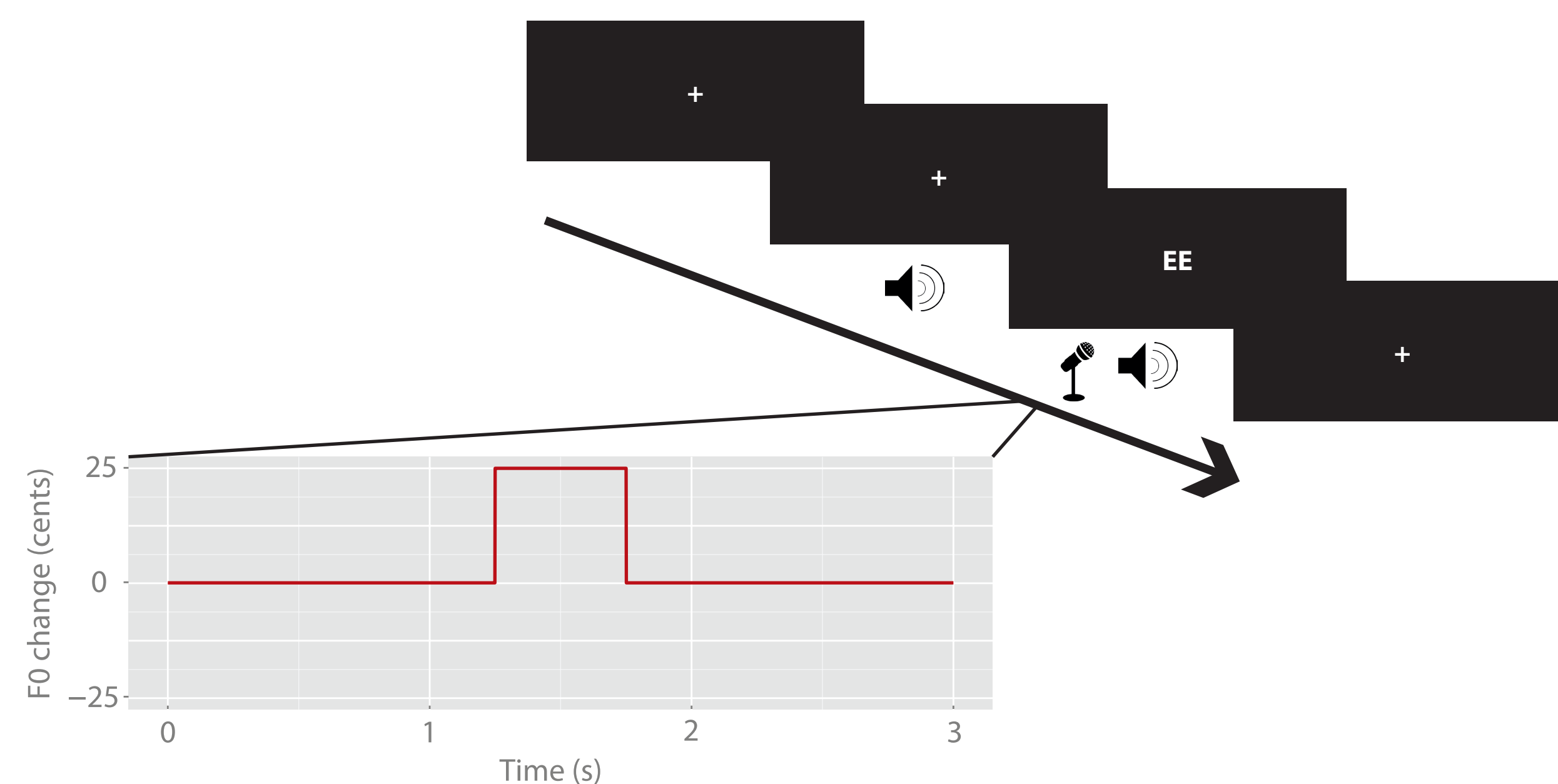
- Auditory feedback is important during speech production
- F0 shifts in auditory feedback lead to perturbation-related responses (PRR) in the speaker's produced speech [1]
- Speakers show responses that either oppose or follow the F0 shift [2,3]
- Following responses are largely unaccounted for in current models of speech production

**What factors determine whether people follow or oppose feedback perturbations?**

## DESIGN

### METHODS

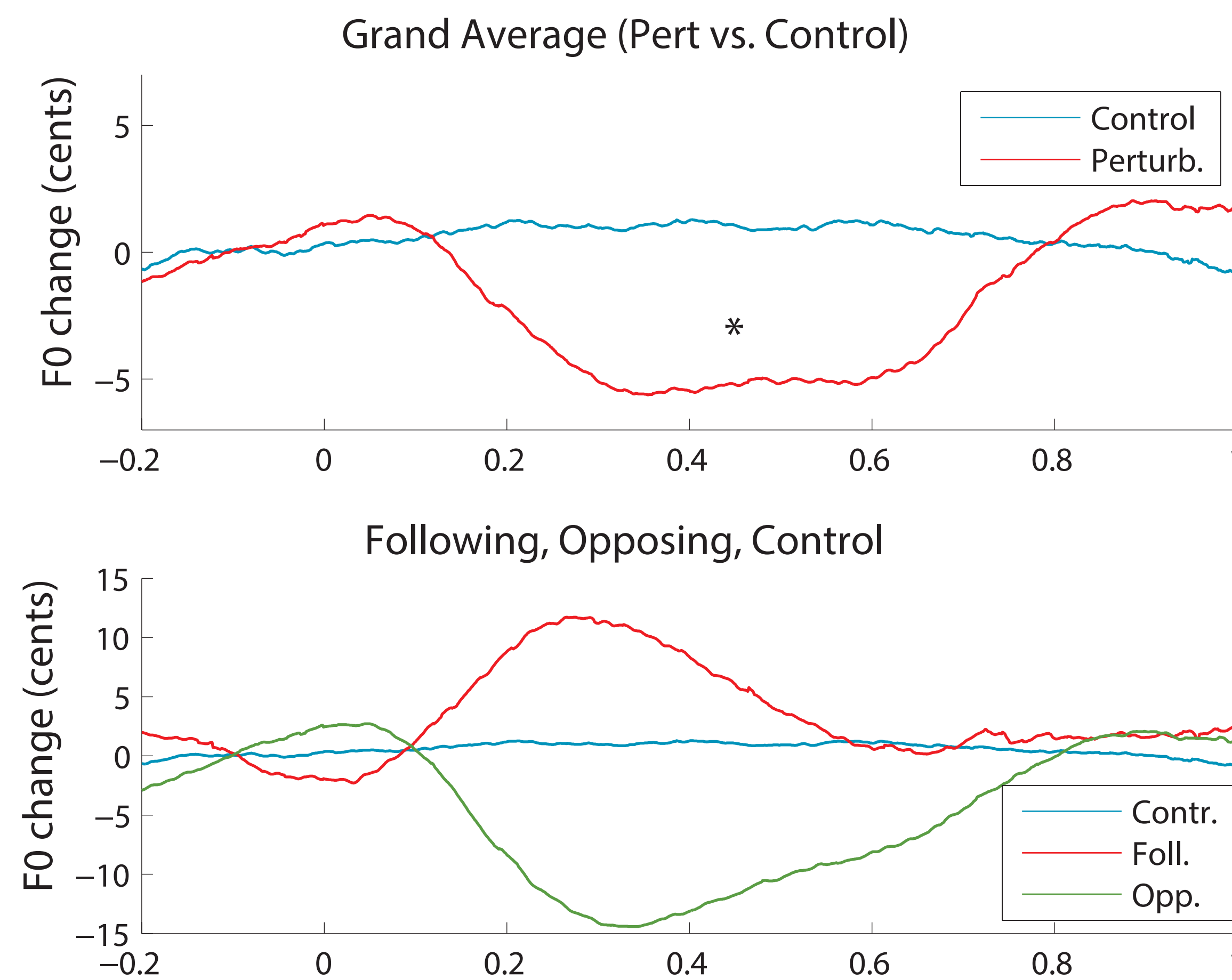
- 39 Dutch native participants (27 females, mean age = 22)
- Tone-matching task: participants vocalized (/e/) for 3s at the pitch of a short tone stimulus
- 50% trials with pitch perturbation, starting at 500-1500ms post speech onset, duration = 500ms, magnitude = + 25cents
- Pitch shift implemented with Audapter software [4]



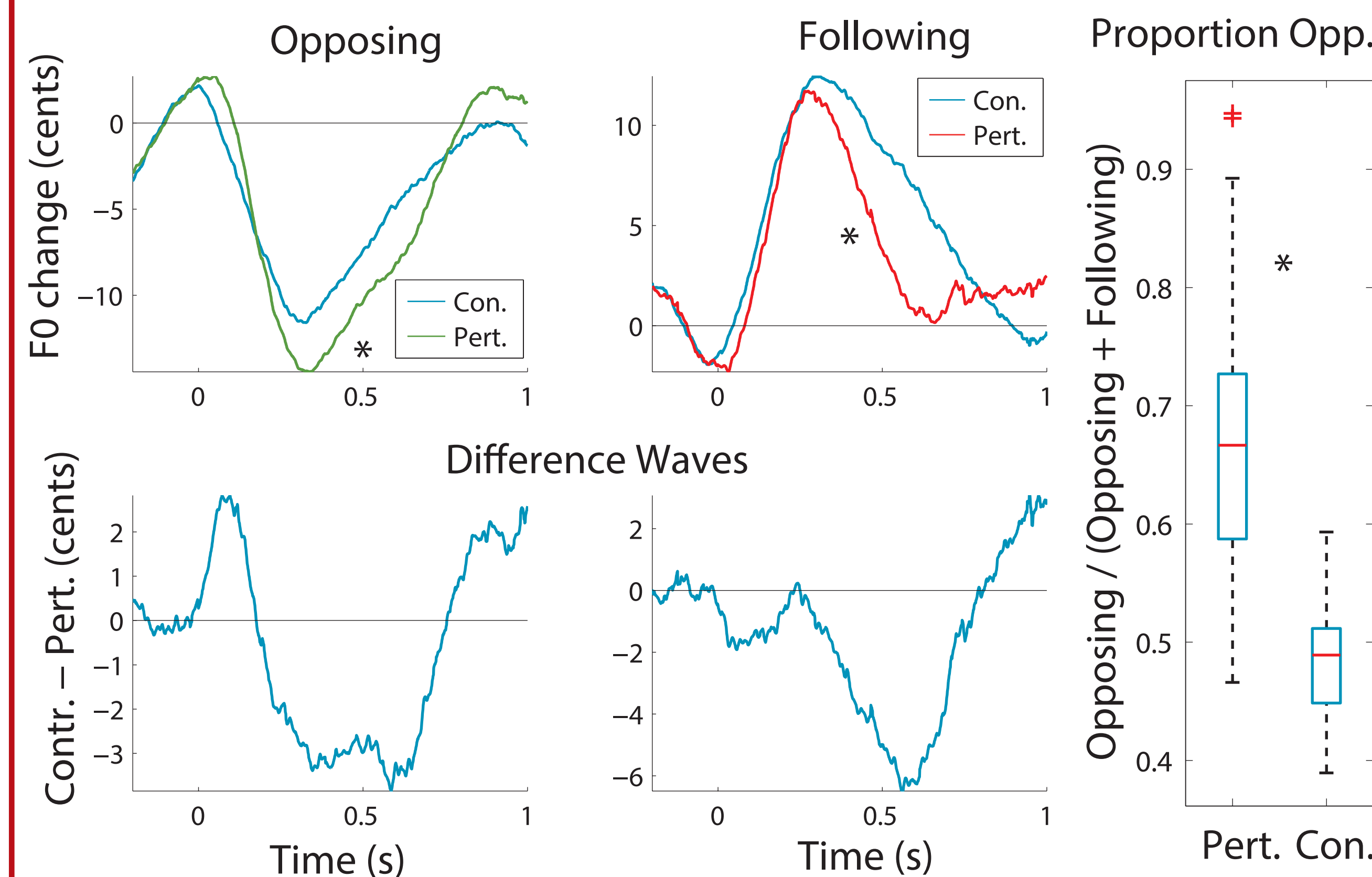
## TRIAL CLASSIFICATION

- Method 1: based on slope between 60ms and point of largest average absolute value of F0 contour
- Method 2: based on Castellan change-point test in time window [0ms 300ms].
- Visual inspection for trials where both methods gave different results
- Same method on non-perturbation trials as a control

## RESULTS

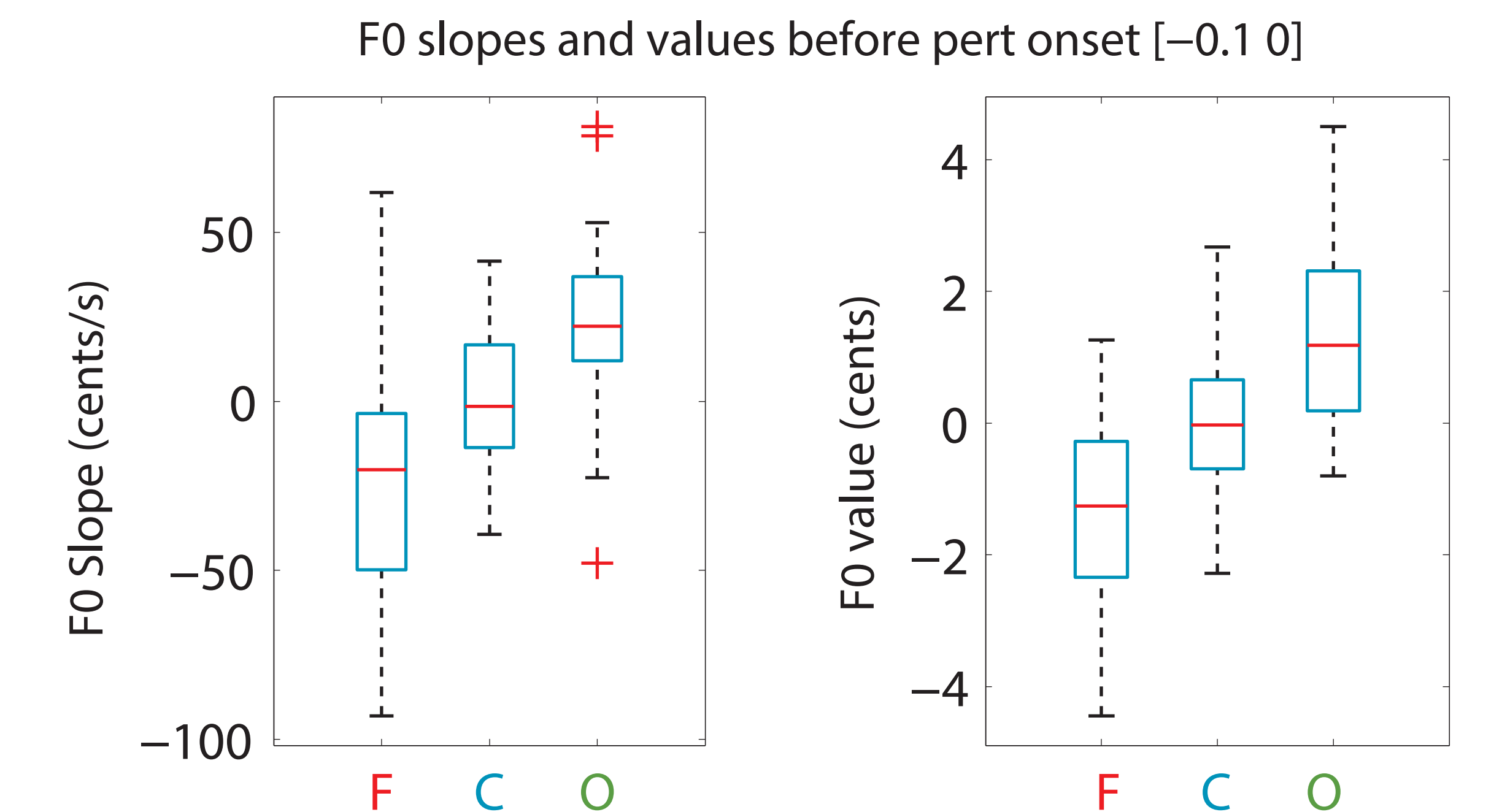


On average, participants responded to the F0 shift by opposing

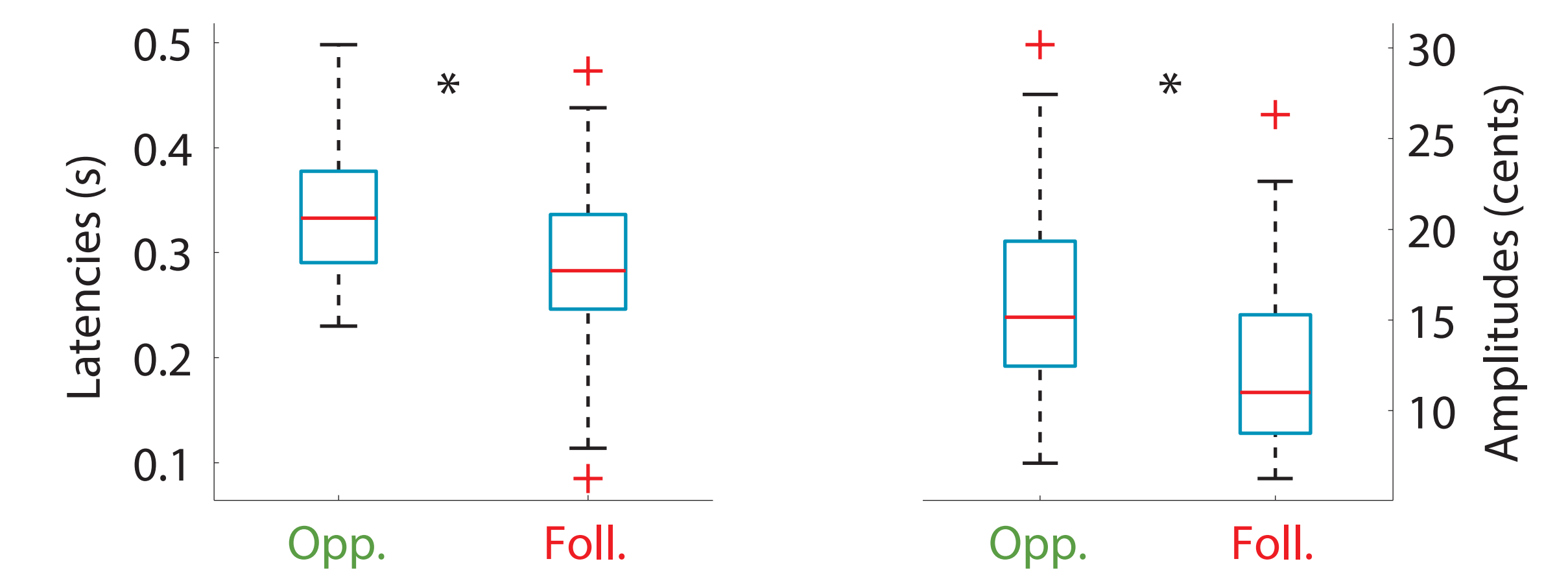


- Lower F0 compared to control trials in both "opposing" and "following" trials --> even "following" trials show opposing effect
- Higher proportion of "opposing" during perturbation trials

## RESULTS (2)



F0 slope or F0 value before pert. onset predicts response type



Following responses are smaller and peak earlier

## CONCLUSIONS

- On average, participants responded to the F0 shift by opposing
- Interaction between PRR and ongoing F0 fluctuations
  - difference between following and opposing before perturbation
  - opposing effect, even in "Following" trials
- Following responses have a smaller and earlier peak
- The choice between an opposing or following response may depend on the state of the system before perturbation onset

## REFERENCES

- [1] Burnett et al., 1998. Voice F0 responses to manipulations in pitch feedback, JASA, 103, 3153-3161.
- [2] Hain et al., 2000. Instructing subjects to make a voluntary response reveals the presence of two components to the audio-vocal reflex, Exp Brain Research, 130, 133-141.
- [3] Behroozmand et al., 2012. Opposing and following vocal responses to pitch-shifted auditory feedback: evidence for different mechanisms of voice pitch control. JASA, 132, 2468-77.
- [4] Cai et al., 2008. A system for online dynamic perturbation of formant frequencies and results from perturbation of the Mandarin triphthong /iau/. Proc. 8th ISSP, 65-68.