

## 1. Background

Acoustic features of vowel phonemes are valuable for both human speaker identification and forensic voice analysis (Remez et al.1997). Possible effects of speech mode change (i.e. from neutral to loud speech) on vowel acoustic have been studied, but comprehensive analysis of a language's whole monophthong inventory is missing. Most studies in forensic acoustics only deal with few phonemes (e.g. Elliot, 2000). **Soft and Loud modes are elicited in speakers in no-noise conditions.**

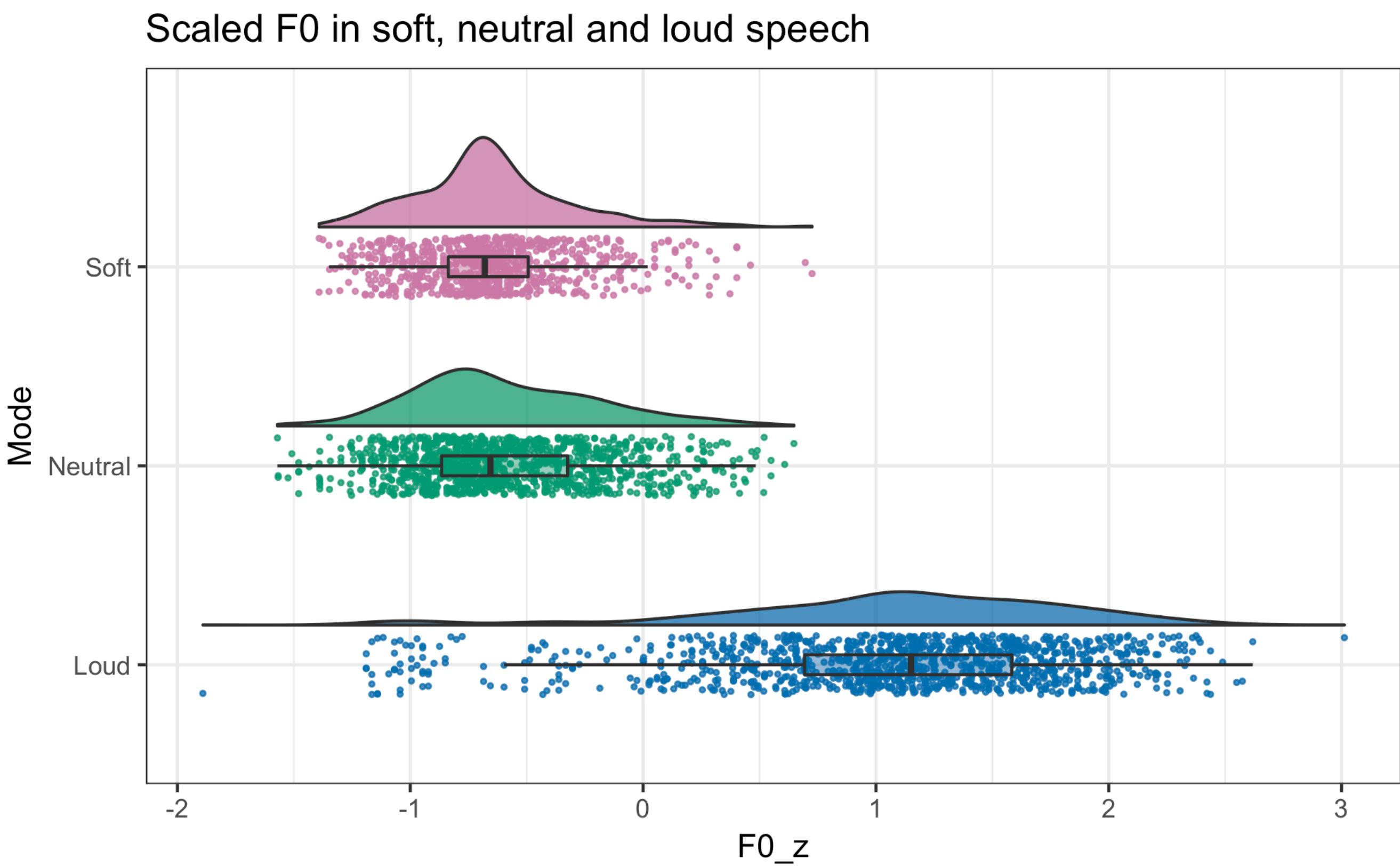
**Research questions:** Do we see acoustic differences for the parameters analysed during production in different 'speech modes' including soft, neutral and loud speech? If so, what are the extent and the directions of these changes?

**Hypotheses:** Change can be found in the acoustic parameters analysed among the three speech modes of the experiment. General patterns can be found throughout the whole vowel monophthong inventory for measures such as F0 (and its SD), F1, F2 and vowel duration

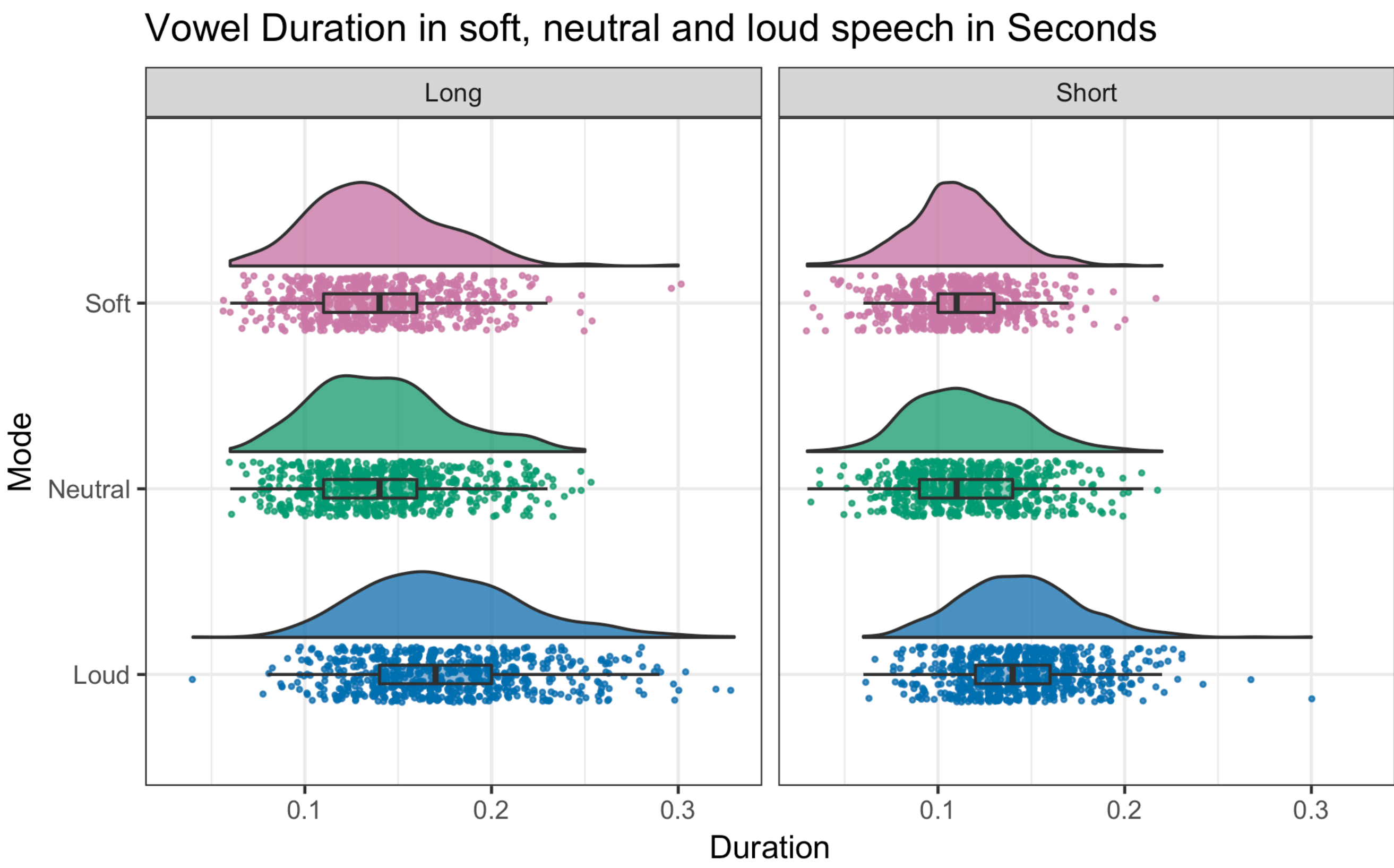
## 2. Methods

8 speakers with L1 Italian (5 males) read a word list of 168 items and a sentence list in each of the three speech modes. The words were recorded with a Zoom H6 microphone and subsequently labelled in Praat for the extraction of acoustic data.

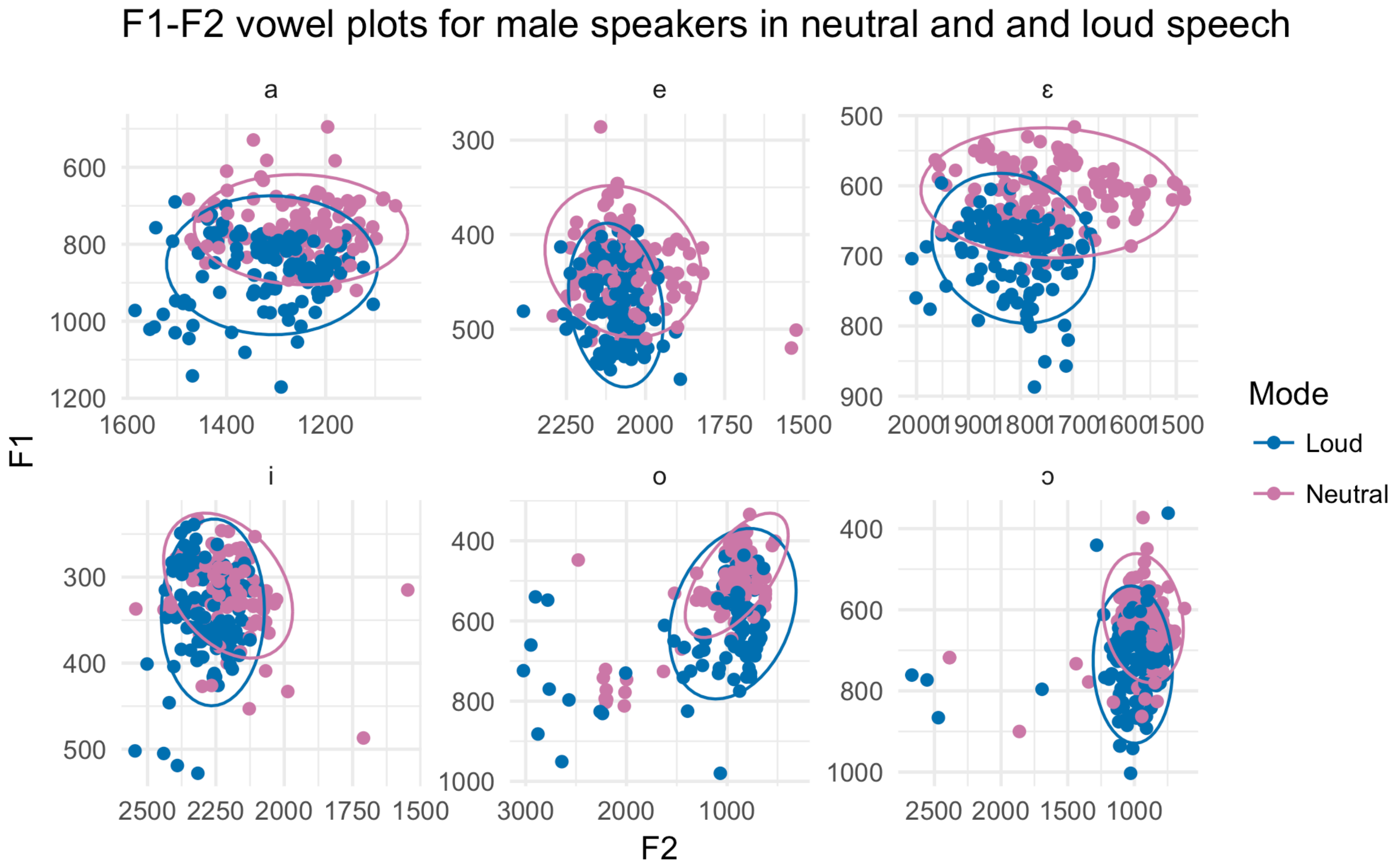
## 3. Results



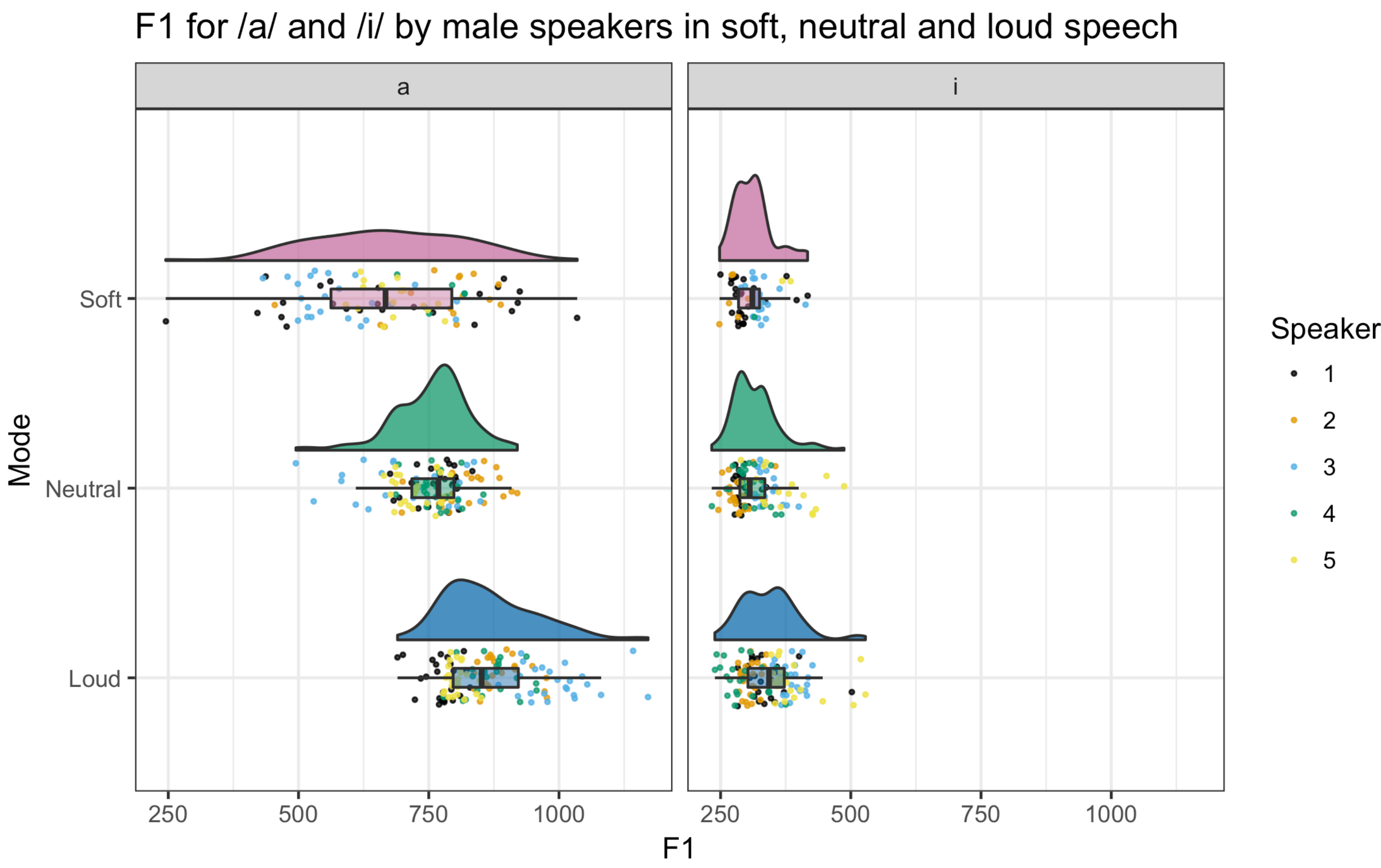
F0 **increases significantly between neutral and loud speech** by 20 Hz (**Imer test**; Kuznetsova et al. 2015:  $t(7) = 7.53$ ,  $p < 0.001$ ) and so does its standard deviation from soft to loud speech.



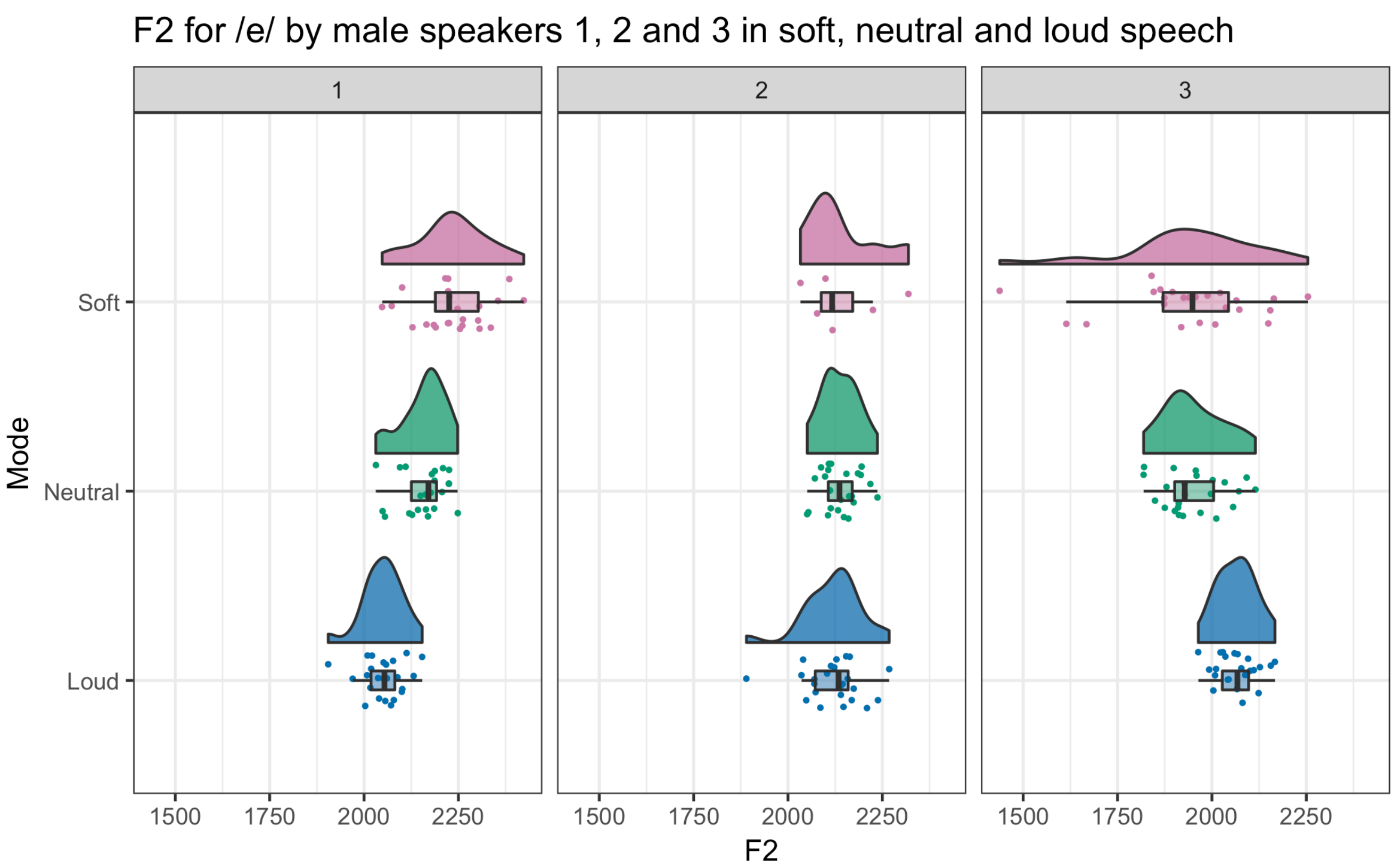
Vowel duration was also found to increase between neutral and loud speech ( $t(7) = 8.41$ ,  $p < 0.0001$ ). Phonological vowel length, which is labelled as **long** and **short** in the plot above, does not play a significant role in the increase of duration in loud speech.



F1 is found to increase significantly from soft to neutral and from neutral to loud. However, the effect is different depending on the vowel. The plot below shows the differences between two vowels: /a/ and /i/. While the values for /i/ are less spread out for all speakers, the increase is smaller than that of /a/. where the values for all speakers are less concentrated.



While F2 is also found to change significantly between soft and neutral and neutral and loud speech modes, the direction of the change is up to single vowels and speaker, as shown in the example below.



## 4. References

Elliot, J. et al. (2000). Comparing the acoustic properties of normal and shouted speech: a study in forensic phonetics. In *Proc. SST-2000: 8th Int. Conf. Speech Sci. & Tech*, pages 154–159.

Kuznetsova, A., Brockhoff, P. B., and Christensen, R. H. B. (2015). Package: Imer test. *R package version*, 2.

Remez, R. E., Fellowes, J. M., and Rubin, P. E. (1997). Talker identification based on phonetic information. *Journal of Experimental Psychology: Human Perception and Performance*, 23(3): 651.