

# The contribution of pitch and loudness control to speech naturalness in ataxia

Caitlin Cloud, BS & Allison Hilger, PhD, CCC-SLP

Boston Speech Motor Control Symposium, June 2021

## Key Takeaways:

Speakers with ataxic dysarthria demonstrate reduced pitch and loudness control compared to age- and sex-matched control speakers. Pitch control within a structured task predicts perceived speech naturalness in both groups.

## Background

Individuals with ataxia frequently experience changes in **prosody** and **speech naturalness** that disrupt their ability to communicate effectively.<sup>1</sup> Previous work has explored acoustic correlates of perceptual speech judgments in ataxia, such as phonatory instability,<sup>2</sup> reduced  $f_0$  variability,<sup>3</sup> exaggerated  $f_0$  shifts,<sup>4</sup> and either reduced or excess variations in intensity.<sup>5</sup> There is no current evidence describing how **pitch and loudness control** specifically could be contributing to the impairment in prosody and speech naturalness.

## Research Objectives

The aim of the present study is to examine the **acoustic correlates of pitch and loudness control** and their impact on **speech prosody** in ataxic speakers as compared to neurotypical control speakers.

## Methods

27 native-English speaking adults with ataxia (AD) and 29 age- and sex-matched control speakers completed two tasks analyzed in this study. Each participant produced a 5-7 step pitch scale and counted from 1 to 5 with increasing loudness.

- **Pitch:** We measured each  $f_0$  step and converted  $f_0$  values to cents for standardization. We calculated mean, standard deviation, and coefficient of variation (CV) values for each participant and compared across groups.
- **Loudness:** We measured each intensity step in dB and calculated mean, standard deviation, and CV values for each participant and compared across groups.
- **Naturalness** ratings from a prior study were used to analyze the contributions of pitch and loudness control to speech naturalness across groups.

## Conclusions

- **Pitch control** in a structured task predicted speech naturalness in both groups.
- **Loudness control** in a structured task did not have a strong relationship with speech naturalness. Intensity steps showed a linear trend in control speakers and a logarithmic trend in AD speakers.
- **Within-group analyses** may provide further insight into the contributions of pitch and loudness control to speech naturalness given the variability in dysarthria severity across AD participants.
- Measures of pitch and loudness control in **conversational speech**, rather than **structured tasks**, may be more closely associated with speech naturalness.

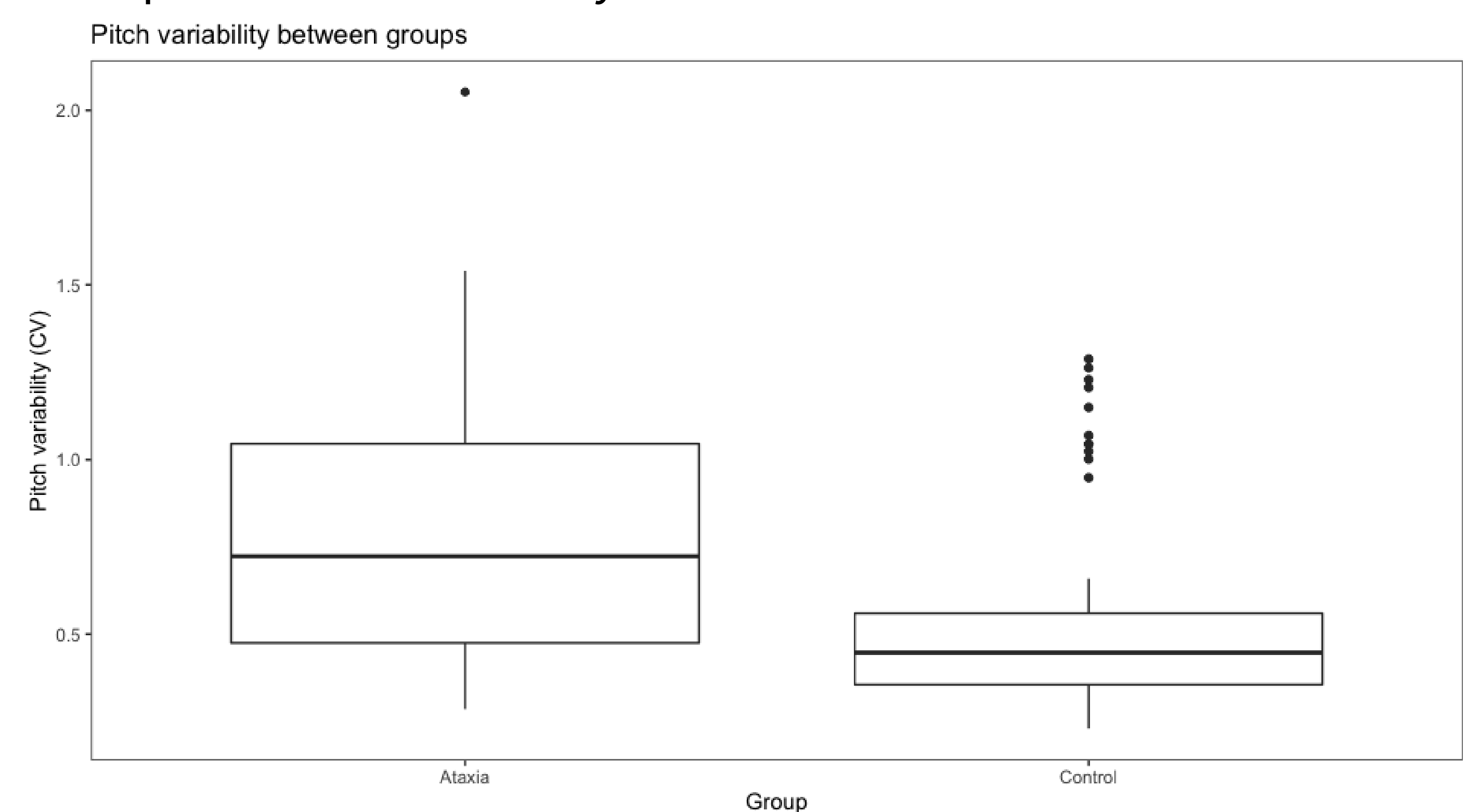
## References

1. Kent et al., 2000
2. Ackermann & Ziegler, 1994; Boutsen et al., 2011
3. Casper et al., 2007
4. Kent & Rosenbek, 1982
5. Boutsen et al., 2011; Lowit et al., 2010; Spencer & France, 2016

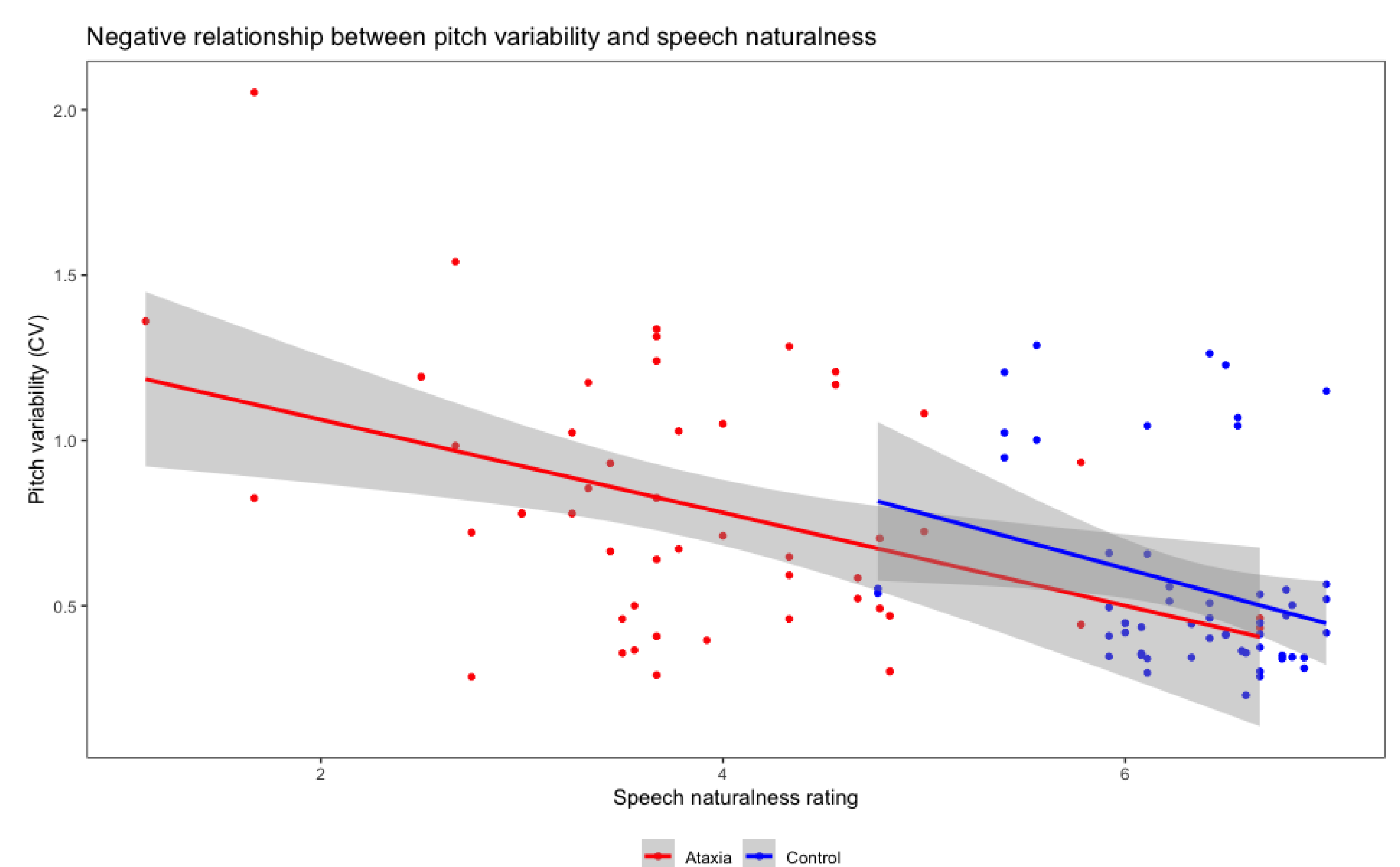
## Results

### Pitch ( $f_0$ ) Control:

(1) On average, control speakers have better pitch control than speakers with ataxic dysarthria.



(2) Reduced pitch control contributes to decreased speech naturalness in both groups.



### Loudness (Intensity) Control

On average, speakers with ataxic dysarthria had reduced loudness control compared to control speakers, with controls showing more linear steps in intensity. However, this measure was not strongly associated with speech naturalness.

#### Intensity step comparison between groups

