Individuals with cerebellar degeneration correct for within-category variation of vowels even in the absence of auditory feedback

Benjamin Parrell\textsuperscript{1}, Zarinah Agnew\textsuperscript{2}, John Houde\textsuperscript{2}, Sri Nagarajan\textsuperscript{2}, Rich Ivry\textsuperscript{3}

\textsuperscript{1}U. Delaware, \textsuperscript{2}UCSF, \textsuperscript{3}UC Berkeley
Cerebellar degeneration leads to increased response to feedback perturbations

Is this behavior relevant to unperturbed speech?
Speakers correct for small deviations from vowel targets

Niziolek et al. 2013
Speakers correct for small deviations from vowel targets

Niziolek et al. 2013
Speakers correct for small deviations from vowel targets

Niziolek et al. 2013
Speakers correct for small deviations from vowel targets

Niziolek et al. 2013
Speakers correct for small deviations from vowel targets

Niziolek et al. 2013
Speakers correct for small deviations from vowel targets

“centering”
Evaluating centering in patients with cerebellar degeneration

Do patients show increased corrective response to self-produced variability?

How is this influenced by auditory feedback?

Niziolek et al. 2015
Methods

Groups:

– Patients with cerebellar degeneration (CD, 13) vs college-aged controls (12)

Context:

– Single words vs three-word phrases

Feedback availability:

– Masking noise vs no noise

Vowels (No effect)

– /i/ vs /ɛ/
Two basic measurements

Average distance to center (variability)

Vowel duration
Patients are more variable than controls
Patients produce longer vowels than controls

Vowel duration (ms)

CD
control

clear
mask
Two derived measurements

Centering magnitude (peripheral trials)

Response latency (peripheral trials)

$L = 48 \text{ ms}$
Patients showed more centering, especially in multiword utterances
Increase in centering not only due to increased duration
Patients showed shorter latencies than controls.
Patients showed shorter latencies than controls

Short latencies suggest centering may be driven mainly by proprioceptive feedback
Noise did not effect centering magnitude or latency

Lack of masking noise effect also points to central role for proprioceptive feedback
Finding 1: increased centering in patients

Patients with cerebellar degeneration show increased centering compared to controls

This difference is exaggerated in multiword utterances

This suggests that patients do make larger feedback corrections in real speech, not only under external perturbations in the lab

Is increased response due to increase variability?
Finding 2: no effect of noise

Unexpectedly, speaking in masking noise had no effect

Previous study (Niziolek 2015) used blocked design, here noise was random

Might blocked design may have led to a shift in strategy or speaking mode?

Presence of centering in noise and short latencies suggest proprioceptive rather than auditory cause
Thanks to...

UD research assistants:
   Sam Cheng, Katrina Connor, Emma Smith

Carrie Niziolek