Motivation

- Many alternations claimed to involve articulatory effort reduction:
  - Intervocalic voicing (Kingston and Diehl 1994)
  - Intervocalic spirantization (Kirchner 2001)
  - Postnasal voicing (Hayes 2004[1999])
  - Final devoicing

- But reasoning about articulatory effort based on abstract models (Hayes 2004[1999]; Kirchner 2001) or indirect measurements

- Effort reduction very hard to observe in action

- Premise of experiment: create conditions in which subjects are likely to produce more ‘easy’ articulations and fewer ‘hard’ ones

- Method: compare intoxicated productions (expected to favor ‘easy’ articulations) with sober ones

⇒ Intoxication impairs cognitive and motor function (Chin and Pisoni 1997), produces errors such as deaffrication (Pisoni et al. 1986, 138,144) that could be interpreted as effort reduction
Experimental Design

- Stimuli: disyllabic words with initial stress
  - 72 words with a single intervocalic stop (e.g., buggy)
  - 56 words with a nasal-stop cluster (e.g., amber)
- Subjects: seven UCSC students plus one pilot subject (linguistics grad student, subject 00), all naïve to purpose of experiment; five plus pilot analyzed so far
- Each subject recorded in two conditions: intoxicated and sober
  - Two conditions on separate days (except subject 00); order varied across subjects
  - Intoxicated condition: recording made with BAC between .10 and .12
- Stimuli read in frame sentence "I SAID __ already."
- Quantities measured:
  - **Consonant Duration** for intervocalic and postnasal stops; duration of latter measured from end of vowel (separate nasal was not always identifiable)
  - **Voicing Duration** for intervocalic and postnasal stops and for [d] of said in frame sentence
  - **Burst Duration** for intervocalic stops
  - **Burst Intensity** for intervocalic stops, after running burst through a high-pass filter (1700 Hz and up) to eliminate voicing
  - **Slope of Intensity Contour** for intervocalic stops: largest slope of intensity contour between minimum in consonant and maximum in following vowel (Kingston 2008)

Results

- Each graph shows one measure, by subject
- Each point: one stimulus word
- Plotting symbol: target consonant (initial consonant for word-final voicing)
- X-axis: sober; y-axis: intoxicated (averaged over two repetitions)
- Lighter gray: outliers (removed from final models)
- Dashed lines: x = y; solid lines: regression lines from linear mixed-effects model
Figure 1: X-PATTERN: Voicing duration by subject for intervocalic stops; stars mark subjects with a slope significantly less than 1 and greater than 0 at $\alpha = .05$.

⇒ Predicts intoxicated measure from sober measure, with by-subject slopes and intercepts

- Starred subjects: slope of regression line is $<1$ and $>0$ at $\alpha = .05$
Figure 2: X-PATTERN: Voicing duration by subject for postnasal stops; stars mark subjects with a slope significantly less than 1 and greater than 0 at $\alpha = .05$.

Figure 3: X-PATTERN: Voicing duration by subject for word-final stops; stars mark subjects with a slope significantly less than 1 and greater than 0 at $\alpha = .05$. 

\[ \alpha = .05 \]
Figure 4: X-PATTERN: Burst duration by subject for intervocalic stops; stars mark subjects with a slope significantly less than 1 and greater than 0 at $\alpha = .05$

Figure 5: SHIFT: Burst intensity by subject for intervocalic stops; stars mark subjects with an intercept significantly greater than 0 at $\alpha = .05$
Figure 6: X-PATTERN: Maximum slope of intensity contour by subject for intervocalic stops; stars mark subjects with a slope significantly less than 1 and greater than 0 at $\alpha = .05$

Figure 7: SHIFT: Consonant duration by subject for intervocalic stops; stars mark subjects with an intercept significantly greater than 0 at $\alpha = .05$
Figure 8: X-PATTERN: Consonant duration by subject for postnasal stops; stars mark subjects with a slope significantly less than 1 and greater than 0 at $\alpha = .05$

Discussion

- Two basic patterns:
  - ‘Shift’: regression line (almost) entirely above or below $x = y$
  - ‘X-pattern’: regression line shallower than $x = y$, cross in middle of data

- ‘Shift’: intoxication induces change in a single direction
  - Less intense bursts
  - Longer intervocalic stops

- ‘X-pattern’: intoxication induces regression to mean
  - Voicing duration intervocally, postnasally, word-finally
    ⇒ But postnasal results may be parasitic on ‘X-pattern’ for overall postnasal consonant duration, and word-final correlations are weak
  - Burst duration
  - Maximum slope of intensity contour
Do these results look like effort reduction? Plausibly:

- ‘Shift’: favor long consonants with weak bursts
- ‘X-pattern’: compression of articulatory space

Does effort reduction look like lenition? Not exactly:

- Unidirectional patterns such as intervocalic voicing, final devoicing favor one type of production over another; corresponding ‘X-patterns’ don’t

References


