A Task Effect on Incomplete Neutralization?
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1 Introduction

(1) Since as early as SPE, a default assumption has been that only a limited subset of phonological information gets passed to the phonetics
   a. Also instantiated in Lexical Phonology’s Bracket Erasure Convention (Kiparsky 1982), and classic OT (Prince and Smolensky 1993)
(2) Some more recent claims allow significantly more information to accessed across the interface (going in both directions), or for ordering of phonological and phonetic rules to vary (Dinnsen and Charles-Luce (1984), Steriade (1997), Warner (2002), McCarthy (2009), among others)
(3) Many types of information are represented in the phonology, and can potentially be passed to the phonetics. Some candidates (some already having strong evidence):
   a. Featural
   b. Prosodic
   c. Morphological?
   d. Underlying features?
(4) Roadmap for this talk:
   a. Incomplete Neutralization
   b. Two previous pilots ((1) minimal pair reading and (2) wug task)
   c. The current study (both tasks)

1.1 Incomplete Neutralization

(5) (Complete) neutralization: A process obscures an underlying distinction
   a. /XAY/→[XCY] and /XBY/→[XCY]
(6) Incomplete neutralization: Small phonetic differences (often duration) in supposedly neutralizing contexts (Warner et al. 2004)
   a. /XAY/→[XC’Y] and /XBY/→[XC”Y]
   b. Common (putative) case: coda (or word-final) devoicing (e.g. Port and O’Dell (1985) on German, Slowiaczek and Dinnsen (1985) on Polish, Dmitrieva (2005) on Russian, and van Oostendorp (2008) on all of the above, as well as Catalan and Dutch; but see Fourakis and Iverson (1984) for an opposing view)
(7) Some studies suggest such cases may be due (at least in part) to effects of orthography (see, for example, Warner et al. 2006)

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1 There exist different particular formulations of this term. In particular, Dinnsen (1985), citing Kiparsky (1976), states: ‘A rule of the form A→B/XC_DY is neutralizing if and only if there are strings of the form CBD in the input to the rule.’
1.2 Flapping as Incomplete Neutralization

(8) Another putative case of incomplete neutralization: flapping in American English

(9) Flapping in Canadian English is often cited as an example of opacity
a. On a rule-ordering system, ‘Canadian raising’, which usually applies before voiceless segments, must apply before flapping
b. /ɹaɪt/ → [ɹəɪt] ‘write’ but also /ɹaɪt+ɪŋ/ → [ɹəɪɾɪŋ]

(10) But, a similarly complex process is reported in American, non-raising, dialects
a. Vowel duration increases preceding voiced segments (a fairly robust generalization, which holds in English before the /t/~/d/ contrast is neutralized by flapping, see Chen (1970))
   b. Possible expectation: if /d/ and /t/ neutralize to [ɾ], duration of preceding vowels should be affected identically

(11) Several studies show a distinction in pre-flap vowel duration—in these studies, vowels preceding /d/-flaps were approximately 10% longer than those preceding /t/-flaps (Fisher and Hirsh (1976), Fox and Terbeek (1977), Zue and Laferriere (1979), as reported in Dinnsen (1985))
   a. Anderson (1975) claims this as evidence for interaction or interleaving of phonetic and phonological rules
      i. Pre-consonantal vowel lengthening is phonetic, since it varies so much based on the particular consonant
      ii. Flapping is phonological since it manipulates features that are underlingly contrastive, and neutralizes a phonological opposition
      iii. In a rule-ordering system, the phonological flapping rule has to follow the phonetic vowel lengthening in order to get lengthening only before underlingly voiced segments

(12) Some claim that (at least in some dialects) flapping is completely neutralizing (Joos (1942), which is based solely on impressionistic phonetic judgments, Port (1976), Huff (1980))

2 Two Previous Pilots: A Task Effect?

2.1 Pilot 1: Minimal Pair Reading

(13) One speaker performed a minimal pair reading task
(14) The speaker was presented visually with minimal pairs like ‘seeder’ and ‘seater’, and was asked to read each in a frame sentence
(15) 14 tokens, 7 with underlying /d/, 7 with underlying /t/
(16) Vowels preceding /d/-flaps were longer than vowels preceding /t/-flaps (mean difference: 32.8ms; compare to mean difference of vowels before non-flapped [d]/[t]: 108.4ms)
(17) This difference was significant (t-test: p < 0.01)
2.2 Pilot 2: Wug Test

One speaker performed a Wug-style task

The speaker was presented with nonce-words put into a frame sentence that unambiguously identified them as verbs

The speaker was then asked to read a sentence with a blank in it, and to fill in the ‘-er’ form of the verb

a. John learned how to  

b. John was a  

38 tokens (half underlying /d/, half underlying /t/), with 20 distractors

Trend toward longer vowels before /d/-flaps than /t/-flaps, but not significant (mean difference: 4.6ms, t-test: p=0.383)

2.3 Motivations for the current study

One interpretation of these pilot results: there is a task effect

The results in Pilot 1 may come from orthographic influence, hyperarticulation

The trend towards incomplete neutralization in Pilot 2 was not significant—an effect of (extremely) small number of speakers, task, or speaker variation?

3 The Current Experiment

Goals:

a. Look for signs of incomplete neutralization in American English flapping

b. Determine whether there is an effect of minimal pair reading vs. wug task

i. In minimal pair reading tasks, participants read the form—allowing potential orthographic influence

ii. In a paradigm completion/wug task, participants fill in the form by completing a paradigm, rather than reading the form

iii. Potential effect: less hyperarticulation in wug task due to distraction; more hyperarticulation in minimal pair task due to reading

3.1 Materials and Procedure

Two tasks (order of tasks randomized per speaker), separated by a short set of arithmetic problems

Speakers were all native-speaker Rutgers undergraduates; all born and raised in NJ

a. Currently, n=4
3.1.1 Task 1: Paradigm Completion Task (Wug Test)

(29) 30 nonce words—half with word-final /d/, half with word-final /t/
   a. All bisyllabic; one-third with low vowel, one-third with mid vowel, one-third with high vowel

(30) Each nonce word was put into a frame sentence that identified it as a verb:
   a. John learned how to unteed this week

(31) Speakers were shown a sentence with a blank, eliciting the progressive form of the
    nonce verb, which puts the /d/ or /t/ in a flapping environment:
    a. In fact, he was _______ this whole week
    b. After several initial practice examples, all speakers filled in the desired form:
    c. In fact, he was unteeding this whole week

(32) Repeated for all 30 stimuli, randomized, with 20 distractors

(33) Two repetitions of each token

3.1.2 Task 2: Minimal Pair Reading Task

(34) 30 nonce words—half with word-final /d/, half with word-final /t/
   a. Same type as in task 1, except with ‘-ing’
   b. Unlike in task 1, each /d/-word formed a minimal pair with one of the /t/-words
      • E.g. unketting and unkedding

(35) Each nonce word was put into a frame sentence

(36) Speakers were shown two stimuli at a time—one with a /d/ and one with a /t/ (which
    stimulus came first in a given pair was randomized)

(37) Repeated for all 30 stimuli, randomized, with 30 distractors

(38) Two repetitions of each token

4 Results

(39) Recordings performed in the sound attenuated booth in the Rutgers Phonetics and
    Field Research Laboratory; recorded at 44.1 kHz. Phonetic analysis in Praat (Boersma
    and Weenink 2009). Statistical analysis in R (R Development Core Team 2009).

(40) Where the speaker flapped in both repetitions, the second repetition was analyzed.
    When the second repetition was not flapped, the first repetition was analyzed.

   a. Omitted tokens by speaker and task

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Wug omitted</th>
<th>MinPair omitted</th>
</tr>
</thead>
<tbody>
<tr>
<td>#0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>#1</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>#2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>#3</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>
4.1 Vowel Duration

(42) Speakers 0, 1, and 2 showed slightly longer vowels before /d/-flaps than /t/-flaps in the minimal pair reading task.

(43) Speakers 0, 2, and 3 showed slightly longer vowels before /d/-flaps than /t/-flaps in the wug task.

(44) Speaker 1 showed slightly shorter vowels before /d/-flaps than /t/-flaps in the wug task.
4.2 Task Effect

To determine task effect, difference between mean duration of vowels preceding /d/-flaps and preceding /t/-flaps

a. Difference of means, since different stimuli were used in each task to avoid any priming effects—i.e. a given token in one task isn’t correlated with a given token in any other task

Speakers 0, 2, and 3 all trended toward a greater difference in the wug task, with longer pre-/d/ vowels than pre-/t/ vowels

Speaker 1 had a greater distinction in the minimal pair reading task, in which they had longer pre-/d/ vowels. In the wug task, they had longer pre-/t/ vowels
Note that for speakers 0, 1, and 2, the error bars all overlap with 0—in other words, the difference between pre-/d/-vowels and pre-/t/-vowels is not significantly different from no difference at all for these speakers on either task.

For speaker 3, the error bars for the wug task do not overlap 0—the difference between pre-/d/-vowels and pre-/t/-vowels is significant for speaker 3 on the wug task.

### 4.3 Flap Duration

/d/-flaps were overall longer than /t/-flaps.

- LMM regressing flap duration, with underlying voicing status (/t/ or /d/) and task as fixed factors, speaker and item as random factors. Effect of underlying status: $t=-2.166$

Interaction between underlying status and task is approaching significance for flap duration.

- LMM: $t=1.779$
- This can be seen in the bar graphs—the distinction in flap duration between /d/-flaps and /t/-flaps is larger in the minimal pair reading task than the wug task.
5 Discussion

There is a non-significant trend toward longer vowel duration before /d/-flaps than /t/-flaps across both tasks (t=-0.573)

There is a significant effect of task on vowel duration (t=2.303)

a. Vowels were longer in the wug task than the minimal pair task

b. We expect an effect in the opposite direction:
   i. Minimal pair reading tasks may be more prone to hyperarticulation
   ii. In the wug task, each token was preceded by a sentence introducing the un-inflected nonce word, which the subjects read aloud. In the minimal pair reading task, the stimuli were not preceded by such sentences. This is odd, as we expect shorter durations towards the end of a longer utterance

The difference between duration of vowels before /d/-flaps and before /t/-flaps does not vary significantly by task:

a. If this stays true as $n$ increases, it would suggest the degree of neutralization does not vary based on task, even though vowel duration does

/d/-flaps were significantly longer than /t/-flaps

a. If this remains significant as $n$ increases, we have a puzzle: we expect voiced segments to be shorter than their voiceless counterparts (at least in English)

b. One might propose that the vowel lengthening effects (such as they exist) are conditioned by a distinction in the flaps

The interaction between underlying status and task on flap duration is trending towards significance

a. A possible task effect on flap duration, rather than the predicted vowel duration

6 Conclusion and Future Plans

Task does seem to have a significant effect, but on overall vowel duration rather than the difference between vowels before /d/-flaps vs. before /t/-flaps as has been reported

The effect of underlying status on vowel duration trends in the reported direction (longer vowels before /d/-flaps than before /t/-flaps), but is not significant

a. If this trend becomes significant as $n$ increases, it would suggest incomplete neutralization of the type originally expected

With the current data set, there is a significant indication of incomplete neutralization in flap duration—but in an unexpected direction

Plan to run more speakers in the coming weeks

Investigation of other properties of the flap may be useful—perhaps incomplete neutralization in this context lives on in, e.g., spectral variation

A forced-choice perception task, along the lines of Slowiaczek and Szymanska (1989) (on Polish devoicing) and Port and O’Dell (1985) (on German devoicing), would show whether speakers can recover underlying voicing status
(67) If there is indeed incomplete neutralization in this case, what information does the phonetic module need to access in order to produce it?

References


