The Intervocalic Palatal Glide in Cognitive Phonetics

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This study addresses a puzzle in Croatian regarding the fate of the underlying palatal glide in intervocalic position. Approaching the puzzle from the perspective of Cognitive Phonetics (CP),[1] we advance two claims: First, output phonological representations consisting of features are not directly interpretable by the articulatory system; rather, the interface between the phonology and the articulatory system is mediated by a universal transduction system. Second, the main units of speech production are transduced phonological features, and not segments,[2] syllables,[3] or articulatory gestures.[4]

It is traditionally claimed that in Croatian a palatal glide is inserted into a surface representation between two vowels of which at least one is front: e.g., /ʋidio/ → /ʋidijo/ 'he saw', /gleda ix/ → [gledajix] 'he looks at them'.[5], [6] Implicit in this description is the claim that the (supposedly) epenthesized glide receives the same phonetic interpretation as an underlying glide in the same context, i.e., that the SRs in (1) and (2), derived from different URs, are realized without significant differences.[5]

(1) /gleda ix/ → [gledajix] 'he looks at them'
(2) /gledaj ix/ → [gledajix] 'look at them'

A more recent acoustic study, however, disconfirmed both of these claims.[7] It showed that in the realization of both (1) and (2) there are no typical acoustic correlates of intervocalic palatal glides (i.e., a segment with lower F1 and higher F2 than adjacent vowels, and a decreased intensity between F1 and F2). Also, the study showed that in words with underlying /j/, such as (2), the vowel preceding the palatal glide had its own F1 significantly lowered, suggesting that the glide exerted anticipatory coarticulatory influence on the vowel, despite the glide lacking its own typical acoustic correlates (including its own temporal window). In words with no underlying /j/, such as (1), this lowering of F1 of the preceding vowel was not present.

The unresolved question is whether any phonological alternation takes place (e.g., insertion of a glide in (1), or deletion of the glide from forms such as (2)), or are the differences in the acoustic output of (1) and (2) merely due to phonetic implementation?

In line with CP, we will argue that no phonological alternation takes place in this case and that the phenomenon is *cognitive* phonetic with concomitant articulatory consequences.

The phonological mapping in (1) is implausible because there are in fact no acoustic correlates for the realization of [j].[7] It is thus more reasonable to assume the mapping in (3) than the mapping in (1).

(3) /gleda ix/ → [gledaix] 'he looks at them'

CP's general architecture allows for explicitly accounting for the intricate interaction between *intra-* and *inter*-segmental coarticulation which arises in the realization of SRs such as the one in (2).

CP's main proposal is that the phonology-phonetics interface consists of two universal transduction algorithms. The *paradigmatic transduction algorithm*, or PTA, assigns neuromuscular activity to each feature; the *syntagmatic transduction algorithm*, or STA, distributes that activity temporally.[1] PTA and STA transduce features into data structures called $PR_{[F]}$s, where [F] stands for an individual valued feature. PTA's assignment of $PR_{[F]}$s will vary depending on how the features in a given feature bundle (i.e., a segment) are specified (e.g., $PR_{[+\text{ROUND}]}$ will be different for a segment which contains [+HIGH] than for one which contains [–HIGH]), and can therefore lead to *intra*segmental coarticulation. STA's temporal shifting/extending of $PR_{[F]}$s across the boundaries of their original bundles leads to *inter*segmental coarticulation. The realization of [gledajix] (and of other comparable SRs) entails both types of coarticulation simultaneously.

A partial featural specification for the relevant string of segments from (2) is provided in (4). PTA transduces each feature into a corresponding $PR_{[F]}$, as shown in (5). Note that the palatal glide and the front high vowel share all but one $PR_{[F]}$, namely $PR_{[-SYLLABIC]}$. Arguably, a possible articulatory correlate of [–Syllabic] is a narrowing in the oral constriction which leads to lower sonority and thus to a lesser propensity to be included in the syllabic nucleus. Since [j]'s primary constriction is in the palatal region, that segment's $PR_{[-SYL]}$ leads to a more significant palatal constriction compared to that of the high front vowel. In other words, PTA transduces [j]'s [+High] differently than [i]'s [+High] because these two segments have different specifications for [Syl]. PTA thus leads to *intra*segmental coarticulation, as indicated by the vertical purple connection in (5). STA then temporally shifts [j]'s $PR_{[+HIGH]}$ in the anticipatory direction (from 'right' to 'left'), where it influences [a]'s $PR_{[-HIGH]}$. This is a case of anticipatory *inter*segmental coarticulation, as indicated by the horizontal purple connection in (5). A well-known result of this tongue dorsum raising is the lowering of F1,[8] just as the acoustic study[7] showed.

(4)

	a	j	i
Syllabic	+	–	+
Sonorant	+	+	+
Consonantal	–	–	–
High	–	+	+
Low	+	–	–
…			

TRANSDUCTION →

(5)

a	j	i
$PR_{[+SYL]}$	**$PR_{[-SYL]}$**	$PR_{[+SYL]}$
$PR_{[+SON]}$	$PR_{[+SON]}$	$PR_{[+SON]}$
$PR_{[-CONS]}$	$PR_{[-CONS]}$	$PR_{[-CONS]}$
$PR_{[-HIGH]}$	**$PR_{[+HIGH]}$**	$PR_{[+HIGH]}$
$PR_{[+LOW]}$	$PR_{[-LOW]}$	$PR_{[-LOW]}$
…		

PTA (connecting j's $PR_{[-SYL]}$ and $PR_{[+HIGH]}$); STA (connecting a's $PR_{[-HIGH]}$ and j's $PR_{[+HIGH]}$)

Two conclusions can be drawn from this analysis. First, what enters the articulatory system is *not* the output of phonology (e.g., the SR [gledajix]); if it were, we would expect to find at least some independent glide-like acoustic properties between the vowels, but there are none. Therefore, features alone cannot account for the phonology-phonetics interface, and a cognitive phonetic stage, distinct from both phonology and articulatory phonetics, is needed for transduction of features and for planning anticipatory coarticulation.

Second, since phonological features are the input to CP, PTA and STA produce a data structure of a finer lever of granularity than segments, syllables, or articulatory gestures. Such a data structure ($PR_{[F]}$) is necessary for explicitly capturing the intricate interaction between intra- and inter-segmental coarticulation analyzed in (5), as well as numerous other comparable interactions. This suggests that it is worthwhile to entertain the hypothesis that transduced features ($PR_{[F]}$s) are the basic units of speech production.

References

[1] Volenec, Veno & Charles Reiss. 2018. Cognitive Phonetics: The Transduction of Distinctive Features at the Phonology-Phonetics Interface. *Biolinguistics* 11.

[2] Hickok, Gregory. 2014. The architecture of speech production and the role of the phoneme in speech processing. *Language and Cognitive Processes* 29/1: 2–20.

[3] Levelt, Willem J. M., Ardi Roelofs & Antje S. Meyer. 1999. A theory of lexical access in speech production. *Behavioral and Brain Sciences* 22/1: 1–38.

[4] Browman, Catherine & Louis Goldstein. 1989. Articulatory gestures as phonological units. *Phonology* 6: 201–252.

[5] Škarić, Ivo. 1991. Fonetika hrvatskoga književnog jezika. In Radoslav Katičić (ed.), *Povijesni pregled, glasovi i oblici hrvatskoga književnog jezika*. 61–376. Zagreb: HAZU – Nakladni zavod Globus.

[6] Marković, Ivan. 2013. *Hrvatska morfonologija*. Zagreb: Disput.

[7] Volenec, Veno. 2013. Acoustic analysis of the intervocalic J in Croatian speech. *Speech* 30/2: 117–151.

[8] Stevens, Kenneth. 1998. *Acoustic Phonetics*. Cambridge, MA: MIT Press.