Optionality and the Phonetics-Phonology Interface

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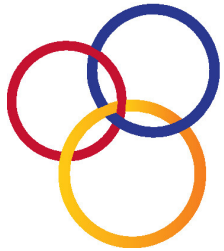

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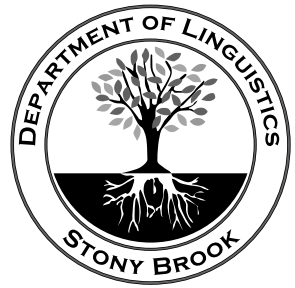
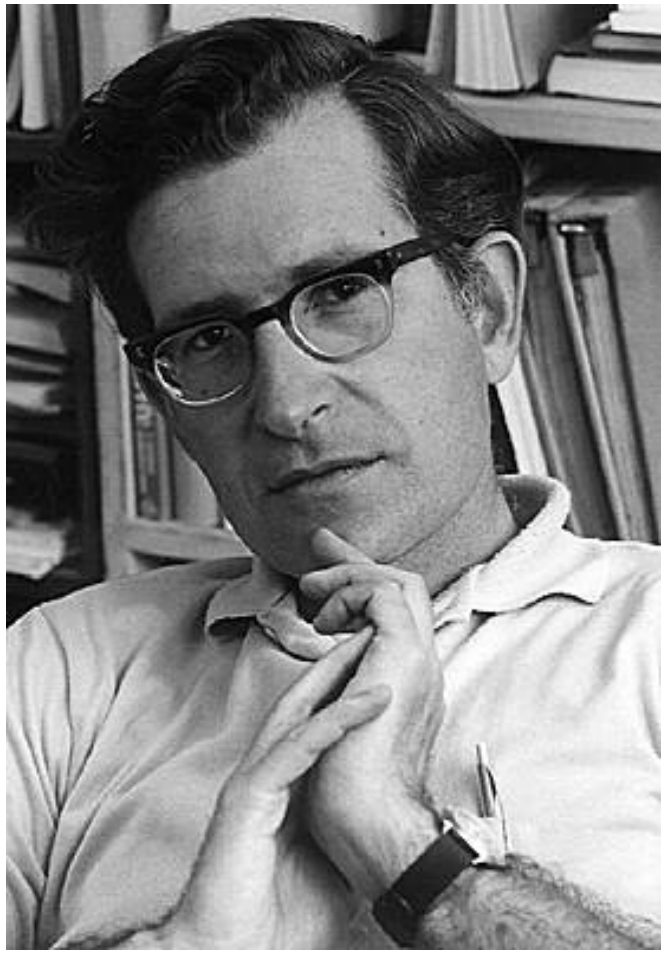


Knowledge in Generative Grammar

…it is perhaps worth while to reiterate that a generative grammar is not a model for a speaker or a hearer. It attempts to characterize in the most neutral possible terms the knowledge of the language that provides the basis for actual use of language by a speaker-hearer.



Chomsky (1965)

Phonological Knowledge

- Phonological Knowledge
  - Representations
  - Rules/Constraints

- The primary goal of phonological theory is to characterize the nature of phonological knowledge.

- But our characterizations are always going to be dependent on our theories of the phonetic implementation of phonological structure!

Optionality as the Application of Phonological Knowledge

- If phonological knowledge is simply the basis for actual language use, then it may be possible to neglect that knowledge.
- Optionality could then be thought of as the choice to use phonological knowledge during phonetic implementation.
- This would allow for an account of optionality without probabilities/weights or diacritics being part of the phonological grammar.

Focus of Today's Talk

Optionality

- Optional application of phonological knowledge can be a property of phonetic implementation and not a property of the phonological grammar.
- I provide a sketch of how this might be implemented and what other working assumptions it requires.

Optionality

Phonological Optionality

- Optionality $\approx$ Variability
- Phonological Optionality:

1. a single phonological input has multiple outputs.
   (free variation)

2. a phonological process applies to some, but not all, lexical items.
   (lexical variation)

Anttila (2007), Zuraw (2010)

Optionality

- Primary focus of today's talk will be free variation.
- Two dimensions of interest:
  - Global vs. Local Application
  - Process Interaction

Labial Voicing in Waoro

- Global optional processes either always occur or always don't occur.
  - [paroparera] ~ [barobarera] (00 ~ 11)
    *[parobarera] ~ *[baroparera] (01 ~ 10)
  - [apaupute] ~ [abaubute] (00 ~ 11)
    *[apaubute] ~ *[abaupute] (01 ~ 10)

Osborn (1966)

Flapping in English

- Local optional process can occur or not occur at each individual application point.
  - [mɑɹkəthəbɪləthi] (00)
  - [mɑɹkəɾəbɪləthi] (10)
  - [mɑɹkəthəbɪləɾi] (01)
  - [mɑɹkəɾəbɪləɾi] (11)

Vaux (2008)

Post-nasal Voiced Obstruent Deletion in Mwera

- An optional process can interact with other processes.
- Nasals assimilate in place to following obstruent.
- Voiced obstruents after nasals optionally delete.
  - /N + dʒutʃi/ → [ɲndʒutʃi] ~ [ɲutʃi]
  - /N + gomo/ → [ŋgomo] ~ [ŋomo]

Harries (1950)

The Phonetics-Phonology Interface

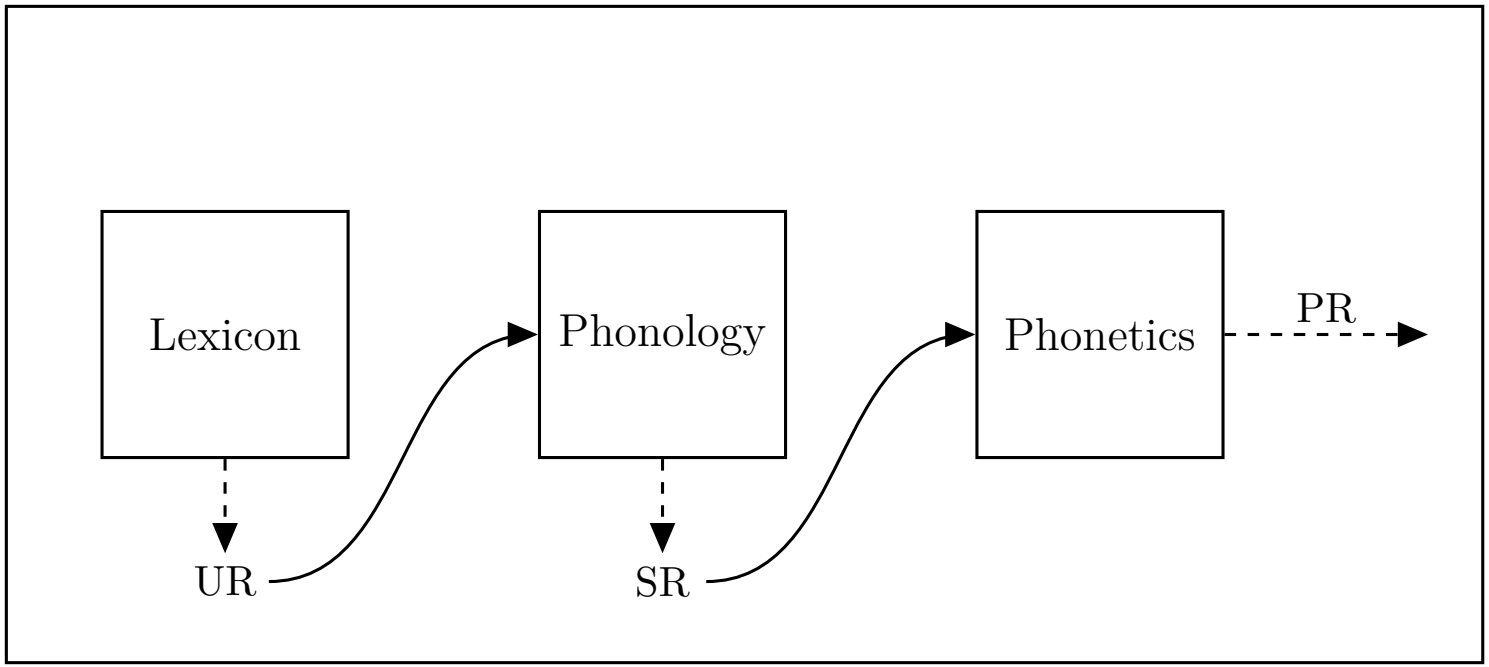
A Common View of the Phonetics-Phonology Interface

- First all of the morphophonological alternations and allophony occur; then the final form is turned into something physical (gestures, acoustic targets).

- This view of the production process in generative linguistics is often referred to as the modular feed-forward model.

Pierrehumbert (2002); Bermúdez-Otero (2007); Kenstowicz (2010)

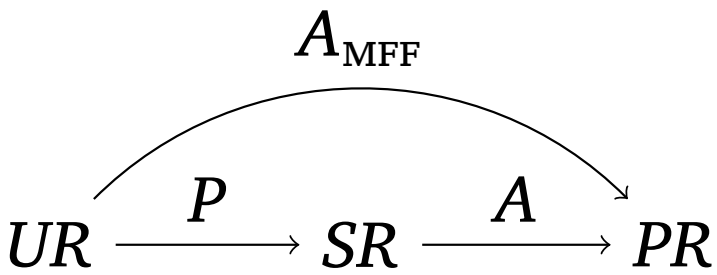
Modular Feed-Forward Model



Pierrehumbert (2002); Bermúdez-Otero (2007); Kenstowicz (2010)

Modular Feed-Forward Model Redux

- Since phonology has the type $P :: UR \rightarrow SR$ and phonetics has the type $A :: SR \rightarrow PR$, the Modular Feed-Forward Model is a composed function $A_{\text{MFF}} :: UR \rightarrow PR$.
  - $A_{\text{MFF}}(P(UR)) = PR$



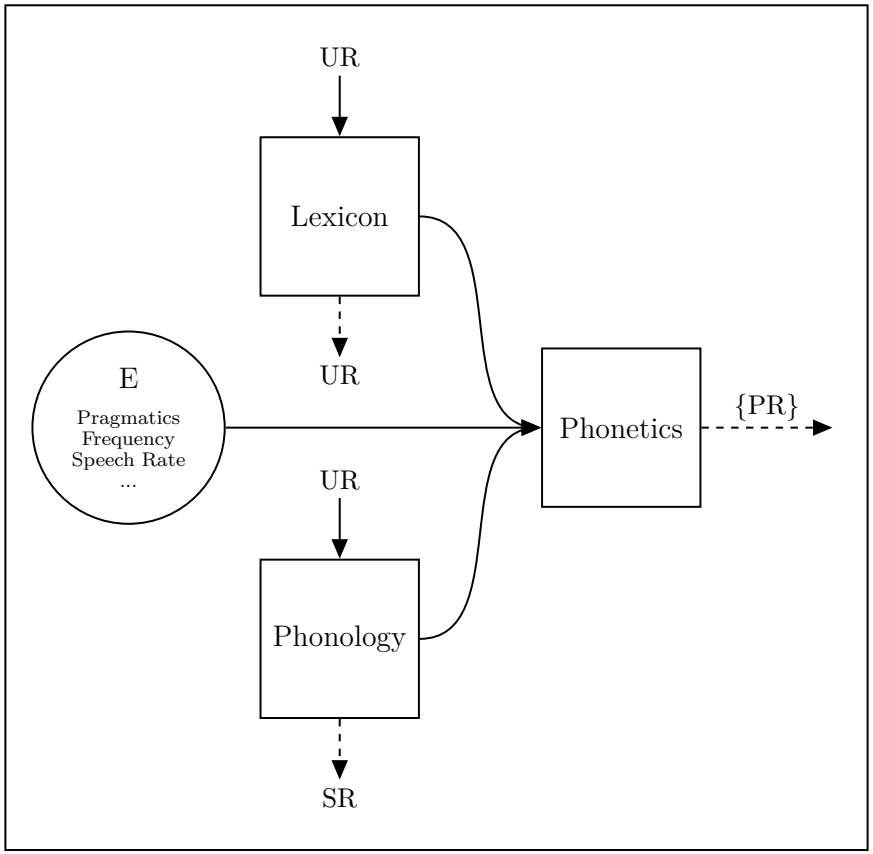
A New View of the Phonetics-Phonology Interface

- The phonetic implementation module takes multiple simultaneous factors, including the entire phonological grammar, and computes the phonetic form based on the interaction of all these factors.

- This view of the production process is the blueprint model of production.

Nelson and Heinz (2022), Nelson and Heinz (submitted)

The Blueprint Model of Production



Nelson and Heinz (2022), Nelson and Heinz (submitted)

The Blueprint Model of Production

- The phonetics function in the Blueprint Model of Production has type $A_{\text{BP}} :: L \rightarrow P \rightarrow E \rightarrow \{PR\}$.
  - "The phonetics function is a higher-order function that takes the lexicon, phonology, and extra-grammatical information and maps them to a set of phonetic representations."

- Structuring the phonetics function in this way allows the production process access to both the underlying and surface form of a given lexical item and makes it clear that extra-grammatical factors influence production.

Nelson and Heinz (2022), Nelson and Heinz (submitted)

Arguments Against Against Discrete Phonological Knowledge

- Based on the structure of the phonetics-phonology interface under the purview of the BMP, we show with simulations that phenomena like incomplete neutralization and variation in homophone duration can be accounted for with discrete phonological knowledge.

- Consequently, we show that the structure of the interface has ramifications for our theories of phonological knowledge and how we interpret phonetic data in relation to said theories.

Nelson and Heinz (2022), Nelson and Heinz (submitted)

Simulating Incomplete Neutralization with Discrete Phonological Knowledge

c_{UR} determined by L; c_{SR} determined by P

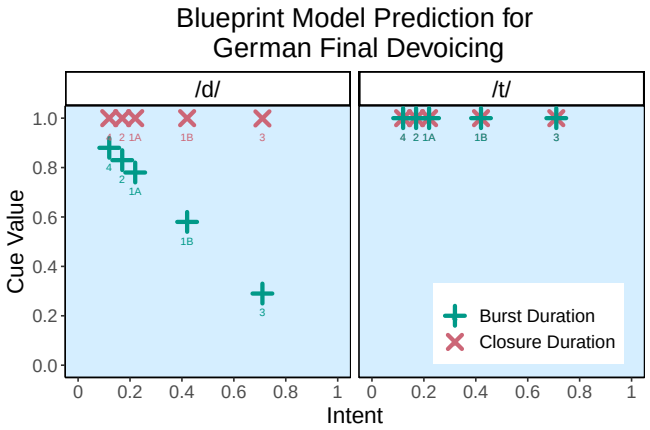
$$c = c_{UR} \times i^{\alpha} + c_{SR} \times (1 - i)^{\alpha}$$

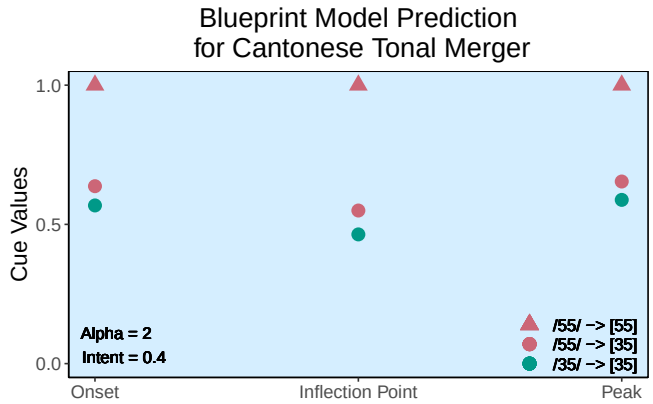
i values determined by E

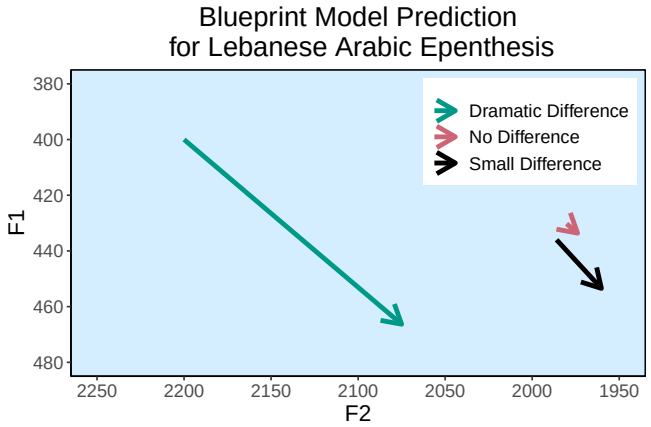
α built in to function

- Phonetic cue c is realized as the weighted average of the phonetic realization of that cue for the categorical *UR* and *SR* values.
- Extra-grammatical factors control the weighting.

Simulating Incomplete Neutralization with Discrete Phonological Knowledge







Nelson and Heinz (2022), Nelson and Heinz (submitted); Data from: Port and Crawford (1989), Yu (2007), Hall (2013)

Optionality and the BMP

Extending IN analysis to Optionality

- Optionality/variability can be thought of as a parameter $\nu \in \{0, 1\}$ that chooses whether or not to use the surface form (phonological knowledge) in the computation.

- $\nu = 1$ "don't apply phonological knowledge"
- $\nu = 0$ "apply phonological knowledge"

- $c = c_{UR} \times \max(\nu, i)^{\alpha} + c_{SR} \times (1 - \max(\nu, i))^{\alpha}$

Returning to Waoro (Global Optionality)

	Feature	c
UR	[−voice]	0
SR	[+voice]	1

- [−voice] → [+voice]
- $i = 0$; $\alpha = 1$

Returning to Waoro (Global Optionality)

	Feature	c
UR	[−voice]	0
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- [−voice] → [+voice]
- $i = 0$; $\alpha = 1$

$$c = c_{UR} \times \max(v, i)^{\alpha} + c_{SR} \times (1 - \max(v, i))^{\alpha}$$

When voicing rule is applied, $v = 0$:

$$c = 0 \times \max(0, 0)^{1} + 1 \times (1 - \max(0, 0))^{1} = 1$$

Since phonetic form $c = 1$ is equal to [+voice], we get forms:

[barobarera], [abaubute]

Returning to Waoro (Global Optionality)

	Feature	c
UR	[−voice]	0
SR	[+voice]	1

- [−voice] → [+voice]
- $i = 0$; $\alpha = 1$

$$c = c_{UR} \times \max(v, i)^{\alpha} + c_{SR} \times (1 - \max(v, i))^{\alpha}$$

When voicing is not applied , $v = 1$:

$$c = 0 \times \max(1, 0)^{1} + 1 \times (1 - \max(1, 0))^{1} = 0$$

Since phonetic form $c = 1$ is equal to [+voice], we get forms:

[paroparera], [apaupute]

Moving Beyond Global Optionality

- The account sketched in the previous slides works well for global optionality.
- But what about local optionality?

- The BMP has been presented as a static implementation model of sorts, but it need not be limited in this way!

Planning Effects on Local Optionality

- Rather than plan based on word-sized chunks (or larger), planning could occur on a morpheme by morpheme basis.
- Blending procedure would then occur over smaller windows.

- English Flapping:

Planning Chunks	Possible Outputs			
(/mɑrkətəbɪləti/), ()	[maɹkətʰəbɪlətʰi]			[maɹkəɾəbɪləɾi]
(/mɑrket/ + /əbɪl/), (əti)	[maɹkətʰəbɪlətʰi]	[maɹkəɾəbɪlətʰi]	[maɹkətʰəbɪləɾi]	[maɹkəɾəbɪləɾi]
(/mɑrket/), (/əbɪl/ + /əti)	[maɹkətʰəbɪlətʰi]		[maɹkətʰəbɪləɾi]	
(/mɑrket/), (/əbɪl/), (/əti)	[maɹkətʰəbɪlətʰi]		[maɹkətʰəbɪləɾi]	

Planning Effects on Local Optionality

- Production planning has previously been proposed as a way to account for variability.
- Here, it is usually framed in terms of lexical access/prosodic domains.

- But lexical access alone can't account for the optional flapping facts:
  - Surrounding morphemes of /əti/ don't change the triggering environment!

Wagner (2012), Tanner et al. (2017), Kilbourn-Ceron and Goldrick (2021), Du and Durvasula (2024)

Process Interaction (Mwera)

- Recall that assimilation & optional post-nasal voiced obstruent deletion interact in Mwera.
  - UR: /N + gomo/
  - SR: [ŋgomo] ∼ [ŋomo]

- Under the account sketched so far applying the phonological knowledge would yield [ŋomo] and not applying the phonological knowledge would yield [Ngomo] (placeless nasal in SR).

- Is this so bad?

Process Interaction (Mwera)

- Phonetic co-articulation would yield something quite like [ŋgomo]!
- Is there a way to tease apart phonetic co-articulation from phonological assimilation?
  - Probably!
- This approach to the interface/optionality shines a light in new places to look.

Conclusion

Takeaways

- Making phonology an argument to phonetic implementation allows us to view it as knowledge that can be used to a greater or lesser extent.
- Side effect of this is that phonology always happens.
- The specific analysis makes use of helpful assumptions: dynamic planning over morpheme-sized chunks, phonetic co-articulation. These also make further predictions.
- Are there limitations to only using UR and SR?

Thank You!

A "model" is a set of initial conditions (possibly together with some of the observational theories) which one knows is bound to be replaced during the further development of the programme, and one even knows, more or less, how.

Lakatos (1970)

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