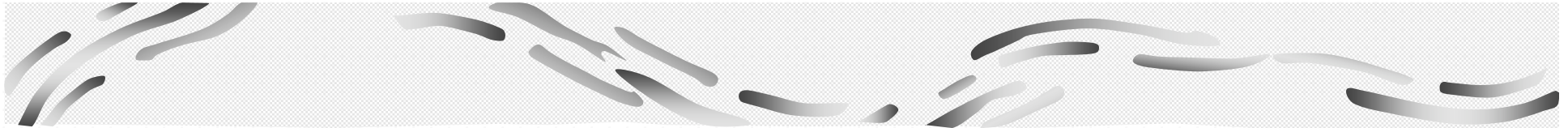


Featural enhancement with probabilistic faithfulness constraints



Paul Boersma & Silke Hamann
University of Amsterdam & ZAS Berlin
paul.boersma@uva.nl, silke@zas.gwz-berlin.de
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Constraint types in Optimality Theory

- 1. Faithfulness constraints:

FAITH e.g. IDENT(voice)

- 2. Constraints against difficult outputs:

*STRUC e.g. NOCODA, *[spread glottis]

- 3. Third type:

Constraints that positively express the need for the presence of a certain phonological feature if a certain other feature has a certain value.

[+A] [+B]! “exclamation constraints”

[+back] [+round]! *[+back, -round]

Types of faithfulness constraints

*|X|_U ≠ Y

- ☛ Speaker-based faithfulness (McCarthy & Prince 1995):
“An element X in the underlying form should not be pronounced as Y on the surface.”
- ☛ Listener-oriented faithfulness (Boersma 1998):
“An element X in the underlying form should not be pronounced as something that will be perceived as Y by the listener.”
- ☛ Probabilistic faithfulness (Boersma 2003ab):
“An element X in the underlying form should not be pronounced as something that has a probability of p percent of being perceived as Y by the listener.”

Aim of the talk

- ☞ To show that the effects often accounted for by exclamation constraints can better be explained by (independently needed) probabilistic faithfulness constraints.
- ☞ Three cases:
 - Rounding of back vowels
 - Aspiration of voiceless plosives
 - Retroflexion of apicals

Case 1: rounding of back vowels

[i a ʊ] □ [i a u]

- ☛ ***+B/I** (Smolensky 1993:9, Kaun 1995:140):
“The feature [+back] is worse than the feature [–back] in combination with the features [–round, +high, –low].”
- ☛ **COLOR** (Kirchner 1993:5):
“A vowel is [front] or [round] iff it is [–low].”
“reflects the acoustic enhancement relation between vowel backness and rounding.”
- ☛ This is not markedness, but enhancement.

But what is enhancement?

- ☛ Enhancement is not unconditional markedness.
- ☛ Enhancement is the auditory improvement of an *existing* phonological contrast.
- ☛ COLOR (contrast-enhancing version):
“a *contrastively* [–front] vowel is [+round].”
- ☛ Why?
 - Auditorily, [–front] means [low F2].
 - Lip rounding lowers F2, therefore reduces the chance that the listener will perceive /+front/.
- ☛ This calls for probabilistic faithfulness.

Probabilistic [front] faithfulness

IDENT (front, $p\%$):

“pronounce an underlying |−front| vowel as something that will have no more than p percent chance of being perceived as /+front/.”

Example 1: underlying |+high, −front|, in the presence of a |+high, +front| vowel.

- if pronounced as [ɯ], then violates e.g. IDENT (front, 20%);
- if pronounced as [u], then violates only e.g. IDENT (front, 5%).

Backness enhancement at work


+high, –front	IDENT (front, 20%)	*[lip rounding]	IDENT (front, 5%)
[ɯ] □ /+front/ 20% /–front/ 80%	*!		*
☞ [u] □ /+front/ 5% /–front/ 95%		*	*

- ☞ Fixed ranking by confusion: higher for higher p .
- ☞ *[lip rounding] is a purely articulatory constraint.

Why contrastiveness matters (1)

Example 2: underlying |+low, –front|, in the absence of a |+low, +front| vowel.

- The candidate /+low, +front/ will never be perceived, so no enhancement is necessary:

+low, –front	IDENT (front, 20%)	*[lip rounding]	IDENT (front, 5%)
 [a] □ /+front/ 0% /–front/ 100%			
[ɒ] □ /+front/ 0% /–front/ 100%		*!	

Why contrastiveness matters (2)

- ☞ Prediction from previous slide: since the front/back contrast tends to be restricted to nonlow vowels, low vowels tend not to be enhanced by rounding, even if back.
 - This explains Kirchner's [–low] condition.
- ☞ Second prediction: in languages where high vowels do not have a front/back contrast either, they will not be enhanced by rounding.
 - So-called 'vertical' vowel systems with [i], e.g. Marshallese (Flemming 2002).

Case 2: aspiration of voiceless plosives

lp t kl □ [p^h t^h k^h]

ASPIRATE (Kirchner 1997:93, 1998:75):

“A stop is [+spread glottis] iff it is [–voice], occurring in initial position in a stressed or word-initial syllable.”

“descriptive approximation”

- The ‘initial position’ condition is meant to describe the difference between English [p^hi:k] and [spi:k].

Is this enhancement?

- ☛ Yes, because it is the auditory improvement of an *existing* voicing contrast.
- ☛ ASPIRATE (contrast-enhancing version):
“a *contrastively* [–voice] vowel is [+asp].”
- ☛ Why?
 - Auditorily, [–voice] means [few voicing periods].
 - Aspiration lowers the number of voicing periods, therefore reduces the chance that the listener will perceive /+voice/.
- ☛ This calls for probabilistic faithfulness.

Probabilistic [voice] faithfulness

IDENT (voice, $p\%$):

“pronounce an underlying |−voice| plosive as something that will have no more than p percent chance of being perceived as /+voice/.”

Example 1: underlying |+plos,−voice|, in the presence of a |+plos,+voice| segment.

- if pronounced as [p], then violates e.g. IDENT (voice, 30%);
- if pronounced as [p^h], then violates only e.g. IDENT (voice, 8%).

Voicelessness enhancement at work

pik 'peak'	IDENT (voice, 30%)	*[spread glottis]	IDENT (voice, 8%)
[pi:k] □ /bi:k/ 30% /pi:k/ 70%	*!		*
☞ [p ^h i:k] □ /bi:k/ 8% /pi:k/ 92%		*	*

- ☞ Fixed ranking by confusion: higher for higher p .
- ☞ *[spread glottis] is purely articulatory.

Why contrastiveness matters (3)

- Example 2: underlying |+plos,–voice|, in the absence of a |+plos,+voice| segment.
 - The candidate /+plos,+voice/ will never be perceived, so no enhancement is necessary:

spik 'speak'	IDENT (voice, 30%)	*[spread glottis]	IDENT (voice, 8%)
☞ [spi:k] □ /spi:k/ 100% /sbi:k/ 0%			
[sp ^h i:k] □ /spi:k/ 100% /sbi:k/ 0%		*!	

Why contrastiveness matters (4)

- ☞ Prediction from previous slide: since the English voicing contrast does not occur in onset after /s/, plosives after /s/ are not enhanced by aspiration.
 - This explains Kirchner's "initial position" condition.
- ☞ Second prediction: in languages where plosives do not have a voicing contrast at all, they will not be enhanced by aspiration.
 - This relates the Swedish [b–p^h], with its lack of a plain [p], to contrast enhancement, in contradiction to SPECIFY "Stops must be specified for a laryngeal feature." (Beckman & Ringen 2004: 108), which would predict languages with only [b] or only [p^h].

Case 3: retroflexion of apicals

$[\underset{\text{a}}{\text{t}} \text{ t}] \square [\underset{\text{a}}{\text{t}} \underset{\text{a}}{\text{t}}]$

APICAL \square RETRO(FLEX): (Flemming 2003b: 354)

Def: “*Contrastively* [apical] coronals must be [–anterior]”

“Retroflexes are preferred over apical alveolars in languages like Walmatjari because retroflexes are perceptually more distinct from laminal coronals than are apical alveolars.”

- ☛ Already explicitly formulated as a contrast-enhancing constraint, i.e. in such a way that it is powerless in languages that do not contrast apicals with laminals.
- ☛ It still calls for probabilistic faithfulness...

Probabilistic [laminal] faithfulness

IDENT (lam, $p\%$):

“pronounce an underlying $[-\text{lam}]$ plosive as something that will have no more than p percent chance of being perceived as $[\text{lam}]$.”

Example: underlying $[\text{ant}, -\text{lam}]$ (i.e. $[\text{t}]$) in the presence of $[\text{ant}, +\text{lam}]$ (i.e. $[\text{t}^h]$).

- if $[\text{t}]$ is pronounced as $[\text{t}^h]$, it has a 10% chance of being perceived as $[\text{t}^h]$ (Anderson 1997), so it violates IDENT (lam, 10%);
- if $[\text{t}]$ is pronounced as $[\text{t}]$, it has a 1% chance of being perceived as $[\text{t}^h]$ (Anderson 1997), so it violates only IDENT (lam, 1%).

Apical enhancement at work in Walmatjari

$[ut̚]$	IDENT (lam, 10%)	IDENT (anterior, 99%)	IDENT (lam, 1%)
☞ $[ut̚]$ □ $ t̚ $ 99% $ t̚ $ 1%		*	*
$[ut̚]$ □ $ t̚ $ 90% $ t̚ $ 10%	*!		*

- ☞ Adapted from Boersma & Hamann (2005).
- ☞ IDENT(anterior) is necessary because Walmatjari has two contrastive apicals, an anterior $[t̚]$ and a posterior $[t̚]$.

Conclusion

- Many constraints proposed in the literature that look like markedness constraints are really about enhancing an existing contrast.
- They should therefore be replaced with probabilistic faithfulness constraints, which are sensitive to underlying forms.
- This has the theoretical advantage of being more principled, and the empirical advantage of explaining that these constraints are active only if there is an underlying contrast.


Alternatives


- ☛ Constraints like COLOR, ASPIRATE and SPECIFY fail to lay the cause of the effect where it belongs, namely in the maintenance of a contrast.
- ☛ Explicitly contrast-optimizing constraints like MINDIST (Flemming 1995) and SPACE (Padgett 2001) cannot be used for evaluating underlying forms in a production tableau (Flemming 2002:33ff., Boersma 1998:361, McCarthy 2002:227).
- ☛ Constraints like APICAL \square RETRO are still insensitive to whether the apical is underlying or not.

Our assumption on perception

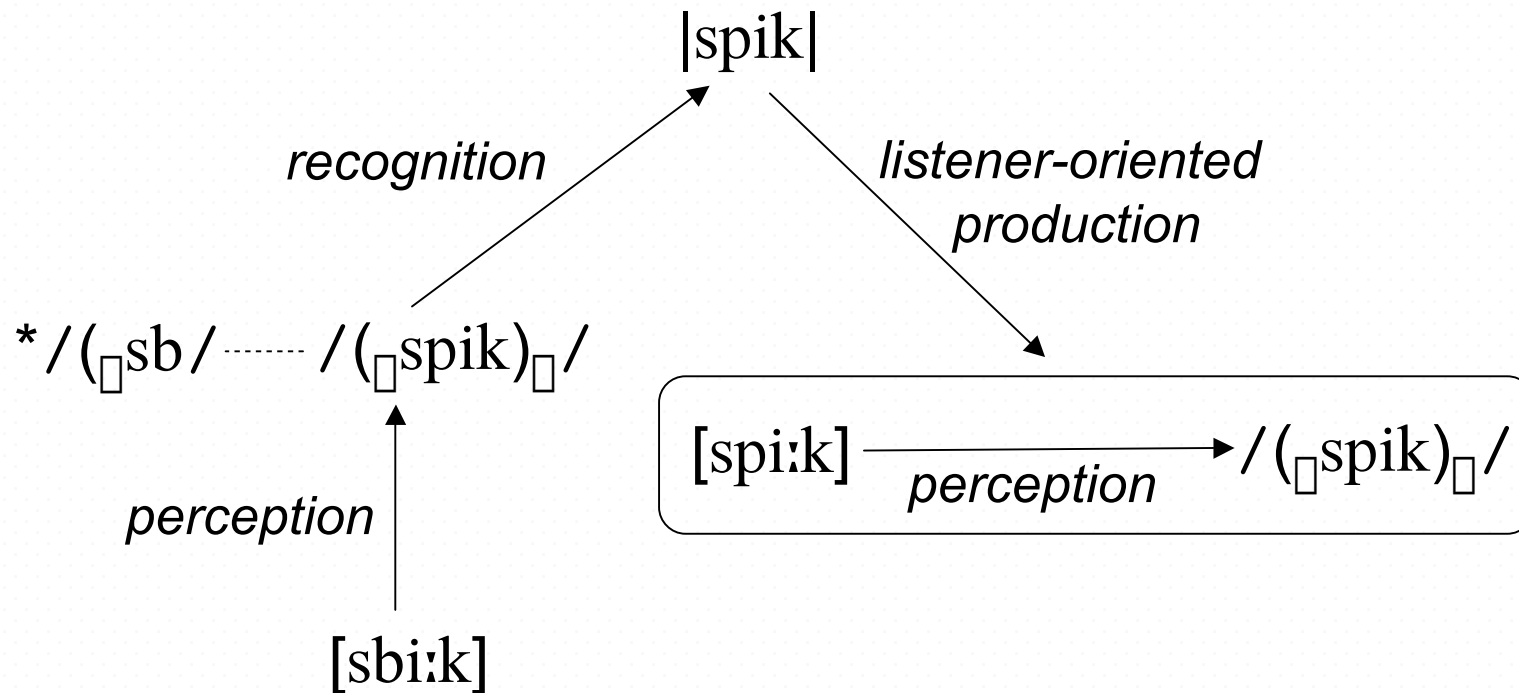
- ☞ We have assumed that non-existent phonemes are never perceived, hence never appear as candidates:
 - “in a language with underlying $|+low,-front|$ but without underlying $|+low,+front|$, $/+low,+front/$ is never perceived.”
 - “in English, $/(_sb/$ is never perceived.”
- ☞ This is formalized by structural constraints:
 - $* /+low,+front/$ $* /(_sb/$
 - (note: independently needed by Kirchner as well)

Phonological perception in English

[sbi:k]	* /(_□ sb/	[voicing periods] should not be /p/
/(_□ sbik) _□ /	*!	
 /(_□ spik) _□ /		*

-  The constraint “[voicing periods] should not be /p/” is an example of auditory-to-surface faithfulness (Escudero & Boersma 2001/2003). If you regard auditory forms as discrete (e.g. Pater 2004), this constraint could be something like IDENT_{AS}(voice).

The big picture: auditory richness of the base



- The structural constraint works in perception, so that $*(sb/$ structures never enter the lexicon.

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