Output-Driven Maps in Phonology

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Outline

• Surface Orientedness
  – Inadequacies of process opacity

• Output-Driven Maps
  – Formalizes surface orientedness

• Output-Driven Maps in Optimality Theory

• Output-Driven Syntax?
The Intuition: Surface Orientedness

- **Longstanding Issue**: to what extent are phonologies “surface oriented”?
  - (Chomsky 1964; Kiparsky 1971, 1973; Kisseberth 1970)
- **Surface Oriented**: disparities between input and output are only introduced to the extent necessary to satisfy output conditions.
- Said another way: phonological disparities are driven by phonotactic restrictions.

- What could this mean, precisely?
- How can this be formally expressed?
Output Conditions

- Coda Devoicing
- Output Condition: no voiced obstruents in codas.
- Disparity: input voiced segment with a voiceless output correspondent.

- Intuition: the disparity is tolerated in order to satisfy the output condition.
  - surface oriented
Contrary I: Chain Shifts

• Chain shifts are inherently contrary to intuitions of surface orientedness.

  /a/ → [e]  /e/ → [i]  /i/ → [i]

• If /e/ → [i] is necessary, then should be /a/ → [i]

• If /a/ → [e] is sufficient, then should be /e/ → [e]
Contrary II: Derived Environment Effects
(Lubowicz 2003)

• Derived environment effects are inherently contrary to intuitions of surface orientedness.

/\textipa{a}/ \rightarrow \textipa{[i]} \quad /\textipa{e}/ \rightarrow \textipa{[e]} \quad /\textipa{i}/ \rightarrow \textipa{[i]} \quad

• If /\textipa{a}/ \rightarrow \textipa{[i]} is necessary, then should be /\textipa{e}/ \rightarrow \textipa{[i]} \quad

• If /\textipa{e}/ \rightarrow \textipa{[e]} is sufficient, then should be /\textipa{a}/ \rightarrow \textipa{[e]} \quad

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Process Opacity

• Traditional notions of transparency / opacity (Kiparsky 1971, 1973) are properties of **processes**, not maps.
  – Change your process analysis, and opacity can (dis)appear.
  – Epenthesis and assimilation in Lithuanian (Baković 2007).

• Does not fit well with Optimality Theoretic analyses.
  – Processes are not constructs of the theory.
OT is Inherently Transparent

• Markedness constraints are conditions on the output.
• Faithfulness constraints resist disparities.
• **Therefore**: disparities are always motivated by output conditions.

• Issue: OT grammars can generate chain shifts.
OT is Inherently Opaque

• Markedness constraints are conditions on the output.
• Markedness constraints can be violated by grammatical forms.
• Opacity is linguistic generalization that is violated in surface forms (McCarthy 1999, Idsardi 2000).
• Therefore: OT grammars inherently realize opacity.

• Issue: many seemingly transparent phenomena involve violation of markedness constraints.
  – What’s opaque about preserving voicing in onsets?
Shared: Focus on Markedness Constraints

• Both:
  – focus on markedness constraints.
  – adopt markedness constraints as the relevant output conditions.

• Inherently transparent:
  – Opacity is: disparity not motivated by output conditions.
  – violation of output conditions is irrelevant.

• Inherently opaque:
  – Opacity is: violated output conditions.
  – motivation for disparity is irrelevant.
Wanted: A More Abstract Alternative

• Characterize “surface orientedness” solely in terms of input-output maps.
  – Without reference to processes, constraints, etc.

• Such a characterization would apply equally to SPE, Optimality Theory, and other phonological theories.
  – and possibly beyond.
What Kind of Stunt is This?

• Define what it means for disparities in a map to be driven by output conditions,

• **without** committing to what the output conditions actually are.
Terminology

• A **candidate** is an input, an output, and a correspondence relation between them.
  \[ /p_1a_2k_3a_4/ \rightarrow [p_1\acute{a}_2k_3a_4] \]

• A candidate has a set of **disparities**.

• A phonological **map** is the set of grammatical candidates.
From Intuition to Formalization

- **Surface Oriented**: a term of convenience used to refer to certain intuitive notions about phonological maps.

- **Output-Driven**: a defined property of phonological maps that formally captures the intuitions of surface orientedness.
Output-Driven Maps (Tesar 2014)

• A map is output-driven if:
  – for every grammatical candidate $A\rightarrow X$ of the map:
  – if candidate $B\rightarrow X$ has greater similarity than $A\rightarrow X$,
  – then $B\rightarrow X$ is also grammatical.

• Simplified:
  – for every grammatical candidate $A\rightarrow X$ of the map:
  – if input $B$ is more similar to $X$ than $A$ is,
  – then $B$ also maps to $X$. 
Greater Similarity

• Candidate B→X has **greater similarity** than A→X if every disparity in B→X has an identical corresponding disparity in A→X.
  – Only defined for pairs of candidates sharing the same output.

\[
\begin{align*}
\text{A→X} & \quad \text{páká} \rightarrow \text{paká}: & [+ - + -] & \rightarrow [- - + +] \\
\text{B→X} & \quad \text{paká} \rightarrow \text{paká}: & [- - + -] & \rightarrow [- - + +]
\end{align*}
\]

• Similarity is **relational**.
Relative Similarity \( (\text{up} = \text{greater similarity}) \)
Relative Similarity (+/−stress  +/−length)

- - + +

+ - + +  - + + +  - - - +  - - + -

+ + + +  + - - +  + - + -  - + - +  - + + -  - - - -

+ + - +  + + + -  + - - -  - + - -

+ + - -

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(A Piece of) An Output-Driven Map

- \textit{páká}: \rightarrow \textit{páka} \quad 2\text{ disparities}
- \textit{páká} \rightarrow \textit{páka} \quad 1\text{ disparity}
- \textit{páka}: \rightarrow \textit{páka} \quad 1\text{ disparity}
- \textit{páka} \rightarrow \textit{páka} \quad 0\text{ disparities (Identity Mapping)}

- Output-driven: simply removing some obstacles to an output ensures reaching that same output.
Idempotency

- All grammatical outputs “map to themselves”.
  - Common assumption, especially in phonotactic learning.

- All output-driven maps are idempotent.
  - No input is more similar to an output X than X itself.
  - If any input maps to X, then X maps to X.

- Consequence: maps with chain shifts are not output-driven.
Derived Environment Effects

• DEEs are not output-driven.
  \[ /a/ \rightarrow [i] \quad /e/ \rightarrow [e] \quad /i/ \rightarrow [i] \]

• \[ /e/ \rightarrow [i] \] has greater similarity than \[ /a/ \rightarrow [i] \]

• DEEs are just like CSs:
  – Not output-driven: \[ A \rightarrow X, \text{ but not } B \rightarrow X \]
  – Chain Shift: \[ B = X \]
  – Derived Environment Effect: \[ B \neq X \]
ODM Unifies CSs and DEEs
Output-Driven Maps in Optimality Theory

• An OT system is guaranteed to define only output-driven maps if:
  – All constraints of Con are output-driven-preserving.
Output-Driven-Preserving Constraints

- A constraint is ODP if:
  - when $B \rightarrow X$ has greater similarity than $A \rightarrow X$,
  - and $B \rightarrow Y$ has fewer violations than $B \rightarrow X$,
  - then $A \rightarrow Y$ must have fewer violations than $A \rightarrow X$.

- Consequence: all markedness constraints are ODP.

- Markedness cannot distinguish:
  - $A \rightarrow X$ vs. $A \rightarrow Y$
  - $B \rightarrow X$ vs. $B \rightarrow Y$
A Developing Theory of Faithfulness

• A constraint can only be non-ODP if it makes reference to something outside of the output itself.
  – Faithfulness: reference to both input and output.

• “Basic” IO faithfulness constraints are ODP.
  – MAX, DEP, IDENT

• Others are non-ODP.
  – Conjoined faithfulness constraints
  – Positional faithfulness constraints
Learning Output-Driven Maps (Tesar 2014)

• Output-drivenness greatly accelerates the learning of underlying forms (along with rankings).

• Structure in the space of inputs which can be powerfully exploited.

• Limitation: presumes that all phonological maps are output-driven.
Output-Driven Syntax?

• What are syntactic maps like?

• What is the space of possible inputs?

• What is the inventory of disparities?
  – movement?
  – feature merging?
Conclusions

• Output-Driven Maps capture intuitions about surface orientedness in a general way.
  – Combines well with Optimality Theory.

• Applying the concept to a domain requires being specific about what the map is.
  – Inputs
  – Outputs
  – Disparities
References