

Raising and Flapping in Canadian English: grammar and acquisition

Ricardo Bermúdez-Otero (*University of Newcastle upon Tyne*)

Please cite as:

Bermúdez-Otero, Ricardo (2004). 'Raising and Flapping in Canadian English: grammar and acquisition.' Handout of paper presented at the CASTL Colloquium, University of Tromsø, 2 November 2004. Available at www.bermudez-otero.com/tromsoe.pdf

AIMS

- §1 This paper argues for *a stratal solution to the problem of phonological opacity in OT*. Stratal OT is shown to possess significant advantages over its competitors:
- Stratal OT imposes *tight formal restrictions on the space of possible opacity effects*: all opacity effects arise from the interaction between cycles; there is no cycle-internal opacity.
 - In Stratal OT, therefore, the interaction between phonological processes can be *deduced from their morphosyntactic domain of application*.
 - Because of this, Stratal OT supports a *learning model* that is capable of accounting for the acquisition of opacity effects even in nonalternating items.
- §2 The advantages of Stratal OT are illustrated with a case study of the *classic counterbleeding interaction* between Diphthong Raising and Flapping in Canadian English:
- The relative order of Raising and Flapping need not be stipulated, but can be deduced from the fact that Raising is *stem-level*, whereas Flapping is *phrase-level*;
 - The proposed learning model shows how children can use evidence from alternations such as *write* [ɹəɪt] ~ *writer* [ɹəɪrə] and *ride* [ɹaɪd] ~ *rider* [ɹaɪrə] to assign correct underlying representations to the flaps in nonalternating items such as *mitre* [məɪrə] and *spider* [spəɪrə].

THE PROBLEM OF PHONOLOGICAL OPACITY

Definition

- §3 Kiparsky's (1982 [1971]: 75; 1973: 79) rule-based definition:

A rule R of the form $\alpha \rightarrow \beta / \gamma _ \delta$ is opaque if there are surface representations in the language having

- either (i) α in the environment $\gamma _ \delta$ (*underapplication*)
or (ii) β derived by R in an environment other than $\gamma _ \delta$ (*overapplication*)

- §4 Rule-ordering approach:

Rule R is ordered before another rule S such that

- either (i) S creates the target of R (viz. $\gamma \alpha \delta$) (*counterfeeding*)
or (ii) S destroys the environment of R (viz. $\gamma _ \delta$) (*counterbleeding*)

The problem for OT

§5 A large set of phonological phenomena previously modelled by means of opaque rules cannot be described in the original version of OT (Prince & Smolensky 1993):

The signature of underapplication:

- a language has grammatical output forms containing $[\gamma\alpha\delta]$,
- yet there is independent evidence requiring the ranking $*\gamma\alpha\delta \gg \text{FAITH-}\alpha$.

The signature of overapplication:

- a language has expressions where input $/\alpha/$ is unfaithfully mapped onto output $[\beta]$,
- yet there is no markedness constraint M ranked above $\text{FAITH-}\alpha$ such that the mapping $/\alpha/ \rightarrow [\beta]$ in these expressions increases harmony with respect to M.

How significant is the problem?

§6 Opacity is one of the clearest instances of *Plato's Problem* (Chomsky 1986) in phonology, as learners must acquire generalizations that are not true on the surface.

⇒ The ability to explain the acquisition of opaque grammars should be regarded as one of the main criteria by which generative theories of phonology are to be judged.

APPROACHES TO OPACITY IN OT: STRATAL OT

The common ground to the main approaches

§7 Opaque generalizations are true of some representation different from, but related to, the output.

§8 *Stratal OT* (e.g. Bermúdez-Otero 1999, 2003, etc.; Kiparsky 2000, 2002, etc.):

the opaque generalization holds true of a *phonological cycle associated with a subdomain of the expression.*

§9 *Transderivational correspondence:*

- paradigmatic opacity (e.g. *writer* $[\text{j}\text{æ}\text{i}\text{r}\text{ə}]$) ⇒ OO-correspondence (e.g. Benua 1997) the opaque generalization holds true of the *output representation of a grammatically related expression* (e.g. *write* $[\text{j}\text{æ}\text{i}\text{t}]$);
- nonparadigmatic opacity (e.g. *mitre* $[\text{m}\text{æ}\text{i}\text{r}\text{ə}]$) ⇒ sympathy (McCarthy 1999, 2003) the opaque generalization holds true of the *output selected (for the same input) by a related constraint hierarchy.*

Sympathy is invoked where an analysis based on OO-correspondence is not available.

Stratal OT

§10 *Cyclic application*

Given a linguistic expression e with a phonological input representation I , the phonological function P applies recursively from the inside out within a nested

hierarchy of phonological domains associated with the morphosyntactic constituent structure of *e*:

i.e. if $I = [[x][[y]z]]$, then $P(I) = P(P(x), P(P(y), z))$.

§11 *Level segregation*

The phonology of a language does not consist of a single function P , but of a set of distinct functions or ‘levels’ $\{P_1, P_2, \dots, P_n\}$, such that the specific function P_i applying to domains of type δ_i is determined by the type of morphosyntactic construction associated with δ_i .

Bermúdez-Otero (in preparation) and Kiparsky (2000, 2003, etc.) acknowledge three levels (the *stem level*, *word level*, and *phrase level*), roughly corresponding to the cyclic, postcyclic, and postlexical strata of classical ruled-based Lexical Phonology.

§12 *Cycle-internal transparency*

Each cycle involves a single pass through *Gen* and *Eval*:

i.e. $P_i(\delta_i) = Eval_i(Gen(\delta_i))$

Within cycles, computation is parallel; seriality only arises from the interaction between cycles.

§13 *Key predictions*

- Within each cycle, the input-output mapping is transparent; *opacity arises only from the serial interaction between cycles*.
- The complexity of opacity effects is bounded by the *number of cycles*, which is in turn independently constrained by the *morphosyntactic structure* of the linguistic expression.
- The only criterion that determines the level ascription of a phonological process (i.e. a ranking of constraints) is the *morphosyntactic domain where the process applies*: e.g. a process cannot be assigned to the word level if it does not apply transparently in word-level domains.

RAISING AND FLAPPING IN CANADIAN ENGLISH: GRAMMAR

A classic case of opacity

- §14 • *Raising* /aɪ, aʊ/ → [əɪ, ʌʊ] / ___ [-voice] under certain prosodic conditions
- *Flapping* /t, d/ → [ɾ] / $\left\{ \begin{array}{c} \text{I} \\ \text{V} \end{array} \right\}$ ___ V under certain prosodic conditions
- Flapping *counterbleeds* Raising, so that Raising appears to *overapply*.

	<i>writing</i>	<i>riding</i>	<i>mitre</i>	<i>spider</i>
UR	/ɹaɪt-ɪŋ/	/ɹaɪd-ɪŋ/	/maɪtəɹ/	/spaɪdəɹ/
Raising	ɹəɪtɪŋ	—	məɪtəɹ	—
Flapping	ɹəɪɾɪŋ	ɹaɪɾɪŋ	məɪɾəɹ	spaɪɾəɹ

For discussion, see Joos (1942), Chomsky (1964: 74), Chomsky & Halle (1968: 342), Bromberger & Halle (1989: 58-61), Kenstowicz (1994: 6-7), Hayes (1999: §8).

§15 The opacity effect is psychologically real: evidence from repetition-priming experiments in Luce *et al.* (1999: 1892):

Our results suggest that — at least in the recognition of flapped items in American English — recovery processes do indeed map the surface manifestation of the flap onto representations in which underlying abstract voicing categories are well specified.

Raising

§16 Raising is triggered by a following *voiceless segment* (henceforth C):

e.g. *write* [ɹəɪt] cf. *ride* [ɹaɪd]
 knife [nəɪf] cf. *knives* [naɪvz]

§17 Raising is bounded by the *prosodic word* (ω):

e.g. *high school* $[\omega' [\omega' \text{'haɪ}][\omega' \text{'sku:l}]]$ cf. unverbated $[\omega' \text{'həɪ,sku:l}]$
 tie shop $[\omega' [\omega' \text{'taɪ}][\omega' \text{'ʃɑ:p}]]$

§18 Within ω , the trigger C may belong to a following weaker foot:

e.g. *nitrate* $[\omega' [\Sigma' \text{'nəɪ}][\Sigma' \text{tɹeɪt}]]$

But the trigger C must not belong to a stronger foot:

e.g. *syphonic* $[\omega' [\Sigma' \text{saɪ}][\Sigma' \text{fɑ:nɪk}]]$
 citation $[\omega' [\Sigma' \text{saɪ}][\Sigma' \text{teɪʃn}]]$

Possible analysis: the prosodic domain of Raising is the *colon* (κ), defined as a sequence of a (strong) foot plus any weaker feet following it within ω :

e.g.

ω	ω
κ	κ
/ \ Σ _s Σ _w	/ \ Σ _w Σ _s
nəɪ tɹeɪt	saɪ fɑ:nɪk

§19 Raising *underapplies before word-level suffixes* (Bermúdez-Otero 2003):

e.g. *eyeful* [ɑɪfʊl], *[əɪfʊl] cf. *Eiffel* [əɪfəl]
 Frauship [fɹɑʊʃɪp], *[fɹɑʊʃɪp]

Implication: Raising applies at the stem level.

Why not pursue a prosodic, rather than morphophonological, analysis?

e.g. *eyeful* $[\omega' [\omega' \text{aɪ}]\text{fʊl}]$?

Because there is no independent phonetic evidence for an ω -boundary intervening between a word-level suffix and its base:

e.g. sensitivity of gradient duration rules to boundaries (Sproat 1993: 178)

[...F]or no speaker is it the case that the + [e.g. *+ic*; RB-O] or # [e.g. *#ing*; RB-O] boundary contexts show a significant difference from each other or from the no-boundary context (0). On the other hand, for every speaker [...] the difference between the compound boundary cases and the other lexical cases [sc. 0, +, #; RB-O] is significant. [...W]hile there is no evidence of sensitivity to weaker lexical boundaries (+ and #), duration rules are sensitive to the edges of other domains, including compound boundaries.

Raising and Prefortis Clipping

§20 A connection between Canadian Raising and Prefortis Clipping has long been surmised (e.g. Trudgill 1986, McMahon 2000).

Strong position: *the environments of Canadian Raising and Prefortis Clipping are in fact identical.*

§21 Evidence:

- Prefortis Clipping *underapplies* before word-level suffixes:

e.g.	<i>awe-some</i>	Wells (1990) / ^l ɒ: səm/	i.e. [ɒ:səm], *[ɒsəm]
	<i>law-ful</i>	Wells (1990) / ^l lɒ: f ^ɹ l/	i.e. [lɒ:f ^ɹ l], *[lɒf ^ɹ l]
cf.	<i>gruesome</i>	Wells (1990) / ^l gru:s əm/	i.e. [grusəm], *[gru:səm]
	<i>waffle</i>	Wells (1990) / ^l wɑ:f ^ɹ l/	i.e. [waf ^ɹ l], *[wɑ:f ^ɹ l]

- Prefortis Clipping *overapplies* before flapped /t/, i.e. is *counterbled* by *Flapping*:

e.g.	<i>utter</i>	<i>udder</i>	
	UR	/ʌtəɹ/	/ʌdəɹ/
	Clipping	ʌtəɹ	—
	Flapping	ʌɾəɹ	ʌɾəɹ
	SR	[ʌɾə̃]	[ʌɾə̃]

[Phonetic evidence (Zue & Laferriere 1979, Patterson & Connine 2001, etc.):

- (i) no significant difference in mean duration between flapped /d/ and flapped /t/;
- (ii) on average, vowels 9ms longer before flapped /d/ than before flapped /t/;
- (iii) near merger —difference maintained in production but not exploited in lexical recognition.

⇒ A gradient, nonneutralizing phonetic process of durational adjustment reduces, but does not eliminate, the categorical length difference between clipped and unclipped vowels before flaps.]

§22 Conclusions: Raising applies at the stem level to clipped diphthongs.

§23 Rankings for Raising:

- CLEARDIPH » IDENT[mid],
 - CLIPDIPH » IDENT[low],
- and
- CLIPDIPH » CLEARDIPH,

where

- **CLEARDIPH**
Maximize the distance between diphthongal elements.
⇒ *əi, *ʌu.

- **CLIPDIPH**
In clipped diphthongs, minimize the distance between elements.
⇒ *aɪt, *aʊt.
- **IDENT[mid]**
Let α be an input segment, and let β be its output correspondent; if α is [mid], then β is [mid].
⇒ /əi, ʌʊ/ * → [aɪ, aʊ].
- **IDENT[low]**
Let α be an input segment, and let β be its output correspondent; if α is [low], then β is [low].
⇒ /aɪ, aʊ/ * → [əi, ʌʊ].

Flapping

§24 I assume the Kiparsky-Jensen analysis:

- Stops are tensed at the word level if foot-initial (in certain dialects, if colon-initial); otherwise, they are lax.
- At the phrase level, lax [t] and lax [d] are flapped between in the environment V/ɪ__V.

§25 Flapping must be phrase-level because *its domain straddles word boundaries*:

e.g. *He hit Ann* [hi hɪr æn] cf. *hit* [hɪt]
 He hid Ann [hi hɪd æn] cf. *hid* [hɪd]

Support for Stratal OT

§26 The counterbleeding interaction between Raising and Flapping follows, as predicted by the theory, from their *level ascription*, which is independently determined by their *morphosyntactic domain*:

Raising precedes Flapping because Raising is stem-level and Flapping is phrase-level.

LEARNABILITY

Restrictiveness ≠ learnability

- §27 • If two theories of grammar T_1 and T_2 define the grammar spaces S_1 and S_2 respectively, and if both S_1 and S_2 are too large for convergence to be guaranteed by brute-force searching, then the prime determinant of learnability will be the *relative efficiency of the learning algorithms associated with T_1 and T_2* , rather than the *relative size of S_1 and S_2* (Tesar & Smolensky 2000: 2-3).
- A phonological model cannot achieve explanatory adequacy in respect of opacity simply by restricting the space of possible opaque effects; one must show that the learner is able to search that space effectively.

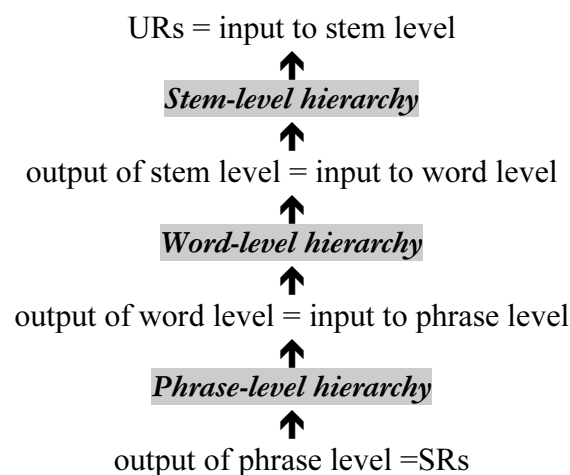
The acquisition of opacity in Sympathy Theory

- §28 • There is, at present, no algorithm for acquiring sympathy-theoretic grammars (McCarthy 1999: 340).
- *Proposal:* Assume a \otimes O-IDENT » IO-FAITH bias (Dinnsen *et al.* 2000).
 - *Problem:* Historically, opaquely derived surface properties are reanalysed as underlying, not vice versa.
 - *Conclusion:* Sympathy Theory cannot account for the acquisition of opacity.

The acquisition of opacity in Stratal OT

§29 *Iterative stratum construction*

input to level n = output of level $n-1$



§30 *Emergence of opacity*

- Let a process p apply at level n and become opaque at level $n+1$.
- Assume an ordinary constraint ranking algorithm that *only acquires output-true rankings*.

Then:

- Ex hypothesi, p is not output-true at $n+1$. Accordingly, the ranking algorithm will not set up the hierarchy for p at $n+1$.
- Assume that the learner assigns input representations correctly at $n+1$; see §32 and §33 below. Now, input to $n+1$ = output of n . Ex hypothesi, p is output-true at n . Accordingly, the ranking algorithm sets up the hierarchy for p at n .

§31 *Constraint ranking by pure phonotactic learning under the identity map*

- To find the constraint hierarchy of a level n , given output forms:
 - (i) assume the identity map ($I = O$),
 - (ii) assume a MARKEDNESS » FAITHFULNESS bias,
 - (iii) demote markedness constraints and promote faithfulness constraints just enough to derive the output from identical input.

See e.g. Prince & Tesar (1999), Hayes (1999).

- Alternations normally conspire to bring collocations in line with output phonotactics (Kisseberth 1970).

Accordingly, *purely distributional evidence* will normally suffice to find the constraint rankings driving not only phonotactics but also alternations.

§32 *Input assignment (I): alternations prompt departures from the identity map*

- Learners only depart from the identity map when faced with *alternations* (Yip 1996; cf. Alderete & Tesar 2002).

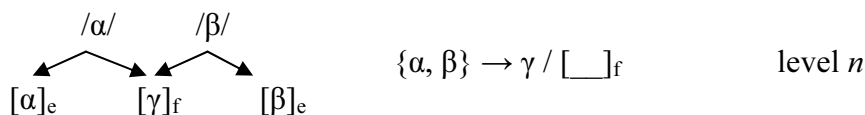
In line with *Input Optimization* (Prince & Smolensky 1993: §9.3), departures from the identity map are minimal.

- **Input optimality** (Bermúdez-Otero in preparation)
An input representation is optimal iff it has no competitor that
 - generates an identical set of output alternants,
 - and generates all output alternants no less efficiently,
 - and generates some output alternant more efficiently [where efficiency = satisfaction of high-ranking faithfulness constraints].
- Where more than one input representation is optimal, follow one of the following heuristics:
 - Hale's heuristic** (after Hale 1973: 420)
Prefer inputs that are well-formed outputs.
 - Heuristic for asymmetric paradigms**
In an asymmetric paradigm, prefer those inputs that generate the morphologically unmarked member most efficiently.

§33 *Input assignment (II): Archiphonemic Prudence*

Dealing with opacity in non-alternating items:

- Let the following situation of *contextual neutralization* obtain at level n :



- If the *archiphonemic string* $[\gamma]_f$ occurs in the output representation of a non-alternating item i level n , then
 - assume that, in i too,

$$\begin{array}{ccc}
 & / \alpha / & / \beta / \\
 & \downarrow & \downarrow \\
 \text{either} & & \text{or} \\
 & [\gamma]_f & [\gamma]_f
 \end{array}$$
 - put the two possible input representations for i at level n in ‘*quarantine*’ by excluding them from the data set triggering acquisition at level $n-1$;
 - when the constraint hierarchy for $n-1$ is known, discard any input representation for i at level n that is not a well-formed output at level $n-1$.

§34 *Interim evaluation of the model*

- It makes the most of the *assets of the synchronic theory*, fully exploiting the serial interaction between strata (§29) and the intimate connection between the domain of a process and its stratal ascription (§30).

- It adopts independently motivated solutions to the problem of acquiring constraint rankings (§31) and input representations for alternating items (§32).
- Only stipulation: Archiphonemic Prudence (§33).

RAISING AND FLAPPING IN CANADIAN ENGLISH: ACQUISITION

Acquiring the phrase-level cophonology

§35 *Constraint rankings*

- Flapping is output-true \Leftrightarrow The ranking for Flapping is set up by pure phonotactic learning.
- Raising misapplies \Leftrightarrow The ranking for Raising is not established:

<i>Datum</i>	<i>Triggered ranking</i>
məɪrə̃ > maɪrə̃ ‘mitre’	IDENT[mid] » CLEARDIPH
ɹəɪrɪŋ > ɹaɪrɪŋ ‘writing’	
aɪfəl > əɪfəl ‘eyeful’	CLEARDIPH » CLIPDIPH

§36 *Input assignment for alternating items*

- [hɪt] *hit* ~ [hɪr æn] *hit Ann*
optimal input: /hɪt/
- [hɪd] *hid* ~ [hɪr æn] *hid Ann*
optimal inputs: /hɪd/ and */hɪr/; Hale’s heuristic and the heuristic for asymmetric paradigms select /hɪd/.

§37 *Input assignment for non-alternating items*

- The analysis of alternations shows that there is an archiphonemic string [ɹ] with two possible input correspondents /t/ or /d/.
- Accordingly, by Archiphonemic Prudence:

<i>Quarantined item</i>	<i>Phrase-level input candidates</i>
[məɪrə̃] ‘mitre’	/məɪtəɪ/, /məɪdəɪ/
[spɑɪrə̃] ‘spider’	/spɑɪtəɪ/, /spɑɪdəɪ/
[rəɪrɪŋ] ‘writing’	/ɹəɪtɪŋ/, /ɹəɪdɪŋ/
[raɪrɪŋ] ‘riding’	/ɹaɪtɪŋ/, /ɹaɪdɪŋ/

Acquiring the word-level cophonology

§38 *Constraint rankings (I)*

- Raising does not overapply in the output of the word level:
 - surface [məɪrə̃] ‘mitre’ is under quarantine;
 - at the phrase level, [ɹəɪr ʌp] ← /ɹəɪt ʌp/ ‘write up’.
- Raising underapplies in the output of the word level:
e.g. [aɪfəl] *eyeful*.

- Triggered ranking: IDENT[low] » CLIPDIPH » CLEARDIPH » IDENT[mid].

§39 Quarantine lifting (I)

		IDENT[low]	CLIPDIPH	CLEARDIPH	IDENT[mid]
mæidəɪ	mæidəɪ			*!	
	maɪdəɪ ☀				*
mætəɪ ☞	mætəɪ ☞			*	
	maɪtəɪ		*!		*
ɹæɪdɪŋ	ɹæɪdɪŋ			*!	
	ɹaɪdɪŋ ☀				*
ɹætɪŋ ☞	ɹætɪŋ ☞			*	
	ɹaɪtɪŋ		*!		*

§40 Constraint ranking (II)

Flapping does not apply in the new word-level outputs [mætəɪ] and [ɹætɪŋ]
 ⇒ The constraint ranking for Flapping is blocked.

§41 Input assignment

Trivial (no alternations): [aɪ] eye ~ [aɪfʊl] eyeful ← /aɪ-/ eye
 [ɹæɪt] write ~ [ɹæɪtɪŋ] writeing ← /ɹæɪt-/ write

Acquiring the stem-level cophonology

§42 Constraint ranking

- Raising does not overapply in the output of the stem level. Recall that surface [mæɪrəɪ] *mitre* and [ɹæɪrɪŋ] *writing* have been correctly assigned the phrase-level input representations /mætəɪ/ and /ɹætɪŋ/ by Archiphonemic Prudence.
- Raising does not underapply in the output of the stem level:
 [aɪfʊl] ← /aɪ-/ + /-fʊl/ at the word level
- The normal application of Raising triggers the ranking {CLEARDIPH » IDENT[mid]}, {CLIPDIPH » IDENT[low]}, and {CLIPDIPH » CLEARDIPH}; see §23 above.

§43 Quarantine lifting (II)

		CLIPDIPH	CLEARDIPH	IDENT[low]	IDENT[mid]
spartəɪ	spartəɪ	*!			
	spætəɪ ☀		*	*	
spardəɪ ☞	spardəɪ ☞				
	spæɪdəɪ		*!	*	
ɹaɪtɪŋ	ɹaɪtɪŋ	*!			
	ɹætɪŋ ☀		*	*	
ɹaɪdɪŋ ☞	ɹaɪdɪŋ ☞				
	ɹæɪdɪŋ		*!	*	

SELECTED REFERENCES

- Alderete, J. & B. Tesar (2002). Learning covert phonological interaction: an analysis of the problem posed by the interaction of stress and epenthesis. Report no. RuCCS-TR-72. Piscataway, NJ: Rutgers Center for Cognitive Science. (ROA 543)
- Benua, Laura (1997). *Transderivational identity: phonological relations between words*. PhD dissertation, University of Massachusetts, Amherst.
- Bermúdez-Otero, R. (1999). *Constraint interaction in language change [Opacity and globality in phonological change.]* PhD dissertation, University of Manchester / Universidad de Santiago de Compostela.
- Bermúdez-Otero, R. (2002) Cyclicity or sympathy? A case study. Handout of paper presented at the 10th Manchester Phonology Meeting. [Available at <http://www.staff.ncl.ac.uk/r.bermudez-otero/10mfm.pdf>]
- Bermúdez-Otero, Ricardo (2003). The acquisition of phonological opacity. In Jennifer Spenader, Anders Eriksson & Östen Dahl (eds), *Variation within Optimality Theory: Proceedings of the Stockholm Workshop on 'Variation within Optimality Theory'*, 25-36. Stockholm: Department of Linguistics, Stockholm University. [Expanded version available at <http://www.staff.ncl.ac.uk/r.bermudez-otero/stockholm.pdf>]
- Bermúdez-Otero, R. (forthcoming). Stratal Optimality Theory: synchronic and diachronic applications. (Oxford Studies in Theoretical Linguistics) Oxford: Oxford University Press. [Drafts available at http://www.staff.ncl.ac.uk/r.bermudez-otero/Stratal_Optimality_Theory.htm]
- Bermúdez-Otero, R. & A. McMahon (forthcoming). English phonology and morphology. In B. Aarts & A. McMahon (eds), *The handbook of English linguistics*. Oxford: Blackwell. [Available at <http://www.staff.ncl.ac.uk/r.bermudez-otero/bermudez-otero&mcmahon.pdf>]
- Bromberger, S. & M. Halle (1989). Why phonology is different. *Linguistic Inquiry* 20: 51-70.
- Chambers, J. K. (1973). Canadian raising. *Canadian Journal of Linguistics* 18: 113-35.
- Chomsky, N. (1964). Current issues in linguistic theory. In J. Fodor & J. Katz (eds), *The structure of language*. Englewood Cliffs, NJ: Prentice Hall. 50-118.
- Chomsky, N. (1986). *Knowledge of language: its nature, origin, and use*. Westport, Conn.: Praeger.
- Chomsky, N. (2001). Beyond explanatory adequacy. *MIT Occasional Papers in Linguistics* 20.
- Chomsky, N. & M. Halle (1968). *The sound pattern of English*. New York: Harper and Row.
- Dinnsen, D. A., L. W. McGarrity, K. M. O'Connor & K. A. B. Swanson (2000). On the role of sympathy in acquisition. *Language Acquisition* 8: 321-361.
- Gussenhoven, C. (1986). English plosive allophones and ambisyllabicity. *Gramma* 10: 119-141.
- Hale, K. (1973). Deep-surface canonical disparities in relation to analysis and change: an Australian case. In T. A. Sebeok (ed), *Current trends in linguistics*. Vol. 11: *Diachronic, areal, and typological linguistics*. The Hague: Mouton. 401-458.
- Hayes, B. (1999). Phonological acquisition in Optimality Theory: the early stages. Ms, UCLA (ROA 327). To appear in R. Kager, J. Pater & W. Zonneveld (eds), *Fixing priorities: constraints in phonological acquisition*. Cambridge: Cambridge University Press.
- Jensen, J. T. (2000). Against ambisyllabicity. *Phonology* 17: 187-235.
- Joos, M. (1942). A phonological dilemma in Canadian English. *Language* 18: 141-4.
- Kahn, D. (1976). *Syllable-based generalizations in English phonology*. PhD dissertation, MIT.
- Kenstowicz, M. (1994). *Phonology in generative grammar*. Cambridge, MA: Blackwell.
- Kiparsky, P. (1971). Historical linguistics. In Dingwall, W. O. (ed.) *A survey of linguistic science*. College Park: Linguistics Program, University of Maryland. 576-649. Reprinted in Kiparsky, P. (1982: 57-80).
- Kiparsky, P. (1973). Abstractness, opacity and global rules. Bloomington: Indiana University Linguistics Club. Also in Fujimura, O. (ed.) (1973). *Three dimensions of linguistic theory*. Tokyo: TEC Company. 57-86.
- Kiparsky, P. (1979). Metrical structure assignment is cyclic. *Linguistic Inquiry* 10: 421-441.
- Kiparsky, P. (1982). *Explanation in phonology*. Dordrecht: Foris.
- Kiparsky, P. (2000). Opacity and cyclicity. *The Linguistic Review* 17: 351-365.
- Kiparsky, P. (2002). Syllables and Moras in Arabic. In C. Fery and R. Vijver (ed.) *The Syllable in Optimality Theory*. Cambridge: Cambridge University Press.
- Kiparsky, P. (forthcoming). *Paradigm effects and opacity*. Stanford: CSLI Publications.
- Kisseberth, C. (1970). On the functional unity of phonological rules. *Linguistic Inquiry* 1: 291-306.
- Luce, Paul A., Jan Charles-Luce & Conor McLennan (1999). Representational specificity of lexical form in the production and perception of spoken words. *Proceedings of the XIVth International Congress of Phonetic Sciences (ICPhS99), San Francisco, August, 1999*: 1889-1892.
- Malécot, A. and P. Lloyd (1968). The /t:/d/ distinction in American alveolar flaps. *Lingua* 19: 264-272.
- McCarthy, J. J. (1999). Sympathy and phonological opacity. *Phonology* 16: 331-399.

- McCarthy, J. J. (2003). Sympathy, cumulativity, and the Duke-of-York gambit. In C. Féry & R. v. d. Vijver (eds), *The syllable in Optimality Theory*. Cambridge: Cambridge University Press.
- McMahon, A. M. S. (2000). *Lexical Phonology and the history of English*. Cambridge: Cambridge University Press.
- Patterson, David & Cynthia M. Connine (2001). Variant frequency in flap production: a corpus analysis of variant frequency in American English flap production. *Phonetica* **58**: 254-275.
- Prince, A. & P. Smolensky (1993). *Optimality Theory: constraint interaction in generative grammar*. Report no. RuCCS-TR-2. New Brunswick, NJ: Rutgers University Center for Cognitive Science. (Revised August 2002: ROA 537.)
- Prince, A. & B. Tesar (1999). Learning phonotactic distributions. Report no. RuCCS-TR-54. New Brunswick, NJ: Rutgers University Center for Cognitive Science. (ROA 353)
- Sproat, R. (1993). Looking into words. In S. Hargus & E. Kaisse (eds), *Studies in Lexical Phonology* (Phonetic and Phonology 4). San Diego: Academic Press.
- Tesar, B. & P. Smolensky (2000). *Learnability in Optimality Theory*. Cambridge, MA: MIT Press.
- Trudgill, Peter (1986). *Dialects in contact*. Oxford: Blackwell.
- Vance, T. (1982). 'Canadian Raising' in some dialects of the Northern United States. *American Speech* **62**: 195-210.
- Wells, J. C. (1982). *Accents of English*. Vol. 3: *Beyond the British Isles*. Cambridge: Cambridge University Press.
- Yip, M. (1996). Lexicon optimization in languages without alternations. In J. Durand & B. (eds). *Current trends in phonology: models and methods*. Vol. 2. Salford: European Studies Research Institute. 759-790.
- Zue, V. W. & M. Laferriere (1979). Acoustic study of medial /t, d/ in American English. *Journal of the Acoustical Society of America* **66**: 1039-1050.

CONTACT DETAILS

Ricardo Bermúdez-Otero

School of English Literature, Language, and Linguistics
University of Newcastle
Newcastle upon Tyne NE1 7RU
England

R.Bermudez-Otero@ncl.ac.uk

<http://www.staff.ncl.ac.uk/r.bermudez-otero/>