NELS 35 – University of Connecticut October 23, 2004
Kathryn Flack

Lateral phonotactics in Australian languages[*]

1. Introduction

Phonotactic restrictions on laterals:

- Laterals rarely appear word-initially.
- Laterals almost never appear postconsonantally.

Distribution is implicational: If laterals appear word-initially, they appear postvocalically.
If laterals appear postconsonantally, they appear word-initially.

(1) a. Panyjima (Dench 1991)
Laterals: l̪ l ɭ ʎ Word-initial: *l̪ *l *ɭ *ʎ Postconsonantal: *l̪ *l *ɭ *ʎ

b. Anindilyakwa (Leeding 1989)
Laterals: l̪ l ʎ Word-initial: l̪ l ʎ Postconsonantal: *l̪ *l *ʎ

Problem: How should these restrictions be explained?

Two possible explanations:

Positional sonority restrictions (e.g. Gouskova 2002, 2003; Smith 2002)
Sonority properties of laterals predict their distribution.

Licensing by Cue (LBC; e.g. Jun 1995; Kochetov 1999; Steriade 1997, 1999)
The interaction of lateral acoustics with contextual acoustics predicts their distribution.

This paper will show that:

An analysis based on positional sonority restrictions can explain lateral distribution.

The acoustic properties of laterals do not support a Licensing by Cue analysis.

[*] Thanks to John Kingston, John McCarthy, Joe Pater, Lisa Selkirk, Lyn Frazier, Michael Becker, Tim Beechey, Shigeto Kawahara, Ehren Reilly, Anne-Michelle Tessier, Adam Werle, Matt Wolf, and the participants in UMass Second Year Seminar and Phonology Group for suggestions and helpful discussion; also to Claire Bowern, Gavan Breen, and Rob Pensalfini for language data and expertise.

2. A sonority-based account

2.1. *Word-initial restrictions*

Languages like Panyjima don’t allow laterals word-initially.

Smith (2002): Minimize the sonority of word-initial onsets, in order to maximize the perceptual salience of word beginnings.

(2) [*ONSET/X]/σ_1 The leftmost premoraic segment in a word must have sonority less than that of X. (Smith 2002)

(3) [*ONS/Glide]/σ_1 » [*ONS/Rhotic]/σ_1 » [*ONS/Lateral]/σ_1 » [*ONS/Nasal]/σ_1 » [*ONS/Stop]/σ_1
↑
IDENT[F][1]

(on constraint hierarchies of this general type, see Prince and Smolensky 1993)

(4)

/lana/	[*ONS/Lateral]/σ_1	IDENT[F]
lana	*!	
➔ tana		*

This correctly predicts that when no laterals surface initially, no rhotics surface initially either.[2]

Panyjima has no initial laterals or rhotics: *r *ɾ *l̪ *l *ɭ *ʎ

2.2. *Postconsonantal restrictions*

Languages like Panyjima and Anindilyakwa allow no laterals postconsonantally (i.e. as the second member of medial coda-onset clusters).[3]

<u>Theoretical preliminaries</u>

- Parker (2002) found that the sonority values in (5) correlate with segments’ acoustic intensity.

---

[1] As this is a phonotactic effect, alternations provide no evidence about which faithfulness constraint bans initial laterals; I use IDENT[F] here, but MAX or DEP would work as well.

[2] Factorial typology predicts that glides should occasionally fail to follow the general sonority-based phonotactic patterns that other consonants do, because glides also have vocalic ([V-Place) features (Clements 1991). Formally, this means that the ranking IDENT[V-Place] » *sonority restrictions* » IDENT[F] is possible. Throughout Australian languages, it is possible for glides to surface word-initially and postconsonantally.

[3] Restrictions against *CL* sequences must be syllable-contact effects because languages like Gooniyandi (McGregor 1990) have initial (tautosyllabic), but not medial (heterosyllabic), CL clusters: *plan.pi.ɾa* ‘on one’s back’, but **kap.la*.

(5)

w j	11
r	10
l̪ l ɭ ʎ	9
ɾ	8
m n̪ n ɳ ɲ ŋ	6
p t̪ t ʈ c k	1

(relevant earlier work includes Clements 1990, Selkirk 1984, Steriade 1982, among others)

- Syllable contact is enforced by Gouskova's (2002, 2003) *DISTANCE X constraint hierarchy.

(6) *DISTANCE X The sonority difference between consonants in a heterosyllabic cluster may not be X.[4]

(7) ←steep rise ———————— flat ———————— steep fall →
…*DIST +3 » *DIST +2 » *DIST +1 » *DIST 0 » *DIST -1 » *DIST -2 » *DIST -3 …
e.g. **m.l*   **ʈ.c*   **l.m*

<u>Analysis of postconsonantal lateral restrictions</u>

The ranking in (8) is necessary in order to appropriately describe the complete inventory of heterosyllabic clusters. This ranking independently predicts a lack of lateral-final clusters.

(8) *DIST +8 » *DIST +3 » *DIST +1 » *DIST 0 » *DIST -1 » *DIST -2 » **IDENT[F]** » *DIST -5
e.g. **p.l*   **m.l*   **ɾ.l*   **ɭ.l*   **r.l*   **w.l*   ✓*n.c*

IDENT[F] » *DIST -5: The Panyjima cluster with the smallest (=worst) allowable sonority drop is N-Stop.

(9) *kan.ta* 'leave it!'
Sonority: 6.1 → slope = -5

(10)

/kan.ta/	IDENT[F]	*DIST -5
➔ kan.ta		*
kal.ta	*!	

[4] The *DISTANCE hierarchy is formally developed through relational alignment of the *ONSET/X and *µ/X hierarchies; this produces a syllable-contact hierarchy which may also be characterized in terms of numeric sonority contours.

*DIST -4 » IDENT[F]: Clusters with a drop of -4 (e.g. *r*.ŋ) never surface faithfully.

(11)

/tarŋa/	*DIST -4	IDENT[F]	*DIST -5
tar.ŋa	*!		
➔ tar.ka		*	

The ranking in (8), *DIST -4 » IDENT[F] » *DIST -5, predicts the absence of lateral-final clusters.

(12)

/tawla/	*DIST -2	*DIST -4	IDENT[F]	*DIST -5
taw.la	*!			
➔ taw.ta			*	

2.3. *Interim summary*

Australian languages commonly ban laterals word-initially and postconsonantally.

These restrictions can be explained in terms of the relatively high sonority of laterals.

Such an analysis correctly predicts other phonotactic patterns in Australian languages.

3. Alternative: Licensing by Cue

Licensing by Cue (LBC) would explain lateral phonotactics in terms of the interaction of lateral acoustics and contextual acoustics (Steriade 1997, 1999).

LBC has been applied to the phonotactics of <u>retroflex segments</u>.

Cross-linguistically, retroflexion is implicationally licensed: V_ > #_ > C_

Retroflexes differ from apico-alveolars in their left-edge F3, F4 transitions (Steriade 1999; Stevens and Blumstein 1975); this makes them <u>acoustically left-anchored</u>.

A segment's left-edge environment renders its left-edge cues more or less perceptable.

LBC analyses claim that the presence of asymmetrical segmental cues <u>determines</u> possible patterns of segmental phonotactics.

Observation: Laterals have the same V_ > #_ > C_ implicational distribution as retroflexes.

Experimental question: Are laterals, like retroflexes, acoustically left-anchored?

Result: There is no evidence of left anchoring in laterals.

3.1. Methods

Recordings from three Australian languages where lateral manner of articulation has an implicational V_ > #_ > C_ distribution.[5]

(13) a. Ngandi (Arnhem Land; Heath 1978)
Laterals: l ɭ Word-initial: l *ɭ Postconsonantal: l *ɭ

b. Jingulu (Mindi; Pensalfini 1997)
Laterals: l ɭ ʎ Word-initial: l ɭ *ʎ Postconsonantal: *l *ɭ *ʎ

c. Warlpiri (Pama-Nyungan; Nash 1986)
Laterals: l ɭ ʎ Word-initial: l *ɭ *ʎ Postconsonantal: *l *ɭ *ʎ

(Retroflex and palatal laterals are sometimes subject to independent restrictions, e.g. LBC, in particular phonotactic positions.)

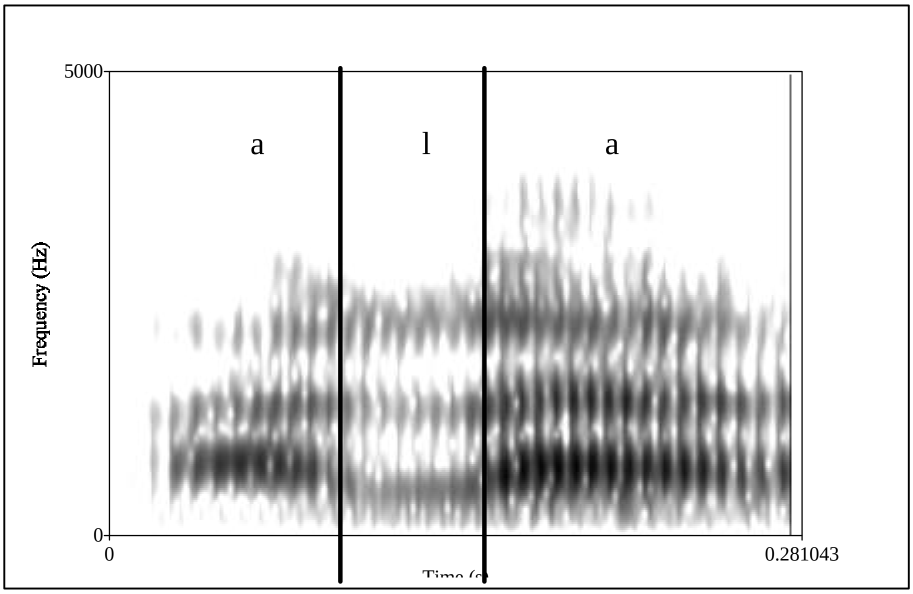

Figure 1. [ala], from Jingulu *kalaɾa*

Likely locus of acoustic asymmetry:

Formant transitions: **NO** – transitions appear basically symmetrical (unlike retroflexes). Stevens (1998: 550) reports long anticipatory F2 transitions in English laterals; these are not present in Australian laterals.

Overall spectral intensity: **YES** – laterals are less intense than vowels. The mouth is relatively closed and the supralingual cavity causes an acoustic zero.

---

[5] The author and Rob Pensalfini recorded a Jingulu speaker in Ngukurr in 1998; Tim Beechey recorded a Ngandi speaker in Numbular in 2003. Warlpiri data came from instructional Warlpiri-language tapes (Laughren et al. 1996).

Procedure:

Available tokens of laterals in each language, pronounced by a single speaker, in the context *a_a*, were selected.

- <u>Ngandi:</u> 10 *l*, 14 ɭ
- <u>Jingulu:</u> 5 ʎ, 9 *l*, 8 ɭ
- <u>Warlpiri:</u> 15 ʎ, 13 *l*, 12 ɭ

Edges of each lateral and flanking vowels were identified by hand.

Spectral amplitude measures in each lateral were taken (in Praat; Boersma and Weeninck 1992) at the midpoints of the glottal pulses which include the following positions:

- Midpoint of preceding and following vowels
- Midpoint of lateral
- Last three pulses in preceding vowel; first and last three pulses in lateral; first three pulses in following vowel

Amplitude measurements were normalized as follows:

- The intensity of the preceding vowel was subtracted from the intensity at points temporally preceding the lateral midpoint.
- The intensity of the following vowel was subtracted from the intensity at points following the lateral midpoint; this normalization to the nearest flanking vowel was intended to compensate for differences in e.g. the location of stress relative to the lateral.
- The intensity of the lateral midpoint was compared to to the intensity at the midpoints of both preceding and following vowels, to evaluate relative coarticulation.

Predictions: If laterals are left-anchored,

…preceding vowels should be less intense (more coarticulated with laterals) than following vowels

AND/OR

…vowel → lateral transitions should be less intense (more lateral-like) than lateral → vowel transitions.

3.2. *Results*

<u>Preceding vowels are NOT more coarticulated with laterals than following vowels.</u>

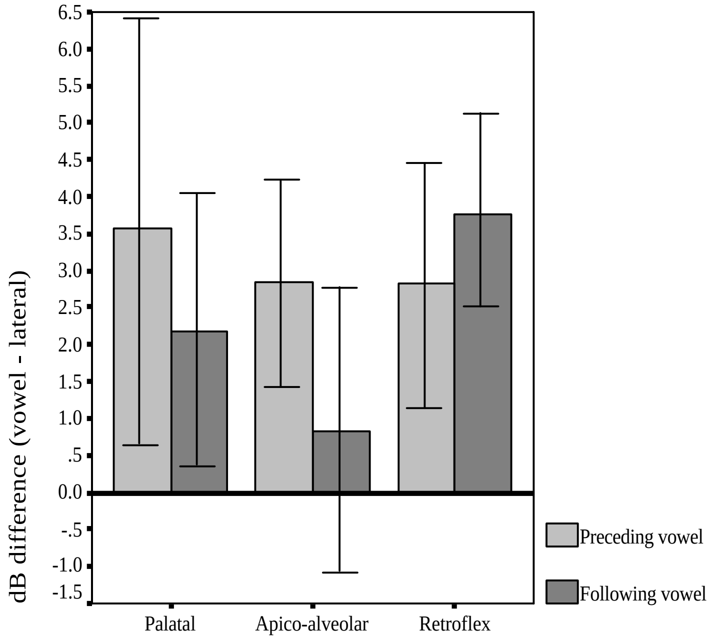

Figure 2. Flanking vowel coarticulation with laterals, measured as difference between the normalized intensity of laterals and preceding/following vowels; low values indicate high coarticulation. Data is averaged across Ngandi, Jingulu, and Warlpiri laterals at each place of articulation, with 95% CI.

Except for possibly in retroflexes, which are known to be independently left-anchored, laterals do not induce asymmetrical coarticulation in preceding vowels.

Anticipatory transitions are NOT more characteristically lateral than following transitions.

Does the end of the pre-lateral vowel look characteristically lateral? NO.

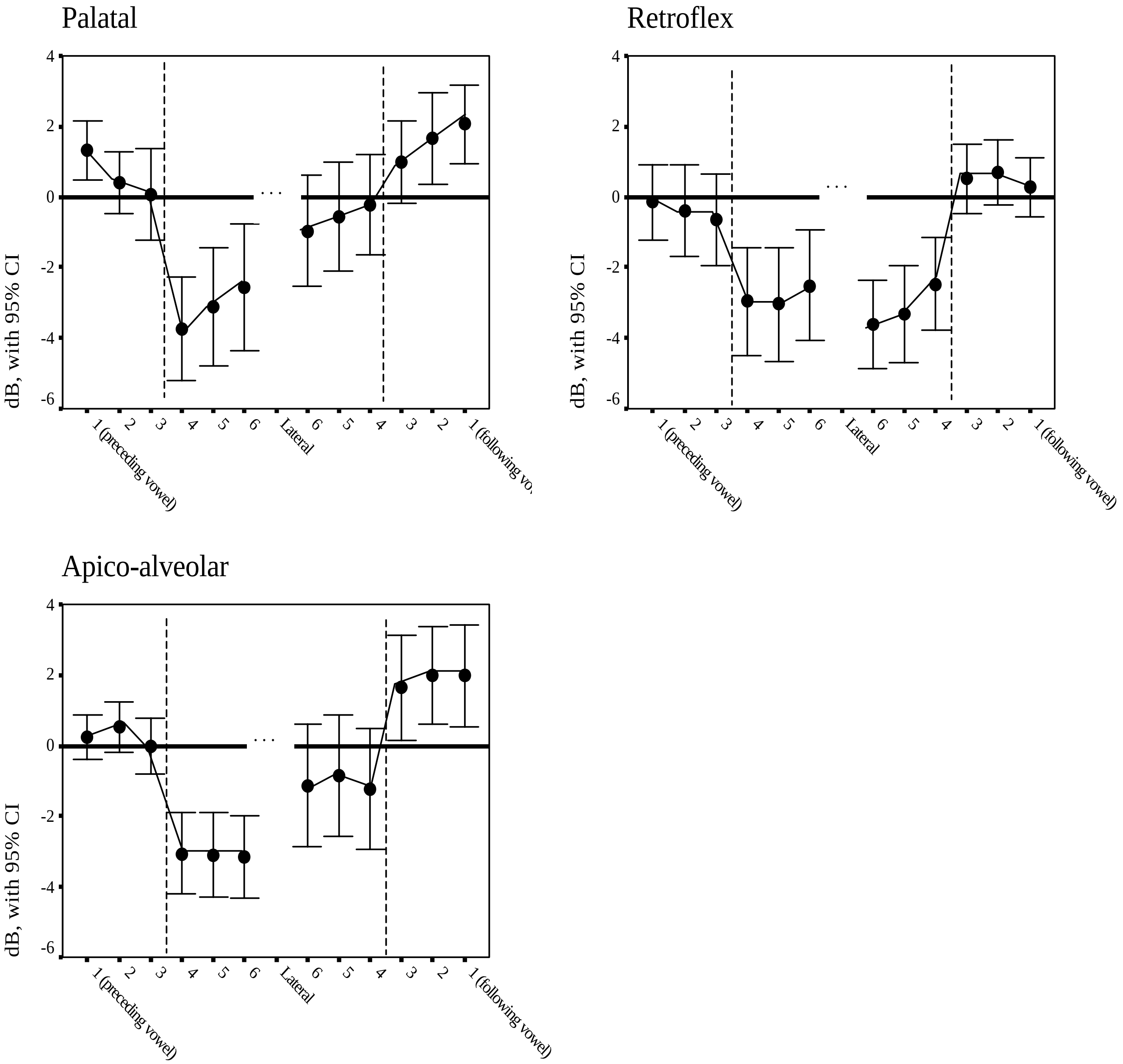

Figure 3. Normalized intensity across lateral edge transitions. Data points are at the midpoints of the three glottal pulses immediately preceding and following each edge of the lateral. Horizontal lines represent the intensity at the midpoints of each flanking vowel. Vertical lines represent lateral edges. Data is averaged across Ngandi, Jingulu, and Warlpiri laterals at each place of articulation, with 95% CI.

Conclusion: There is no evidence that laterals are left-anchored. LBC cannot explain their phonotactic distribution in terms of their acoustic properties.

3.3. *Discussion*

Given the acoustic data above, where would LBC predict that laterals should appear?

Figure 2: Following vowels may be more coarticulated with laterals than preceding vowels.

→ There may be more characteristics of laterality in a following vowel.

➔ **Laterals may be right-anchored.**

Figure 3: A brief, burst-like amplitude peak (relative to mid-vowel amplitude) follows a lateral.

Abrupt acoustic events play a crucial role in segment identification. (Blumstein and Stevens 1979, 1980; Stevens and Blumstein 1978)

→ More information about laterality seems to be available in a following vowel.

➔ **Laterals appear to be right-anchored.**

Laterals are **phonotactically left-anchored**, but are if anything **acoustically right-anchored**.

LBC (strong): Asymmetrical segmental acoustics determine segmental phonotactics.

Edge-sensitive segmental phonotactics are the result of asymmetrical acoustics.

These claims are NOT SUPPORTED by lateral acoustics.

LBC (weak): Asymmetrical segmental acoustics may determine segmental phonotactics (as for retroflex segments), but other factors may also be important (as for laterals).

4. Conclusion

The left-edge environment of a phonotactic position determines whether laterals are licensed.

Lateral acoustics:
- Show no evidence of left-anchoring.
- May show phonotactically unexpected evidence of right-anchoring.

Optimality-theoretic positional sonority restrictions:
- Correctly describe lateral phonotactics.
- Correctly predict other phonotactic patterns.

A sonority-based analysis is the best way to describe lateral phonotactics.

References

Boersma, Paul, and David Weenink (1992) *Praat: Doing Phonetics by Computer*. [www.praat.org]

Blumstein, Sheila E., and Kenneth N. Stevens (1979) Acoustic invariance in speech production: Evidence from measurements of the spectral characteristics of stop consonants. *Journal of the Acoustic Society of America* 66: 1001-1017.

Blumstein, Sheila E., and Kenneth N. Stevens (1980) Perceptual invariance and onset spectra for stop consonants in different vowel environments. *Journal of the Acoustical Society of America* 67: 648-662.

Clements, G. N. (1990). The role of the sonority cycle in core syllabification. In J. Kingston and M. Beckman (eds.) *Papers in Laboratory Phonology I: Between the Grammar and the Physics of Speech.* Cambridge: Cambridge University Press.

Clements, G. N. (1991) Place of articulation in consonants and vowels: A unified theory. In *Working Papers of the Cornell Phonetics Laboratory*, vol. 5, pp. 77-123. Ithaca: Cornell University.

Dench, Alan (1991) Panyjima. In R.M.W. Dixon and B.J. Blake (eds.) *Handbook of Australian Languages*, vol. 4, pp. 125-244. Oxford: Oxford University Press.

Gouskova, Maria (2002) Exceptions to sonority distance generalizations. *CLS 38: Main Session*.

Gouskova, Maria (2003) Relational hierarchies in OT. Ms. Rutgers University.

Heath, Jeffrey (1978) *Ngandi Grammar, Texts, and Dictionary.* AIAS: Canberra.

Jun, Jongho (1995) *Perceptual and Articulatory Factors on Place Assimilation.* Doctoral dissertation, University of California, Los Angeles.

Kochetov, Alexei (1999) A cue-based analysis of the distribution of palatalized stops in Russian. In O. Fujimura, B. Joseph and B. Palek (eds.) *Proceedings of the 1998 Linguistics and Phonetics Conference*, pp. 247-270. Prague: The Karolinum Press.

Laughren, Mary, Robert Hoogenraad, Kenneth Hale, and Robin Japanangka Granites (1996) *A Learner's Guide to Warlpiri: Tape Course for Warlpiri (Wangkamirlipa Warlpirilki)*. Alice Springs: IAD Press.

Leeding, Velma Joan (1989) *Anindilyakwa Phonology and Morphology*. Doctoral dissertation, Sydney University.

McGregor, William (1990) *A Functional Grammar of Gooniyandi*. Amsterdam: John Benjamins.

Nash, David (1986) *Topics in Warlpiri Grammar*. Garland Publishing Inc.: New York.

Parker, Stephen G. (2002) *Quantifying the Sonority Hierarchy*. Doctoral dissertation, University of Massachusetts, Amherst.

Pensalfini, Robert J. (1997) *Jingulu Grammar, Dictionary, and Texts*. Doctoral dissertation, MIT.

Prince, Alan, and Paul Smolensky (1993) *Optimality Theory: Constraint Interaction in Generative Grammar*. RUCCS Technical Report no. 2.

Selkirk, Elisabeth. 1984. On the major class features and syllable theory. In M. Aronoff and R.T. Oehrle (eds.), *Language Sound Structure.* Cambridge, Mass.: MIT Press.

Smith, Jennifer L. (2002) *Phonological Augmentation in Prominent Positions*. Doctoral dissertation, University of Massachusetts, Amherst.
Steriade, Donca (1982) *Greek Prosodies and the Nature of Syllabification*. Doctoral dissertation, MIT.
Steriade, Donca (1997) Phonetics in phonology: The case of laryngeal neutralization. Ms., MIT.
Steriade, Donca (1999) Alternatives to the syllabic interpretation of consonantal phonotactics. In O. Fujimura, B. Joseph, and B. Palek (eds.) *Proceedings of the 1998 Linguistics and Phonetics Conference*, pp. 205-242. Prague: The Karolinum Press.
Stevens, Kenneth N., and Sheila E. Blumstein (1975) Quantal aspects of consonant production and perception: A study of retroflex consonants. *Journal of Phonetics* 3: 215-234.
Stevens, Kenneth N., and Sheila E. Blumstein (1978) Invariant cues for place of articulation in stop consonants. *Journal of the Acoustical Society of America* 64: 1358-1368.