What keeps a historical phonologist up at night?
Part I: Phonologization

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A century on

- Ferdinand de Saussure (1916)
- Explain synchrony through diachrony
  - Blevins (2004): recurrent sound patterns ← changes
- Explain diachrony?
  - Speaking
  - Listening
  - Mingling
  - Synchronic structure?
  - Universals and biases?

Theoretical explanation

- An erroneous position: synchronic linguistics, as it is a science, must predict the range of phenomena we see and the range we don't see
  - E.g. Theory A is good because it explains why X does(n't) happen
  - It also predicts that Y should happen, but Y doesn't
  - That's fine because Y just can't be recovered from the input
- Input isn't arbitrary: has come about over time = diachronic explanation
  - If we invoke diachronic explanation for Y, then if it equally applicable for X, why not just use it there too (duplication problem)?
  - A good general approach: do as much as possible with as little

Theoretical explanation

- But if duplicated or other synchronic constraints empirically motivated, they should not be denied purely for theoretical parsimony
  - 'Diachronic explanation enjoys no epistemological priority over synchronic explanation: any attempt to justify such priority by appeal to Ockham's razor must fail… compelling only when one compares two empirically equivalent theories; … substantively different theories are hardly ever empirically equivalent' (Berm-O 2015)
- What does a theory of diachronic phonology look like?
  - Diachrony informs synchrony; synchrony informs diachrony
  - Amphichronic programme

What is explanation in diachrony?

- Information: Are the raw materials for a change present?
- Applicability: Can that information model the change in a way that matches the diachronic record?
- Causation: Does that information actually cause the change?

Language Acquisition, e.g. word segmentation through distributional regularities

- Information: predictability of following syllable (Harris 1954)
- Applicability: infants identify words
- Causation: infants sensitive to regularities (Saffran, Aslin & Newport 1996)

Diachronic phonology, e.g. Labovian change

- Information: physical/physiological reasons for variation
- Applicability: pool-structure matches common outcomes of sound change
- Causation: arbitrary selection of variants and admission into grammar under social pressure

Phonetics → Phonology / ?___?

- Phonologization (Hyman 1976)
  - Automatic patterns in articulation/perception give rise to controlled patterns
- Innovation problem: origin of new variant?
- Constraints problem: which patterns and conditions? (Weinreich et al. 1968)
- Actuation problem: why here? why now?
- Regularity problem: sound-based or item-based?
- Implementation problem: one for all and all for one?
- Arena problem: who? infants or adults?

The Speaker

Pool-structure

Speaker

- The focus of traditional, neogrammarian sound change typology
  - Articulatory reduction, simplification, variability
  - Residue (e.g. metathesis) have 'psychological' origin
- One extreme: All sound change involves articulatory reduction (Mowrey & Pagliuca 1995)
  - Magnitude of gestures reduced
  - Timing of gestures compressed or overlapped
  - But articulatory strengthening and perceptual effects?
- Other extreme: Speaker only contributes to 'pool of synchronic variation' (Ohala 1989)

Speaker: structured variation

(Garrett & Johnson 2013; Hansson 2008)

- Crucially, 'pool-structure' has very distinctive properties due to channel biases with inherent directionality
- Aerodynamic voicing constraint (Ohala 1983)
  - Constraint against voicing in stops and fricatives, short VOT in e.g. /ti/
  - Diachronic repairs: devoicing, glides from fricatives
- Gestural mechanics: magnitude, timing, location
  - Overlap: back gestures more likely to hide front gestures
    - Debuccalization, deletion: *hand grenade*, insertion: *Thompson*
    - Complex: Latin /gn/ > [ŋn] but not /gm/ > [ŋm] (Sen 2011, 2015)
  - Blend: more constricted gesture of single articulator usually shows greater acoustic change: quantal theory (Stevens 1989)
    - C not V in velar fronting: *keep* vs. *cop* (TB)

Speaker: from the mouth to the mind

- Motor planning (Garrett & Johnson 2013)
  - Speech errors through coactivation or inhibition of similar units: phonetically, structurally, temporally
    - Anticipations, perseverations, exchanges, deletions, insertions, tongue twister patterns
  - Like diachronic C (sibilant) harmony – usually anticipatory
  - Like nonlocal liquid metathesis – structural position
- Motor entrenchment (see Wedel 2007)
  - Practised routines form attractors which bias future motor execution in relation to similarity
    - Sound change: categorical change not widespread gradience
    - Speech error: substitute less frequent for similar more frequent
    - But what are units of these routines (if any)?
- Imitation
  - Similarity at level of community, but associated with social significance

Speaker control: H&H (Lindblom 1990)

- Speakers exert a degree of control
- 'Hypo-' to 'hyperspeech' continuum
  - Ambition of speakers to achieve articulatory targets
  - Social status, register, audience (e.g. listener needs)
- Variation intra- and inter-speaker of phon/lex units
- Successful hypospeech can be root of sound change
  - Minimization of articulatory effort: undershoot
  - Cross-linguistic variation: Italian vs English vowel reduction
- Prosodic conditioning: unstressed syllables

Speaker control: enhancement

- Counter-balanced by maximization of perceptual clarity?
- Requiring 'phonetic knowledge' (Kingston & Diehl 1994)
  - Wilson (2006): artificial learning generalizing /e/-palatalisation to /i/-palatalisation, but not vice versa
- But also structural knowledge of what is important (contrasts)?
- We know speakers exaggerate automatic phonetic effects and/or existing structural patterns
  - Coarticulation not mechanical and universal, but cognitive
  - Resulting in vowel harmony, tonogenesis
  - Contrast maintenance: nasalisation instead of devoicing as a result of aerodynamic voicing constraint?
- Conversely: non-implementation of physiologically and/or perceptually difficult contrasts?

Speaker: lexical effects

- Hypospeech
  - 'Changes that affect high-frequency words first are a result of the automation of production, the normal overlap and reduction of articulatory gestures that comes with fluency' Bybee (2002: 287)
- Hyperspeech
  - Low contextual predictability: harder to access
  - High neighbourhood density: harder lexical retrieval
  - Low-frequency words: low resting activation
    - How do these predict hyperspeech?
- Active speaker control or passive listener-cum-speaker effect (e.g. exemplar memory)?

Frequency Implementation Hypothesis

(Phillips 2001: 123-4; 2006: 181; 2015)

- A. If no analysis beyond the phonetic form of the word is required, then the most frequent words change first
  - Including physiologically based assimilations and reductions
  - Evidence for exemplar theory?
  - Can be very very fast spread in simulation, e.g. Wedel 2007's 'snowballing' effect can produce neogrammarian change but with initial catalysts
- B. Sound changes which require analysis (syntactic, morphological, phonological) affect the least frequent words first
  - Part of speech, morphological constituency
  - = analogical change 'when memory fails' (Hooper 1976)?
  - Per Phillips, type B includes syllable/phonotactic structure

There's structure, then there's structure

- Two discernable types of structural effect? (Sen 2015: 6-7)
- Structure → phonetics → change
  - = type A: indirect influence of structure
  - Latin assimilations, vowel reduction, inverse CL
- Structure → phonetics
  - = type B: direct influence = analogy
  - Latin vocalic epenthesis in /kl/: analogy of morpheme-initial to syllable-initial: affects lower-frequency
  - Honeybone (2013): categorical frequency effects, requiring categorical, non-exemplar-based account

Speaker summary: pool-structure

- Information
  - Structured variation through aerodynamic and articulatory constraints
  - Similarity/difference effects in speech production planning
  - Contextually constrained (H&H)
  - Possible access to 'phonetic (and structural) knowledge'
  - Lexical information affects realization
- Applicability
  - Pool-structure can model practically all attested changes if we permit 'phonetic knowledge
  - Some directionalality: B variants of A, but not A variants of B
  - Motor entrenchment predicts categorical effects
- Causation
  - We can record variation and change-in-progress
  - Selection from structured pool apparently arbitrary

The Listener

Misperception

Listener: the co-ordination problem

- Perceptual cues to identify intended sounds
- Normalization to correct for predictable variation
- Ohala (passim): sound change originates when a listener misperceives or misparses the acoustic signal produced by the speaker…
- …arriving at a representation which differs in some respect from that intended
- All – some – any sound change attributable to this?
- Representational or computational change?
  - Lexical representation replaced or new rule?

Hypo- and hypercorrection (Ohala 1993)

- Hypocorrection
  - Speaker's contextual effects interpreted as phonologically intended, e.g. assimilations: Lat. *atnos* > *annus* 'year'
  - Close correspondence to articulatory effects identified (gestures)
- Hypercorrection
  - Speaker's phonologically intended effect interpreted as contextual, e.g. dissimilations: '*who*se *sword*'
  - Lat. **mīllia* > *mīlia* 'thousands' (/ll/ specified palatalized)
- Confusion of acoustically similar sounds
  - Weak perceptual cues for contrast
  - E.g. neutralization of obstruent voice when unreleased
- But what causes asymmetries in any of these?
  - Hypo-/hypercorrection and confusability are mirror-images

Listener: CCC model (Blevins 2004)

- CHANGE: signal misheard outright: weak perceptual cues to phonological form
  - Speaker (crucially) says [anpa] (so not hypocorrection of coarticulation)
  - Listener perceives as [ampa] and interprets it as /ampa/
  - Context-free place of articulation shifts like /θ/ > /f/
- CHANCE: intrinsically ambiguous signal: phonological form misinterpreted
  - Hypocorrection: Speaker [an͡mpa] for /anpa/ > Listener /ampa/
  - Hypercorrection: *whose sword* dissimilations, etc.
- CHOICE: different variant (from many of different frequencies: H&H) selected as best reflection of phonological form
  - Pool-structure
  - Selection might be arbitrary/socially conditioned
- Only CHANGE is intrinsically asymmetric due to apparent biases in perception, but other types appear to show asymmetries too

Listener: asymmetric perceptual parsing

- Confusability insufficient as there are asymmetries
  - [k] > [ʧ] before front vowels, but no [ʧ] > [k]
  - Intervocalic stop voicing, but no intervocalic stop devoicing
  - [t] > [ʔ] word-finally, but no [ʔ] > [t]
- Many asymmetries attributable to speaker's pool
- Filtering role of the perceptual system is crucial
  - Lax Vs confused as lower, and indeed tend to lower
  - More likely erroneously to interpret an acoustic element as absent than present: palatalization
  - Perceptual hypercorrection, e.g. expect nasality before nasal Cs, so nasal contrast suspended
  - Categorical perception
  - Perceptual magnet effect (Kuhl 1991, 1995)

Misperception? (Scheer 2014)

- If pool-structure provides variation in a way that explains frequency of sound changes
- And socially-based, arbitrary selection of variant as source of sound change is documented (Labov 2010)
- Why do we need misperception, the middle-man?
  - 'Misperception-induced change is only a logical possibility that is based on speculation'
  - 'Nobody has ever documented or measured an actual misperception as the source of language change'
- Information and applicability, but causation is lacking
- What would provide evidence in favour?

(1) Perceptual biases shape sound change: asymmetries

- But whether these are absolutely necessary is debated (Garrett & Johnson 2013)
- Velar palatalization [k] > [ʧ] (Guion 1998)
  - But is there always intermediate [c] diachronically, which is affricated by the speaker as an enhancement?
- Unconditioned [θ] > [f]
  - Intermediate $θ^w$ + enhancement?
- Obstruent + [w] > labial obstruent shifts
  - Articulatory fortition of [w]?
- Alternative explanations depend upon the degree of phonetic and structural knowledge the speaker employs; perceptual parsing bias seems best solution

(2) Link misperception with sociolinguistic patterns (Yu 2013)

- WHO MISPERCEIVES? Why does whole community change?
- Variability in cognitive processing style is an important contributing factor to variation in (mis)perception
  - Women with low AQ (Autism-Spectrum Quotient) and imbalanced brain types (empathizing-systematizing) less likely to engage in perceptual compensation → hypocorrection
- Cognitive processing style shown to correlate with individual differences in social traits: may influence how an individual interacts with other members of his/her social network
- Individuals who are most likely to introduce new variants in a speech community…
- …might also be the same individuals who are most likely to be imitated by the rest of the speech community due to their personality traits and other social characteristics

Questions for Yu (2013)

- Failure to compensate for coarticulation leads to hypocorrection
- Excessive compensation leads to hypercorrection
- Who does this? High AQ individuals?
- How are these changes spread through community?
- Are hypercorrections the result of other principles, e.g. simplicity: why should speaker articulate imperceptible elements?
- Are causes of AQ EQ SQ innate in the individual so present from birth?
- If so, infants might misperceive in L1
- Relevant infants then carry on this grammar into adulthood and play relevant social roles
- The arena problem: so do infants participate in sound change?

Acquisition

- Paul (1886: 34; tr. Weinreich et al. 1968: 108): 'the processes of learning language are of supreme importance for the explanation of changes'
- Aitchison (2003: 739) 'babies do not initiate changes'
- How might L1 be relevant?
  - Child as speaker
  - Child as listener (-cum-speaker)
  - Child as organiser

Child as speaker (Foulkes & Vihman 2015)

- Typical child patterns rare in sound changes
  - Consonant harmony
- Typical sound changes mismatch with child patterns
  - CV-interactions, e.g. palatalizations
- Conflicting repairs for (too) long words and C-clusters
- Child vocal tract not scaled-down adult tract
- Contrast not as important, but information recall is a problem
  - 'We interpret peaks [in error types at a certain age] as an indication that the children were experimenting with articulatory strategies at certain points in their development, eventually dispensing with phonetic forms that are not sufficiently good matches to adult usage'
- What about when they *are* sufficiently good?
- Prediction: as contrast-sensitivity increases, child patterns which are problematic will be lost, but unproblematic ones may be retained

Child as speaker: palatalization

- Vocal tract: palatal contact when articulating dentals/alveolars more likely for young child than for adults
- Ages 2;4-4;2: Palatalization 4th most common error for later talkers, 6th most common error for typical developers: *that is beans* [daçɪçbiːç]
- Ages 2;0-4;0: Initial /t/: most frequent error is [ʧ], usually before close(-mid) V
  - 'indeed predicted as a conditioned sound change'
- Unlike 'peaking' errors which fall away, palatalization error remains relatively stable across the age range (errors in 4–5% from 2;6)
- WHY? Sufficiently good match?
  - Despite origin in immature vocal tract

Child as speaker: coarticulation

- Little re: infants on the purported common articulatory roots of change: coarticulation and reduction
  - Infant variation in [anpa] [an͡mpa] [ampa] for /anpa/?
  - [kʷuː] for /kwuː/ or [ʧi] for /ti/ (YES!)?
- More on perception than production, but 'child as organiser':
- Word: Goodell & Studdert-Kennedy (1990)
  - Intersyllabic coarticulation of tongue height at 19-27 months
- Syllable: Repp (1986)
  - Strong intrasyllabic coarticulation at 4;8 (more than adults, Nittrouer et al. 1989)

Child as listener

- Sufficiently good match suggests child perception relevant
- Perceptual parsing biases present from infancy
- Do children commonly perceive /ampa/ for /anpa/ or /kʷuː/ for /kwuː/ or /ʧi/ for /ti/?
- Common denominator: little (if any) perceptual distance between forms
  - 'Perceptually tolerable articulatory simplification' (Hura et al 1992)
- Is /θ/ > /f/ (e.g. Vihman 1982) also a relic of an immature vocal tract, maintained through perceptual tolerability?
- 'Good match' could also be when perceptibly different variant already exists in adult language
  - Hence older children participate in/accelerate ongoing changes, e.g. glottaling and pre-aspiration in Newcastle

An acquisition hypothesis

- Structure of pool of variation might originate in infancy
  - Perceptually intolerable variants filtered out
  - Tolerable variants surviving
- Imperceptible reanalyses might originate in infancy
  - Adult intended /kwuː/, infant perceived /kʷuː/; all say [kʷuː]
  - Infant misperceivers just like adult ones with low ASQ (Yu 2013)
  - This change only becomes apparent if e.g. u-fronting occurs, so variant representations which might have been present from infancy surface: [kwʉ] vs. [kʉ]
  - Or if it is an 'input restructuring' reanalysis, e.g. phrase-level output analysed as phrase-level input (see tomorrow)
- Acceleration of existing changes may rely on infants
  - Exemplar theory (e.g. Wedel 2007) predicts that a variant can serve as a catalyst for more substantive category change particularly during language acquisition

How far can articulation and perception alone take us?

- Almost all natural and (rarity of) unnatural, including 'crazy' rules (Bach & Harms 1972) accounted for well
  - Natural processes could be 'telescoped' or 'inverted' through reanalysis to produce unnatural results
  - Uncommon results might also come about through typologically uncommon phonetic implementation
  - E.g. Latin vowel reduction, inverse compensatory lengthening, degemination of V:CC, CV:CV > CVC
  - All due to longer Vs in closed syllables than open in archaic Latin (Sen 2012)
- Absolute prohibitions fail to explain unnatural results
- But there are challenges to reductionism…

Some devoicing issues (Anderson 2015)

- Why should devoicing affect fricatives as well as stops?
  - At least some of the aerodynamic effects invoked depend on a closed cavity, but in fact we do not find rules devoicing stops but not fricatives in final position
- How does phrase-final devoicing generalize so easily to word-final or even syllable-final devoicing?
  - The relevant aerodynamic and acoustic effects invoked do not obviously generalize from phrase-final position
  - Rule generalization addressed tomorrow!
- If phonetic cues lead to ambiguity, why do we never find speakers interpreting the result as final voicing of voiceless obstruents?

Universal Grammar

- Synchronic patterns which should be diachronically accessible in fact categorically unattested? 'Straitjacket effects' (de Lacy 2006)
- Position (1) 'Prophylactic' UG: blocks phonetically driven sound change resulting in synchronically unacceptable pattern from occurring
  - Not widely held
- Position (2) 'Triggering UG': Sound change occurs, but repair strategies automatically triggered
  - De Lacy & Kingston (2013)
- Position (3) 'Blind spot UG': Sound change occurs, but pattern not interpreted as being due to a synchronic process
  - Kiparsky (2006)
- Common theme: all-or-nothing, but also gradient analytic biases possible (Moreton 2008; 2010)

Unclear if UG constraints required

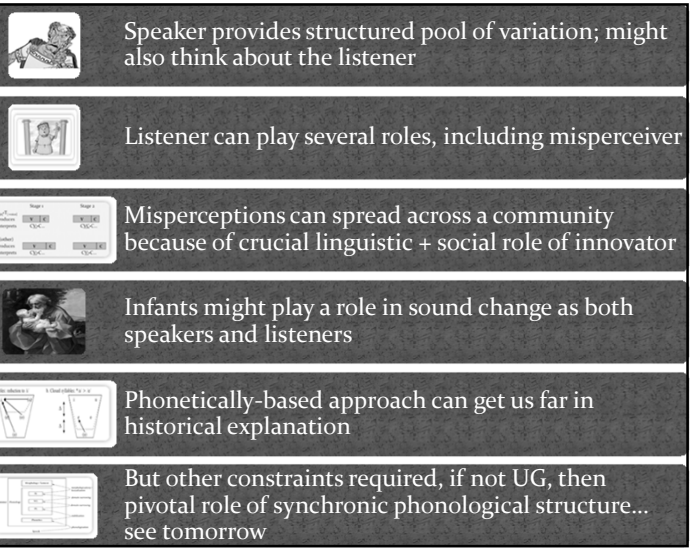
- Lezgian: does final obstruent voicing exist?
  - Yes (Yu 2004)
  - No (Kiparsky 2006)
  - Yes (Anderson 2015)
- Does [k g] epenthesis (not [t d]) exist?
  - No (De Lacy & Kingston 2013)
  - Yes (Anderson 2015): standard Halh Mongolian, [g] inserted to break up vowel sequences
- Diachronically accessible through several changes? Phonetically sound?
- What are full range of predicted accessible changes? Must be pretty big

But if they are… (Anderson 2015)

- No reproductive advantage, but…
- Sound pattern regularity could profitably be incorporated into the Language Faculty as a bias in the learning algorithm
- Facilitating rapid and efficient learning of languages
- 'This is an instance of the Baldwin Effect in evolution (Weber & Depew 2003), arguably essential if we are to believe that the Language Faculty has much specific content'
- Many aspects of UG closely match phenomena which have historical explanation
  - Teasing the two apart will not be easy

Some other (unaddressed) questions

- Successive generations of speakers use innovative variants with increasing frequency: why?
  - Boersma (2009), Hamann (2009) account for cross-generational trends
- What are the top-down influences on lexical diffusion?
  - Pressure of markedness constraints in marginal contrasts? (Berm-O 2007)
- What is the role of 'Structural analogy' (Blevins 2004) or 'System-internal attractors' (Wedel 2007)?
- To what extent is phonology a self-organizing complex system? (Wedel 2007; Lindblom et al. 1984)



References

- Aitchison, Jean (2003). 'Psycholinguistic perspectives on language change', in Brian D. Joseph & Richard D. Janda (eds), *Handbook of Historical Linguistics*. Oxford: Blackwell, 736-43.
- Anderson, Stephen R. (2015). 'Synchronic versus diachronic explanation and the nature of the language faculty', *Annual Review of Linguistics* (2016) 2: 5.1-5.21. Review in Advance first posted online on August 19, 2015. Downloaded from www.annualreviews.org.
- Bach, Emmon & Robert T. Harms (1972). 'How do languages get crazy rules?', in Robert P. Stockwell & Ronald K. S. Macaulay (eds), *Linguistic change and generative theory*. Bloomington, IN: Indiana University Press, 1-21.
- Blevins, Juliette (2004). *Evolutionary phonology: the emergence of sound patterns*. Cambridge: Cambridge University Press.
- Bermúdez-Otero, Ricardo (2007). 'Diachronic phonology', in Paul de Lacy (ed.), *The Cambridge Handbook of Phonology*. Cambridge: Cambridge University Press, 497-517.
- ——— (2015). 'Amphichronic explanation and the life cycle of phonological processes', in Patrick Honeybone & Joseph C. Salmons (eds), *The Oxford Handbook of Historical Phonology*. Oxford: Oxford University Press, 374-399.
- Boersma, Paul (2009). 'Cue constraints and their interaction in phonological perception and production', in Paul Boersma & Silke Hamann (eds), *Phonology in Perception*. Berlin: Mouton de Gruyter, 55-109.
- Bybee, Joan L. (2002). 'Word frequency and context of use in the lexical diffusion of phonetically conditioned sound change', *Language Variation and Change* 14: 261-90.
- de Lacy, Paul (2006). 'Transmissibility and the role of the phonological component', *Theoretical Linguistics* 32: 185-96.
- de Lacy, Paul & John Kingston (2013). 'Synchronic explanation', *Natural Language and Linguistic Theory* 31: 287-355.
- de Saussure, Ferdinand (1916). *Cours de linguistique générale*. Lausanne-Paris: Payot.
- Foulkes, Paul & Marilyn Vihman (2015). 'First language acquisition and phonological change', in Patrick Honeybone & Joseph C. Salmons (eds), *The Oxford Handbook of Historical Phonology*. Oxford: Oxford University Press, 289-312.
- Garrett, Andrew & Keith Johnson (2013). 'Phonetic bias in sound change', in Alan C. L. Yu (ed.), *Origins of Sound Change: Approaches to Phonologization*. Oxford: Oxford University Press, 51-97.
- Goodell, Elizabeth W. & Michael Studdert-Kennedy (1990). 'From phonemes to words, or from words to phonemes: how do children learn to talk?', poster presented at the International Conference on Infant Studies, Montreal. [Cited in Vihman 1996].

References

- Gaion, Susan G. (1998). 'The role of perception in the sound change of velar palatalization', *Phonetica* 55: 18-52.
- Hamann, Silke (2009). 'The learner of a perception grammar as a source of sound change', in Paul Boersma & Silke Hamann (eds), *Phonology in Perception*. Berlin: Mouton de Gruyter, 111-49.
- Hansson, Gunnar Ó. (2008). 'Diachronic explanations of sound patterns', *Language and Linguistics Compass* 2(5): 859-93.
- Harris, Zellig S. (1954). 'Distributional structure', *Word* 10: 146-162. Reprinted in Jerry A. Fodor and Jerrold J. Katz (eds) (1964), *The Structure of Language: Readings in the Philosophy of Language*. Englewood Cliffs, N.J.: Prentice-Hall, 775-794.
- Honeybone, Patrick (2013). 'Frequency effects are not incompatible with Formal Phonology: how exceptionless should we expect change to be?', paper presented at GLOW 36 workshop: *Diachronic Workings in Phonological Patterns*, Lund, April 2013.
- Hooper, Joan B. (1976). 'Word frequency in lexical diffusion and the source of morphophonological change', in W. M. Christie (ed.), *Current Progress in Historical Linguistics: Proceedings of the Second International Conference on Historical Linguistics, Tucson, Ariz., 12–16 January 1976*. Amsterdam: North-Holland, 95-105.
- Hura, Susan, Björn Lindblom & Randy Diehl (1992). 'On the role of perception in shaping phonological assimilation rules', *Language and Speech* 35: 59-72.
- Hyman, Larry (1976). 'Phonologization', in Alphonse Juilland, A. M. Devine & Laurence D. Stephens (eds), *Linguistic Studies offered to Joseph Greenberg on the Occasion of his Sixtieth Birthday*. Saratoga, CA: Anma Libri, 407-18.
- Kingston, John & Randy L. Diehl (1994). 'Phonetic knowledge', *Language* 70: 419-54.
- Kiparsky, Paul (2006). 'The amphichronic program vs. evolutionary phonology', *Theoretical Linguistics* 32: 217-36.
- Kuhl, Patricia K. (1991). 'Human adults and human infants show a "perceptual magnet effect" for the prototypes of speech categories, monkeys do not', *Perception and Psychophysics* 50: 93-107.
- ——— (1995). 'Mechanisms of developmental change in speech and language', in Kjell Elenius & Peter Branderud (eds), *Proceedings of the 13th International Congress of Phonetic Sciences*. Vol. 2. Stockholm: KTH and Stockholm University, 132–9.
- Labov, William (2010). *Principles of Linguistic Change: Cognitive and Cultural Factors*. Malden, MA: Wiley-Blackwell.
- Lindblom, Björn (1990). 'Explaining phonetic variation: a sketch of the H&H theory', in William J. Hardcastle & Alain Marchal (eds), *Speech Production and Speech Modeling*. Dordrecht, The Netherlands: Kluwer, 403-39.

References

- Lindblom, Björn, Peter MacNeilage & Michael Studdert-Kennedy (1984). 'Self-organizing processes and the explanation of phonological universals', in Brian Butterworth, Bernard Comrie & Östen Dahl (eds), *Explanations for language universals*. Berlin: Mouton. 181-203.
- Moreton, Elliott (2008). 'Analytic bias and phonological typology', *Phonology* 25(1): 83-127.
- ——— (2010). 'Underphonologization and modularity bias', in Steve Parker (ed.), *Phonological Argumentation: Essays on Evidence and Motivation*. London: Equinox, 79-101.
- Mowrey, Richard & William Pagliuca (1995). 'The reductive character of articulatory evolution', *Rivista di Linguistica* 7: 37-124.
- Nittrouer, Susan, Michael Studdert-Kennedy & Richard S. McGowan (1989). 'The emergence of phonetic segments: evidence from the spectral structure of fricative-vowel syllables spoken by children and adults', *Journal of Speech and Hearing Research* 32: 120-32.
- Ohala, John J. (1983). 'The origin of sound patterns in vocal tract constraints', in Peter F. MacNeilage (ed.), *The Production of Speech*. New York: Springer-Verlag, 189-216.
- ——— (1989). 'Sound change is drawn from a pool of synchronic variation', in Leiv Egil Breivik & Ernst Håkon Jahr (eds), *Language Change: Contributions to the Study of its Causes*. Berlin: Mouton de Gruyter 173-198.
- ——— (1993). 'The phonetics of sound change', in Charles Jones (ed.), *Historical Linguistics: Problems and Perspectives*. London: Longman, 237-78.
- Paul, Hermann (1886). *Prinzipien der Sprachgeschichte*. 2nd ed. Halle: Max Niemeyer.
- Phillips, Betty S. (2001). 'Lexical diffusion, lexical frequency, and lexical analysis', in Joan L. Bybee and P. J. Hopper (eds), *Frequency and the emergence of linguistic structure*. Amsterdam: Benjamins, 123-36.
- ——— (2006). *Word frequency and lexical diffusion*. New York; Basingstoke: Palgrave Macmillan.
- ——— (2015). 'Lexical diffusion in historical phonology', in Patrick Honeybone and Joseph C. Salmons (eds), *The Oxford Handbook of Historical Phonology*. Oxford: Oxford University Press.
- Repp, Bruno H. (1986). 'Some observations on the development of anticipatory coarticulation', *Journal of the Acoustical Society of America* 79: 1616-19.

References

- Saffran, J. R., R. N. Aslin & E. L. Newport (1996). 'Statistical learning by 8-month-old infants', *Science* 274: 1926-8.
- Scheer, Tobias (2014). 'The mechanics of phonological change', paper presented at the First Edinburgh Symposium on Historical Phonology, Edinburgh, 13-14 January 2014.
- Sen, Ranjan (2011). 'Diachronic phonotactic development in Latin: the work of syllable structure or linear sequence?', in Charles Cairns & Eric Raimy (eds), *Handbook of the Syllable*, Brill's Handbooks in Linguistics 1. Leiden; Boston: Brill, 417-41.
- ——— (2012). 'Reconstructing phonological change: duration and syllable structure in Latin vowel reduction'. *Phonology* 29(3): 465-504.
- ——— (2015). *Syllable and Segment in Latin*. Oxford Studies in Diachronic and Historical Linguistics 16. Oxford: Oxford University Press.
- Stevens, Kenneth N. (1989). 'On the quantal nature of speech', *Journal of Phonetics* 17: 3-46.
- Vihman, Marilyn M. (1982). 'A note on children's lexical representations', *Journal of Child Language* 9: 249-53.
- ——— (1996). *Phonological Development: The Origins of Language in the Child*. 1st ed. Oxford; Cambridge, MA: Blackwell.
- Weber, Bruce H. & David J. Depew (eds) (2003). *Evolution and Learning: The Baldwin Effect Reconsidered*. Cambridge, MA; London: MIT Press.
- Wedel, Andrew B. (2007). 'Feedback and regularity in the lexicon', *Phonology* 24(1): 147-85.
- Weinreich, Uriel, William Labov & Marvin I. Herzog (1968). 'Empirical foundations for a theory of language change', in W. P. Lehmann & Yakov Malkiel (eds), *Directions for Historical Linguistics: A Symposium*. Austin: University of Texas Press, 95-188.
- Wilson, Colin (2006). 'Learning phonology with substantive bias: an experimental and computational study of velar palatalization', *Cognitive Science* 30: 945-82.
- Yu, Alan C. L. (2004). 'Explaining final obstruent voicing in Lezgian: phonetics and history', *Language* 80: 73-97.
- ——— (2013). 'Individual differences in socio-cognitive processing and the actuation of sound change', in Alan C. L. Yu (ed.), *Origins of Sound Change: Approaches to Phonologization*. Oxford: Oxford University Press, 201-27.