Origins of Sound Change

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Approaches to Phonologization

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Part IV. Social and computational dynamics

Preface

The content of this volume grew out of a workshop on phonologization held at the University of Chicago, Illinois, in April, 2008. The majority of the chapters in this volume are based on papers presented at the workshop. In an attempt to broaden the breadth and perspectives presented in this volume, however, others were added.

The term 'phonologization', which Larry Hyman defined in 1976 as 'what begins as an intrinsic byproduct of something, predicted by universal phonetic principles, ends up unpredictable, and hence, extrinsic' (Hyman 1976: 408), gained prominence as a result of the publication of Hyman's seminal article under the same name. As Hyman reviews in his contribution to this volume, however, defining 'phonologization' is not so straightforward given the complexity in delineating the boundary between what is phonetic and intrinsic and what is phonological and extrinsic. He considers the role of contrast in the phonologization process and suggests that the term 'phonologization' needs to be extended to cover other ways that phonological structure either changes or comes into being. He ultimately concludes that phonologization is but one aspect of the larger issue of how (phonetic, semantic, pragmatic) substance becomes linguistically codified into form. Elizabeth Hume and Frédéric Mailhot, on the other hand, seek to conceptualize the phenomenon of phonologization from the perspective of information theory (Shannon 1948). In particular, they argue that information-theoretic concepts such as entropy—which models a cognitive state of the language user associated with the amount of uncertainty regarding the outcome of some linguistic event—and surprisal—which is context-dependent and is associated with individual elements of the system—are useful tools for understanding how external factors, individually and together, influence the progression of sound change. Phonologization, for example, is predicted to preferentially affect elements linked to extreme degrees of surprisal.

Many issues are intertwined when discussing the phenomenon of phonologization. As such, the task of arranging the chapters into coherent sections was made all the more difficult. In the end, I have settled on four broad themes, corresponding to different facets of phonologization research. It is important to point out, however, that many chapters touch on themes that would have made them just as appropriate under a different heading.

Much energy has been dedicated to understanding sound change by identifying the very early inception of change, that is, the identification of perturbations of the speech signal, conditioned by physiological constraints on articulatory and/or auditory mechanisms, which affect the way sounds are analyzed by the listener. While this emphasis on identifying the intrinsic variation in speech has provided important

insights into the origins of widely attested cross-linguistic sound changes, the nature of phonologization has remained largely unexplored. Several factors, however, have been implicated in the phonologization process, chief among them are channel and analytic biases (Wilson 2006, Zuraw 2007, Moreton 2008, 2010, Yu 2011). Channel bias refers to the relative likelihood of a phonetic precursor to sound change becoming phonologized into full-fledged sound patterns (e.g. Hyman 1976, Ohala 1993, Lindblom et al. 1995, Hume and Johnson 2001, Blevins 2004). The four chapters in Part II consider the nature of the channel bias. Andrew Garrett and Keith Johnson review the state of the art of channel bias research, showing that most typologies of sound change have drawn either a two-way distinction between changes grounded in articulation and perception or a three-way distinction among perceptual confusion, hypocorrective changes, and hypercorrective changes. Heike Lehnert-LeHouillier explores the role of language-specific perceptual cues in sound changes involving vowel length and tone/accent on the one hand, and vowel length and vowel height on the other. Based on the results of a cross-linguistic perception experiment, which tested the influence of a falling f_0 and vowel height on the perception of vocalic length, she argues that spectral differences (as acoustic correlates of vowel height) are more tightly linked to the perception of vowel duration than f_0 (as the acoustic correlate of tone/accent). Sam Tilsen, on the other hand, focuses on the contribution of motor planning in sound change. He argues that contrast-maintaining inhibitory interactions during contemporaneously planned articulation play a role in contrast maintenance on diachronic timescales and bias productions toward maximal contrast. Sound change is often assumed to result from listeners having little a priori assumptions about the language to which they are exposed (e.g. Ohala 1993). Such an approach emphasizes the role of first language acquisition in shaping the course of phonologization. Chandan Narayan presents a survey of work addressing developmental processes and the nature of phonological systems and change. He argues that the types of phonetic contrasts that infants fail to discriminate are those that are rare in the world's sound systems, which is in part due to their fragile acoustic-perceptual salience. He also surveys recent research into the fine-grained phonetics of infant-directed speech in English, which shows acoustic conditions similar to those targeted in well-known sound changes in the world's languages. These findings suggest that the ambient language input to infants has the potential to provide the seeds of phonological change.

Analytic biases are limitations in computation or markedness relations and constraints imposed by the Universal Grammar. An analytic bias might render certain patterns difficult to acquire even from perfect learning data. The nature of analytic biases is a matter of much debate. The three chapters in Part II wrestle with this debate. Abby Kaplan argues for the importance of phonological markedness in shaping the nature of the lexicon. She examines two cases of 'underphonologization', one where phonetic pattern is known to influence phonological patterns, and

one where it doesn't. She concludes that phonology rather than phonetics directly influences patterns of lexical frequency. While Kaplan argues for the primacy of phonology over phonetics, Jeff Mielke argues that phonological features are derivative of phonetic effects that are phonologized into sound patterns. He measures the crosslinguistic frequency of occurrence of classes defined by particular features and examines the phonological behavior of these classes. The characteristic behavior profiles of features suggest that different features behave differently (e.g. more or less assimilation or dissimilation, different behavior of + and – values, etc.), often because the need for a particular feature is dominated by a particular type of phonetically-motivated phonological pattern (e.g. voicing assimilation for classes defined by [voice] and [−sonorant]). He argues that the prevalence of these characteristic phonological patterns is best attributed to the phonologization of phonetic effects.

Phonological patterns often show effects of non-derived environment blocking. That is, some sound alternations only obtain at morphological boundaries but not in non-derived environments. How phonetic precursors to sound patterns come to be phonologized only at morphological boundaries has not been previously explored. Rebecca Morley tests the ability of participants to learn an association that was conditioned on a morphological boundary, but that consisted of acoustic information that was sub-phonemic in nature (degree of nasalization on a pre-nasal vowel, which is never contrastive in English), using an artificial grammar learning paradigm. The results show that listeners are successful in learning the morphological association with novel phonetic cues even over short time periods and that grammatical and sub-grammatical components of the linguistic system have the ability to interact. These results thus offer supportive evidence for a historical phonetic origin for phonological processes that only apply (or only fail to apply) in derived environments.

Understanding the emergence of new speech norms requires more than understanding the constraints and biases that shape the trajectory of change. The phonetic and systematic bias factors delineate the preconditions for change, but they do not explain why a change emerges at a particular moment in history, in one community and not others.

The last part of this volume contains chapters that address the issue of the social and computational dynamics of variation and change, a crucial facet of the phonologization process. To bridge the gap between the emergence of new variants and their eventual propagation, a linking theory is needed. Two perspectives are offered in this volume. Alan Yu argues for the potential role systematic individual differences in modes of speech perception may play in the initiation and propagation of sound change. He contends that individuals with different cognitive processing styles, and by extension, different social and personality traits, might arrive at different perceptual and production norms in speech. He suggests that individuals who are most likely to introduce new variants in a speech community (the 'innovators' à la Milroy and

Milroy 1985) 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. Conversely, individuals with yet other cognitive processing styles and personality traits might be more susceptible to the linguistic influence of others (the so-called 'early adopters' à la Milroy and Milroy 1985) and might lead the early phase of linguistic convergence. Andrew Garrett and Keith Johnson, on the other hand, attribute the point of entry to differences in sociolinguistic awareness, that is, how individuals may differ in how they assign social meaning to linguistic differences. They hypothesize that some individuals in a language community, but crucially not others, may attend to linguistic variation within their own subgroup but not to variation in other subgroups. If such individuals become aware of a particular phonetic variant in their subgroup, but are unaware that it is also present in other subgroups, they may interpret the variant as a group identity marker, and they may then use it more often.

While the fact that language change requires variation is undisputed, how variation leads to change is a matter of much debate. Three authors investigate the diachronic dynamics of linguistic variation from a computational perspective. At the level of phonetic cues, the phonologization process often results in transphonologization (Hyman 1976). That is, the phonologization of one phonetic cue is often accompanied by the dephonologization of another. Given that most phonological distinctions are supported by multiple phonetic cues, what factors determine which cues are selected for phonologization and which cue should dephonologize? James Kirby argues for the role of probabilistic enhancement in phonologization through computational simulation of an ongoing sound change in Seoul Korean. He proposes that cues are targeted for enhancement as a probabilistic function of their statistical reliability in signaling a contrast. Simulation results using empirically derived cue values are taken to support the idea that loss of contrast precision may drive transphonologization.

In addition to the transfer of linguistic contrast from one cue dimension to another, phonologization often leads to the establishment of sound patterns. A prime example is the emergence of vowel harmony from vowel-to-vowel coarticulation. Frédéric Mailhot shows that the emergence of a categorical pattern of lexical harmony from vowel-to-vowel coarticulation can be simulated using a simple model of a language transmission/acquisition feedback loop iterated over multiple generations. The progression of sound change does not stop at the introduction of a new variant. Understanding the behavior of a new variant once it is introduced in the speech stream is crucial to explaining the trajectory of sound change. From this perspective, it is intriguing that linguistic systems are replete with cases where multiple variants coexist within the system. Why do some new variants coexist with old ones, while others take over and become the dominant patterns? Morgan Sonderegger and Partha Niyogi explore this issue of stability of variation computationally, using dynamic

modeling. Through a case study of stress shift in English noun/verb pairs, they show that changes in stability of variation (i.e. bifurcation in dynamic modeling) occur only under certain models of learning by individuals in a linguistic population.

Phonologization has emerged as one of the central topics in phonological research in recent years. Many of the recent advances are made possible by researchers crossing disciplinary boundaries and drawing on ideas from other research traditions to address difficult questions previously thought unanswerable. The original call for papers stated that the 'goal of this workshop is to facilitate collaboration among phonologists as well as specialists from neighboring disciplines seeking unified theoretical explanations for the origins of sound patterns in language, as well as to move toward a new and improved synthesis of synchronic and diachronic phonology'. The present collection includes perspectives from phonetics, laboratory and theoretical phonology, computer science, psycholinguistics, language acquisition, cognitive neuroscience, cognitive and social psychology, and sociolinguistics. I hope that this volume will serve as a stimulus to furthering the discussion and cross-pollination of ideas.

This volume is dedicated to the memory of Partha Niyogi, a highly esteemed colleague and a contributor to this volume, who passed away unexpectedly during the course of preparation of the volume.

Chicago, IL   Alan Yu
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Acknowledgements

Notes on Contributors

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Elizabeth Hume is Professor of Linguistics at the University of Canterbury, New Zealand, formerly of the Department of Linguistics at The Ohio State University. She has published on topics including consonant/vowel interaction, feature theory, information theory and phonology, language variation, metathesis, markedness, segmental structure, and the interplay of speech perception and phonology.

Larry M. Hyman received his PhD in Linguistics from UCLA in 1972. He taught at the University of Southern California from 1971 to 1988. He came to Berkeley's Department of Linguistics in 1988, which he chaired from 1991 to 2002. He has worked extensively on phonological theory and other aspects of language structure, concentrating on the Niger-Congo languages of Africa, especially Bantu. He has published several books as well as over 120 articles in both theoretical and Africanist journals.

Keith Johnson is Professor of Linguistics and Director of the Phonology Laboratory at the University of California, Berkeley. He has published two phonetics textbooks, a textbook on quantitative linguistics, and two edited collections on speech perception and phonology. His research focuses on the effects of phonetic and social experience on speech perception.

Abby Kaplan is Assistant Professor (Lecturer) at the University of Utah. Her research focuses on the phonology–phonetics interface, using a combination of experimental and corpus data to study the phonetic grounding of phonological patterns. She received her PhD in 2010 from the University of California, Santa Cruz; her dissertation research investigated the perceptual and articulatory basis of lenition.

James Kirby is Lecturer in Phonetics at the University of Edinburgh. He received his PhD in Linguistics from the University of Chicago in 2010. His research interests include computational models of language acquisition and transmission, the evolution of tone and voice quality, and the languages of Southeast Asia.

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Frédéric Mailhot received his PhD in Cognitive Science from Carleton University, and now works in the Speech team at Google. He is interested in information-theoretic and modeling-based accounts of sound change, as well as exemplar-based modeling of generalization in phonological acquisition and use.

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Partha Niyogi was Professor of Computer Science and Statistics at The University of Chicago. He obtained his undergraduate degree from IIT Delhi and SM and PhD from MIT, and worked at Bell Laboratories before joining the University of Chicago. His research spanned statistical inference, machine learning, speech and signal processing, computational linguistics, and artificial intelligence. He wrote two books (including *The Computational Nature of Language Learning and Evolution*) and many journal and conference papers on these subjects.

Morgan Sonderegger is a PhD candidate in Computer Science and Linguistics at the University of Chicago. He received his BS from MIT and a master's degree from Cambridge University. His research addresses stability and change in phonetics and phonology, both within individuals and at the population level, using corpora and computational and mathematical methods. He is also interested in quantitative approaches to linguistics more generally, particularly phonetics, phonology, language change, and sociolinguistics.

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Alan C. L. Yu is Associate Professor of Linguistics and the College at the University of Chicago. He also directs the Phonology Laboratory and the Washo Documentation Project. His research focuses on phonological theory, phonetics, language typology, and language variation and change. He is the author of *A Natural History of Infixation* (2007, Oxford University Press) and co-editor of the *Blackwell Handbook of Phonological Theory*, 2nd edition (Wiley–Blackwell, 2011).