

Parsing size effects, across the lexicon and across the community

Principal Investigators: Mary Beckman, Kathryn Campbell-Kibler, Kiwako Ito

1. Background. An important recent development in phonology is the emergence of new methods for using corpora and experiments, and a consequently better appreciation of the role of variation in adult representations and processing and in the emergence of phonological competence in language learners. As Ernestus and Baayen (2011: 374) put it recently, “Phonologists have formulated generalizations, some of which, as we know now, thanks to corpus-based research, do not do full justice to the data. Language appears to be much more complex than is generally assumed and this complexity is important for theories of phonology as well as for theories of speech production and comprehension.” The research questions that we propose to address are about the effects of two types of variation in size that we need to understand better before we can develop useful models of how children with normal hearing learn the phonological systems of the speech communities into which they are born.

The first type of variation is in the size of the lexicon. An infant is born knowing no words. By 2 years, a typically-developing child who is learning English may have robust knowledge of how to parse and produce between 200 and 800 words (Dale 1991, Huttenlocher et al. 1991), and while vocabulary growth will not be as rapid in later years, it is a process that stops only at death or at the onset of effects of “non-normal aging” (Zelinski & Kennison 2001). The types of phonological generalization that are supported by smaller lexicons can be very different from those that are supported by larger lexicons (e.g., Charles-Luce & Luce 1990, Pierrehumbert 2001, Edwards et al. 2004, Ettliger 2009). Moreover, there is increasing evidence that early inter-individual differences in vocabulary size are correlated with differences in phonological development and later grammatical development more generally (e.g., Hart & Risley 1995, Rescorla 2002, Hoff 2003, Beckman et al. 2007). The effects of differences in lexicon size interact with effects of semantic predictability (Charles-Luce et al. 1999), which in turn affect the interpretation of other types of phonetic variation that children also must learn to parse as they acquire the phonology of the ambient language. For example, we now have evidence that semantic predictability interacts with adult listeners’ parsing of cross-dialect differences in pronunciation (Clopper et al. 2010, Clopper in press). We do not know when and how children become like adults in their parsing of different sources of phonetic variation, but there is evidence that this competence varies across the population in a way that is partially correlated with neural differences that account for some of the variation in early vocabulary size (e.g., Carroll & Snowling 2004, Munson, Baylis et al. 2010, Yu 2010, Clopper et al. in press).

The second type of variation is differences in physical size across people in the ambient speech community. The average infant’s vocal tract is 4 cm shorter than that of the average 8-year-old, which in turn is 2 cm shorter than that of an average adult female (Vorperian et al. 2009). Cross-cutting this age-related variation, there are gender-related differences in size that become more pronounced after puberty when the descent of the larynx and thickening of the lips in males adds an extra 1.5 to 2 cm to their average overall vocal-tract length (Vorperian et al. 2010). The size of the vocal folds also changes, in a way that is conducive to deeper-pitched and louder voice qualities, as in the “roar” of adult male red deer (Fitch & Reby 2001). Phonological theory has benefited from the development of methods for measuring the ways in which different human cultures structure the interpretation of sociolinguistically codified variation that is phonetically based in the acoustic consequences of this sexual dimorphism of the species (see, e.g., Strand & Johnson 1996, Johnson et al. 1999, Strand 2000, Munson et al. 2006, Stuart-Smith 2007, Rendall et al. 2007). More recently, phonologists also have begun to explore how the parsing of this kind of culture-specific codified talker-size-related variation interacts with the parsing of other sociolinguistic variation (e.g. Babel 2009, Campbell-Kibler 2011) as

well as how and when it emerges in phonological development (see, e.g. Foulkes et al. 2005, Docherty et al. 2006, Munson & Baylis 2007, Li et al. 2008, Beckman 2012).

2. Proposed work. As the above brief review suggests, work on the effects of both types of size variation has figured prominently in the development of methods and theories in laboratory phonology. However, much of the research to date has focused on English. This focus is in part because English has the best developed resources for measuring such things as lexical neighborhood density for speakers of different ages. One of the aims of the proposed work is to develop resources for other languages, beginning with the annotation and analysis of corpora of child-directed speech (CDS) and adult-directed speech (ADS) elicited from Cantonese- and Japanese-speaking women who were primary caretakers of young children at the time of recording. These corpora are only a small subset of corpora that we have worked with (see, e.g., Demuth & McCullough 2009 for the parallel Providence English / Lyon French longitudinal corpus, and Monnin et al. 2011 for parallel French / Drehu CDS corpora). However, we cannot work on all of the corpora at once, and so focus on ones that can be developed and analyzed using the language skills of just two GRAs during the space of just one quarter.

A second aim of the proposed work is to advance our understanding of both types of size variation by harnessing methods currently in use or under development in the Phonological Development Laboratory, the Sociolinguistics Laboratory, and the Eye-Tracking Laboratory in our department. The methods we plan to apply include:

1. New analyses of the Providence / Lyon corpus to explore the relationship between “word age” and “phonological processes”, as in Ettlinger (2009).
2. Analyses of the CDS / ADS corpora to see whether mothers / grandmothers talk differently to baby girls and baby boys, as documented for Tyneside English by Foulkes et al. (2005).
3. Acoustic analyses of target sounds in CDS / ADS corpora and also in associated παιδολογος datasets of child and adult productions to extract natural stimuli covering a good range of relevant acoustic parameters to be examined using methods 4–6.
4. Web-based rating experiments, as in Campbell-Kibler (2008) and Walker (2011), but using continuous Visual Analog Scale ratings, as in Munson, Edwards et al. (2010) and Kong et al. (2011), instead of Likert scales, to evaluate the phonological parsing of gender / age / size.
5. Eye-tracking measures (e.g., Ito & Speer 2008, Ito & Campbell-Kibler 2011, Ito et al. 2012) combined with VAS ratings elicited from the same individuals, as in Kong & Edwards (2011) and Ito et al. (forthcoming), and analyzed in part using methods in Skorniakova & Ito (2011).
6. Combined VAS rating / shadowing tasks, as in Julien (2010), but eliciting ratings of gender / age / size as well as of phoneme category goodness. Eventually, we will also combine these with the “implicit association test” (Greenwald et al. 1998) as used in Babel (2009).

Third, we aim also to develop (and disseminate) good teaching materials so that our students (and others) can begin to acquire the many different skill sets that are needed to do rigorous research in this area. In support of this third aim, we propose to host the department’s 2012 Spring Symposium, as described in the next section.

3. Spring symposium. We propose to host (as the next annual Spring Symposium budgeted in the department’s Targeted Excellence in Investment award) a workshop on “Methods for Parsing Size Effects.” The workshop would be held over one and a half days, beginning on the morning of June 2, 2012. It would be advertised on linguistlist and more broadly as a satellite “pre-event” to the 2012 International Child Phonology Conference (ICPC), which will be held in Minneapolis on June 4-6. (Benjamin Munson, who is organizing ICPC this year, anticipates a large attendance, since that conference has been scheduled to immediately precede two other conferences that attract different subsets of the same audience: the XVIII Biennial International Conference on Infant Studies, to be held in Minneapolis June 7-9, and the annual Symposium on Research in Child-Language Disorders, to be held in Madison June 7-9.)

There will be three sessions, each divided into a “tutorial” part, in which we (the local organizers) present the methods that we have been developing and piloting, and then a “reviewer panel” part, in which three invited experts critique the methods, offer suggestions for improvement, and field questions from us and from the audience. The schedule for this symposium will be as follows.

Saturday, June 2, a.m. – Tutorial 1, on building corpora, doing the number crunching for analyzing vocabulary size effects, and extracting well-balanced stimuli for experiments on talker size effects.

Saturday, June 2, p.m. – Tutorial 2, on designing VAS rating tasks and other tasks for testing effects of parsing talker size effects, and then analyzing results to explore inter-individual differences as well as intra-individual task-related differences.

Sunday, June 3, a.m. – Tutorial 3, on eye-tracking measures of individual differences in response to stimuli that vary in either (or both) type(s) of size effect (e.g., pitting neighborhood density against gender / age prototypicality).

4. Appendix – list of references cited.

- Babel, Molly E. (2009). *Phonetic and social selectivity in speech accommodation*. Doctoral dissertation, University of California, Berkeley.
- Beckman, Mary E., Benjamin Munson, & Jan Edwards (2007). The influence of vocabulary growth on developmental changes in types of phonological knowledge. *Laboratory Phonology* 9, pp. 241-264.
- Beckman, Mary E. (2012). Aligning the timelines of phonological acquisition and change. Invited talk, to be presented at the 2nd Workshop on Sound Change, Munich.
- Campbell-Kibler, Kathryn (2008). I'll be the judge of that: Diversity in social perceptions of (ING). *Language in Society*, 37: 637-659.
- Campbell-Kibler, Kathryn (2011). Intersecting variables and perceived sexual orientation in men. *American Speech* 86(1): 52-68.
- Carroll, Julia M. , & Margaret J. Snowling (2004). Language and phonological skills in children at high risk of reading difficulties. *Journal of Child Psychology and Psychiatry*, 45(3):631-640.
- Charles-Luce, Jan, & Paul A. Luce (1990). Similarity neighbourhoods of words in young children's lexicons. *Journal of Child Language*, 17: 205-215.
- Charles-Luce, Jan, Kelly M. Dressler, & Elvira Ragonese (1999). Effects of semantic predictability on children's preservation of a phonemic voice contrast. *Journal of Child Language*, 26: 505-530.
- Clopper, Cynthia G. (2008). Auditory free classification: Methods and analysis. *Behavior Research Methods*, 40:575-581.
- Clopper, Cynthia G., Janet B. Pierrehumbert, & Terrin N. Tamati (2010). Lexical neighborhoods and phonological confusability in cross-dialect word recognition in noise. *Laboratory Phonology*, 1, 65-92.
- Clopper, Cynthia G. (in press). Effects of dialect variation on the semantic predictability benefit. *Language and Cognitive Processes*.
- Clopper, Cynthia G., Kristin L. Rohrbeck, & Laura Wagner (in press). Perception of dialect variation by young adults with high-functioning autism. *Journal of Autism and Developmental Disorders*.
- Ernestus, Mirjam, & R. Harald Baayen (2011). Corpora and exemplars in phonology. In John A. Goldsmith, Jason Riggle, & Alan C.-L. Yu, eds., *The handbook of phonological theory*, 2nd ed., pp. 374-400. Wiley-Blackwell.

- Dale, Philip S. (1991). The validity of a parent report measure of vocabulary and syntax at 24 months. *Journal of Speech and Hearing Research*, 34: 565-571.
- Demuth, Katherine, & Elizabeth A. McCullough (2009). The longitudinal development of clusters in French. *Journal of Child Language*, 36(2):425-448.
- Docherty, Gerard, Paul Foulkes, Jenny Tillotson, & Dominic Watt (2008). On the scope of phonological learning: Issues arising from socially-structured variation. *Laboratory Phonology* 8, pp. 393-421.
- Edwards, Jan, Mary E. Beckman, & Benjamin Munson (2004). The interaction between vocabulary size and phonotactic probability effects on children's production accuracy and fluency in nonword repetition. *Journal of Speech, Language, and Hearing Research*, 47, 421-436.
- Ettlinger, Marc (2009). Phonological chain shifts during acquisition: Evidence for lexicon optimization. In A. Schardl, M. Walkow & M. Abdurrahman, eds., *Proceedings of the 38th Annual Meeting of the Northeast Linguistics Society*, pp. 259-269.
- Fitch, W. Tecumseh, & David Reby (2001). The descended larynx is not uniquely human. *Proceedings of the Royal Society B: Biological Sciences*, 268: 1669-1675.
- Foulkes, Paul, Gerard Docherty, & Dominic Watt (2005). Phonological variation in child-directed speech. *Language*, 81(1):177-206.
- Greenwald, Anthony G., Debbie E. McGhee, & Jordan L. K. Schwartz (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, 74:1464-1480.
- Hart, Betty, & Todd R. Risley (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore, MD: Paul H. Brookes.
- Hoff, Erika (2003). The specificity of environmental influence: Socioeconomic status affects early vocabulary development via maternal speech. *Child Development*, 74:1368-1378.
- Huttenlocher, Janellen, Wendy Haight, Anthony Bryk, Michael Seltzer, & Thomas Lyons (1991). Early vocabulary growth: Relation to language input and gender. *Developmental Psychology*, 27(2): 236-248.
- Ito, Kiwako, & Shari R. Speer (2008). Anticipatory effect of intonation: Eye movements during instructed visual search. *Journal of Memory and Language*, 58:541-573.
- Ito, Kiwako, & Kathryn Campbell-Kibler (2011). Speaker adaptation to /ɪ/-/ɛ/ merger: An eye-tracking study. *Proceedings of the 17th International Congress of Phonetic Sciences*, pp. 954-957.
- Ito, Kiwako, Nobuyuki Jincho, Utako Minai, Naoto Yamane, Reiko Mazuka (2012). Intonation facilitates contrast resolution: Evidence from Japanese adults and 6-year olds. *Journal of Memory and Language*, 66(1):265-284.
- Ito, Kiwako, Oxana Skorniakova, & Mary E. Beckman (forthcoming). Individual differences in phoneme perception: The link between implicit and explicit judgments of category goodness.
- Johnson, Keith, Elizabeth A. Strand, & Mariapaola D'Imperio (1999). Auditory-visual integration of talker gender in vowel perception. *Journal of Phonetics*, 27:359-84.
- Julien, Hannah M. (2010) *Modifying speech to children: An acoustic study of adults' fricatives*. M.A. thesis, Department of Speech-Language-Hearing Sciences, University of Minnesota.
- Kong, Eun Jong, & Jan Edwards (2011). Individual differences in speech perception: Evidence from visual analogue scaling and eye-tracking. *Proceedings of the 17th International Congress of Phonetic Sciences*.
- Kong, Eun Jong, Jan Edwards, & Mary E. Beckman (2011). Why are Korean tense stops acquired so early: The role of acoustic properties. *Journal of Phonetics*, 39(2):196-211.
- Li, Fangfang, Li, Eun Jong Kong, Mary E. Beckman, & Jan Edwards (2008). Adult acoustics and developmental patterns for gender-marked phonetic variants in Mandarin fricatives and Japanese stops. Poster presented at LabPhon11, 30 June - 2 July 2008, Victoria University of Wellington, Wellington, New Zealand.

- Monnin, Julia, H el ene Loevenbruck, Mary E. Beckman, & Jan Edwards (2011). Vowel context and frequency effects in dorsal and coronal acquisition in Drehu and French. Poster presented at the 9th International Seminar on Speech Production, Montreal.
- Munson, Benjamin, Sarah V. Jefferson, & Elizabeth C. McDonald (2006). The influence of perceived sexual orientation on fricative perception. *Journal of the Acoustical Society of America*, 119(4):2427-2437.
- Munson, Benjamin, & Adriane Baylis (2007). Perceived sex typicality in the speech of children with and without phonological disorder. Poster presented at the Symposium for Research on Child Language Disorders, Madison, WI.
- Munson, Benjamin, Adriane L. Baylis, Miriam O. Krause, & Dongsun Yim (2010). Representation and access in phonological impairment. *Laboratory Phonology* 10: 381-404.
- Munson, Benjamin, Jan Edwards, Sarah K. Schellinger, Mary E. Beckman, & Marie K. Meyer (2010). Deconstructing phonetic transcription: Covert contrast, perceptual bias, and an extraterrestrial view of *Vox Humana*. *Clinical Linguistics and Phonetics*, 24:245-260.
- Pierrehumbert, Janet (2001). Why phonological constraints are so coarse-grained. *Language and Cognitive Processes*, 16(5/6): 691-698.
- Rendall, Drew, John R. Vokey, & Christie Nemeth (2007). Lifting the curtain on the Wizard of Oz: Biased voice-based impressions of speaker size. *Journal of Experimental Psychology: Human Perception and Performance*, 33(5): 1208-1219.
- Rescorla, Leslie A. (2002). Language and reading outcomes to age 8 in late-talking toddlers. *Journal of Speech, Language, and Hearing Research*, 45:360-371.
- Skorniakova, Oxana, & Kiwako Ito (2011). Sensitivity to sub-phonemic variation during lexical identification: Evidence from visual analogue scale (VAS) goodness-ratings. *Proceedings of the 17th International Congress of Phonetic Sciences*, pp. 1866-1869.
- Strand, Elizabeth A., & Keith Johnson (1996). Gradient and visual speaker normalization in the perception of fricatives. In D. Gibbon, ed., *Natural language processing and speech technology, results of the 3rd KONVENS conference*, pp. 14-26. Berlin: Mouton de Gruyter.
- Strand, Elizabeth A. (2000). *Gender stereotype effects in speech processing*. Doctoral dissertation, Ohio State University.
- Stuart-Smith, Jane (2007). Empirical evidence for gendered speech production: /s/ in Glaswegian. *Laboratory Phonology* 9, pp. 65-86. Berlin: Mouton de Gruyter.
- Vorperian, Hourri K., Shubing Wang, Moo K. Chung, E. Michael Schimek, Reid B. Durtschi, Ray D. Kent, Andrew J. Ziegert, & Lindell R. Gentry (2009). Anatomic development of the oral and pharyngeal portions of the vocal tract: An imaging study. *Journal of the Acoustical Society of America*, 125(3): 1666-1678.
- Vorperian, Hourri K., Shubing Wang, E. Michael Schimek, Reid B. Durtschi, Ray D. Kent, Lindell R. Gentry, & Moo K. Chung (2011). Developmental sexual dimorphism of the oral and pharyngeal portions of the vocal tract: An imaging study. *Journal of Speech, Language, and Hearing Research*, 54: 995-1010.
- Walker, Abby (2011). Sociolinguistic sweet spots: Social Meaning of Phrase-Final /t/ in NZE and word frequency. Qualifying paper, Ohio State University.
- Yu, Alan C. L. (2010). Perceptual compensation is correlated with individuals' "autistic" traits: Implications for models of sound change. *PLoS ONE*, 5(8):e11960.
- Zelinski, Elizabeth M., & Robert F. Kennison (2011). The Long Beach longitudinal study: Evaluation of longitudinal effects of aging on memory and cognition. *Home Health Care Services Quarterly*, 19(3): 45-55.