Session 5pSWc

Speech Workshop: Keynote Address

Catherine T. Best, Chair
MARCS Auditory Labs., Univ. of Western Sydney, Penrith South DC, NSW 1797, Australia

Chair's Introduction—5:00

Invited Paper

5:05

5pSWc1. Automatic selective perception (ASP) of first-language (L1) and second-language (L2) speech: A working model. Winifred Strange (Speech Acoust. and Percept. Lab., CUNY-Graduate School, 365 Fifth Ave., New York, NY 10016-4309, strangepin@aol.com)

In this model, speech perception by adults is characterized as an active, information-seeking process whereby native listeners detect the most reliable acoustic parameters that specify phonetic segments and sequences, using highly over-learned, automatic selective perception routines. In laboratory perceptual tasks, differentiation of native (L1) phonetic contrasts is rapid and robust in suboptimal listening conditions even when the listeners focus on other levels of language structure, or indeed on another task. In contrast, late L2 learners must employ greater attentional resources in order to extract sufficient information to differentiate phonetic contrasts that do not occur in their native language. Phonetic and phonological modes of speech perception are described, which can be tapped in the laboratory by manipulations of stimulus complexity and task demands. These experimental manipulations reveal complex interactions between the linguistic experience of listeners and phonetic similarity relationships between L1 and L2 phonological inventories. Illustrative experimental evidence from studies of vowel perception using perceptual assimilation (cross-language identification), speeded discrimination, discrimination in speech babble, and brain indices of discrimination (MMN) will be presented to provide operational definitions of these concepts. Similarities and differences from other current theories of cross-language and L2 speech perception will be discussed. [Work supported by NIH, NSF.]

5:50—6:15 panel-discussion

Session 6aSWa

Speech Workshop: New Perspectives on Developmental Models

Ann R. Bradlow, Chair
Dept. of Linguistics, Northwestern Univ., Evanston, IL 60208

Chair's Introduction—9:00

Invited Papers

9:05

6aSWa1. Infant magnetoencephalography studies exploring neural links between sensory and motor representations for speech. Patricia K. Kuhl (Univ. of Washington, Inst. for Learning & Brain Sci., Mailstop 357920, Seattle, WA 98195-7920, pkkuhl@u.washington.edu)

The adult brain exhibits anatomical and functional specialization specific to speech, but we have little information regarding the infant brain. Recent adult neuroimaging studies show that speech processing is left-lateralized and that two regions of the brain, the superior temporal (ST, auditory area) and inferior parietal (IF, motor area), contribute to the brain's response to speech. To explore brain activation to speech and nonspeech in infants, we used magnetoencephalography to image the whole brain. Experiment 1 examined infants at three ages: newborn, 6 months, and 12 months. Infants showed significant ST activation to both speech and nonspeech stimuli. IF activation was not observed in newborns but in the two older groups of infants we observed synchronous IF and ST activation that was unique to speech. Experiment 2 investigated the nature of this perceptual-motor coupling for speech—specifically, we asked whether synchronous activation reflects the detection of speech signals per se, or whether it signals the recognition of experienced (native-language) speech. Native, non-native, and nonspeech analogs were used to test these alternatives. Our results elucidate the developmental time course of the sensory-motor connections for speech, and address longstanding theoretical issues in speech perception.

9:40

6aSWa2. Bilingual beginnings as a lens for theory development. Janet F. Werker, Suzanne Curtin, and Krista Byers-Heinlein (Dept. of Psych., Univ. of British Columbia, 1236 West Mall, Vancouver, BC V6T 1Z4, Canada, kbyers@psych.ubc.ca)

Phonetic categories become language specific across the first months of life. However, at the onset of word learning there are tasks in which infants fail to utilize native language phonetic categories to drive word learning. In 2005, we advanced a framework to account for why infants can detect and use phonetic detail in some tasks but not in others (Werker and Curtin, 2005; see also Curtin and Werker, 2007). In this framework, PRIMIR (processing rich information from multidimensional, interactive representation), we argue that by their first birthday, infants have established language-specific phonetic category representations, but also encode and represent both subphonetic and indexical details of speech. Initial biases, developmental level, and task demands influence the level of detail infants use in any particular experimental situation. On some occasions phonetic categories are accessed, but in other tasks they are not given priority. Recently, we have begun studying infants who are exposed to two native languages from birth (Werker and Byers-Heinlein, 2008). In the current paper, we will review recent work on speech perception and word learning in bilingual-learning infants. This will be followed by a discussion of how this research has lead to advances in, and changes to, PRIMIR.

SATURDAY MORNING, 23 MAY 2009 SKY BRIDGE AUDITORIUM, 10:30 A.M. TO 12:15 P.M.

Session 6aSWb

Speech Workshop: Early Bilingual Development

Susan G. Guion, Chair
Dept. of Linguistics, Univ. of Oregon, Eugene, OR 97403-1290

Invited Papers

10:30

6aSWb1. Phonetic variability in bilinguals' acquisition of native-vowel category contrasts. Laura Bosch and Marta Ramon-Casas (Dept. of Basic Psych., Univ. of Barcelona, 171 P. Vall d'Hebron, Barcelona 08035, Spain)

Previous research has shown that bilingual infants and toddlers follow a slightly different developmental pattern in building and stabilizing some native vowel contrastive categories, compared to monolingual populations. Once in the lexical stage, bilingual toddlers do not always show the expected mispronunciation effect when presented with familiar words in which a vowel change has been introduced. To better understand bilinguals' protracted process in setting the boundaries for certain, perceptually close, native vowel categories, a phonetic analysis of the input characteristics was undertaken. Speech samples containing target words with Catalan mid-front vowel sounds were recorded from two groups of Catalan-speaking mothers from monolingual and bilingual environments, differing in the use of their L2 (Spanish). First and second formant values of the target vowels were obtained and compared between groups. The vowels were always correctly and contrastively produced, but bilinguals' formant values differed significantly from monolinguals': categories were closer in space and greater variability in production was found. Young bilinguals' sensitivity to phonetic variability in the words they hear may constrain the development of neat representations of contrastive vowel categories in the early lexicon. [Work supported by CONSOLIDER 2010 Program (CSD2007-012).]

11:05

6aSWb2. How are speech sound categories acquired in bilingual first language acquisition? Megha Sundara and Adrienne Scutellaro (Dept. of Linguist., UCLA, 3125 Campbell Hall, Los Angeles, CA 90095-1543, megha.sundara@humnet.ucla.edu)

For bilingual infants, phonetic categories of the two languages develop interdependently. This is supported by the differences in time course and trajectory of development of phonetic perception between Spanish-Catalan bilingual and monolingual infants (Bosch and Sebastián-Gallés, 2003a, 2003b, 2005; Sebastián-Gallés and Bosch, in press). Bosch and Sebastián-Gallés argue that for similar phones, at least initially, infants track statistical regularities across the two languages. This results in a temporary inability of bilingual infants to discriminate acoustically similar phonemes. Research on French-English bilingual infants shows a different pattern. There is evidence that French-English bilingual infants may not differ from their monolingual peers in discrimination of phonetic contrasts (Burns *et al.*, 2007; Sundara *et al.*, 2008). In this talk, data will be presented from Spanish-English bilingual infants to evaluate how development of phonetic perception is affected by (a) frequency of phones and (b) the rhythmic (dis)similarity of the two languages to which bilinguals are exposed.

11:40

6aSWb3. The development of English vowel perception in monolingual and bilingual infants: Neurophysiological correlates. Valerie L. Shafer (Program in Speech-Lang.-Hearing Sci., The Graduate Ctr., CUNY, 365 Fifth Ave. NY, NY 10016)

This research examines the maturation of I-E vowel discrimination, in terms of neurophysiological responses, in infants exposed monolingually to English or bilingually to English and Spanish. The vowels [I] as in "pit" and [E] as in "pet" contrast meaning in English but not in Spanish. Bilingual exposure to English and Spanish alters the distribution of phonetic information heard by an infant and may alter the timecourse of vowel category development in the two languages [e.g., L. Bosch and N. Sebastian-Galles (2003)]. The goal of the current study is to examine whether there is evidence from brain responses indicating differences in the development of this English vowel category as a function of amount of English versus Spanish in the input. Preliminary results reveal that both monolin-

gually and bilingually exposed infants and children show evidence of good discrimination of the English vowels, but that the groups with bilingual exposure more often show increased contribution of the right hemisphere to discrimination compared to the groups receiving monolingual exposure. It is not currently clear why these hemispheric differences are found, but they may be related to differences in how attention is allocated in processing the vowels. [This research was supported by NIH HD46193.]

SATURDAY AFTERNOON, 23 MAY 2009 SKY BRIDGE TERRACE, 1:30 TO 3:00 P.M.

Session 6pSWa

Speech Workshop: Cross-Language Speech Perception and Linguistic Experience: Poster Session C

Suzanne L. Curtin, Chair
Dept. of Psychology, Univ. of Calgary, Calgary, AB T2N 1N4, Canada

Contributed Papers

All posters will be on display from 1:30 p.m. to 3:00 p.m. To allow contributors an opportunity to see other posters, contributors of odd-numbered papers will be at their posters from 1:30 p.m. to 2:15 p.m. and contributors of even-numbered papers will be at their posters from 2:15 p.m. to 3:00 p.m.

6pSWa1. English vowel perception by native speakers of European Portuguese and Mandarin. Andreia S. Rauber (Ctr. for Humanistic Studies, Univ. of Minho, Campus de Gualtar, Braga, Portugal 4715-057, arauber @ilch.uminho.pt)

This study investigated the perception of eight American English stressed syllabic monophthongs (/i, I, E, æ, V, O, U, u/) by two groups of nonnative listeners: Portuguese and Chinese. Each group was formed by 15 English as a foreign language (EFL) learners, with an upper-intermediate level of English proficiency, all undergraduate students at a Portuguese university. An identification test was designed to investigate how the participants would perceive the English vowels, which are not present in their first language (L1) inventory as stressed monophthongs (/I, æ, V, U/ in the case of the Portuguese speakers, and all vowels but /i, u/ in the case of the Mandarin speakers). The large number of target vowels played as stimuli allowed a cross-language analysis of vowel distribution in the acoustic space: for the two groups of EFL listeners, it was more difficult to perceive the English vowels located in a high density area of the English vowel space than those in less crowded areas. For the two groups of speakers, the vowels /æ/ and /U/ had the greatest misidentification rates.

6pSWa2. Does the native language use of duration affect the perception of non-native length contrasts? Yukari Hirata (Dept. of East Asian Lang. and Lit., Colgate Univ., 13 Oak Dr., Hamilton, NY 13346, yhirata@colgate.edu) and Motoko Ueyama (Univ. di Bologna, 47100 Forli, Italy)

This study compared native Italian (NI) and American English (NE) speakers' abilities to perceive Japanese phonemic length contrasts. Japanese has both vowel and consonant length contrasts, Italian has only consonant length contrast, and English has neither. The study examined to which extent the differential use of duration in their native languages affects their abilities to perceive length contrasts in an unfamiliar language. Twenty-two monolingual NI speakers perceived Japanese words in isolation and in sentences and were asked to identify the number of moras in target words, e.g., /o.do.t.ta/ as four moras. Their test scores were compared to those of 18 NE participants [Hirata (2004)] in an analysis of variance. Group (NE, NI) was a between-subjects factor, and context (isolation, sentences) and word type (long vowels, geminates, combination, and short segments) were within-subjects factors. While there was no main effect of group (NI: 44.6%; NE: 39.5%), there was a significant three-way interaction. The NI group scored significantly higher than the NE group on words with geminates spoken in sentences (43.3 vs 31.1%). Results are discussed as to whether the perception of non-native length contrasts is driven by language-specific ability [McAllister *et al.* (2002)] or by more general auditory ability [Bohn (1995)].

6pSWa3. Linguistic experience in tone perception. James Kirby (Phonology Lab., Dept. of Linguist., 1010 E 59th St., Chicago, IL 60637, jkirby@uchicago.edu)

This paper examines the effect of regional dialect on tone perception. Thirty speakers of Northern and Southern Vietnamese performed an AX discrimination task using natural speech tokens of Northern (NVN) speech. NVN distinguishes six tones, three of which are produced with creaky voice, while Southern Vietnamese (SVN) distinguishes only five tones, none of which are canonically produced with creaky voice; however, both groups of listeners have shown some sensitivity to voice quality as well as F0 cues (Brunelle, 2008). While the results of hierarchical cluster analysis show both Northern and Southern listeners broadly group tones by F0 onset, multidimensional scaling shows the effects of dialect-specific perception: despite some familiarity with NVN speech, SVN listeners did not adjust their perceptual cue space when listening to NVN talkers. As a result, tones with similar F0 profiles but different voice qualities were more likely to be confused by SVN listeners. This is consistent with studies showing that perceptual processes are organized in a language-specific fashion, with the acoustic cue space weighted by phonological relevance to L1 perception (Werker and Tees, 1999; Strange, 2002). It is argued that language-specific prosodic as well as segmental experience affects speech processing at the prelexical level.

6pSWa4. Cross-linguistic interpretation of duration. Ellen Broselow, Jiwon Hwang (Dept. of Linguist., Stony Brook Univ., Stony Brook, NY 11794-4376, ellen.broselow@stonybrook.edu), and Nancy Squires (Stony Brook Univ., Stony Brook, NY 11794)

In Korean, intervocalic [l] is realized as tap ([tal]/[tar-i] 'moon /moon+nom'). In English loanwords, however, intervocalic /l/ is generally adapted as a geminate lateral ([sollo] 'solo' but [sara] 'Sarah'). We present evidence from event-related potentials supporting an analysis in which Korean listeners perceive intervocalic single [l] (illegal in Korean) as geminate [ll], reinterpreting the English [r-l] contrast in terms of the Korean [r-ll] contrast ([dari] 'bridge', [dalli] 'differently'). Korean and English participants heard two sets of oddball paradigms, [ele-elle] and [ene-enne]. In both cases, the acoustic difference is the same, 48 versus 98 msec. However, the nasal pair represents a cross-category contrast in Korean ([kanan] 'poverty', [kannan] 'newborn') while the lateral pair represents a noncontrastive difference. Consistent with studies showing a stronger mismatch negativity (MMN) to cross-category changes than to within-category changes, Korean listeners displayed a significantly larger MMN for the nasal pair than for the lateral pair. In contrast, English listeners (for whom the pairs do not differ in categorical status) did not show significantly different responses to the durational changes in nasals versus laterals. Korean listeners' relatively weak

response to durational differences in laterals suggests that their adaptation pattern reflects inaccurate mapping of the acoustic signal to phonological representations. [Work supported by NSF BCS-07460227.]

6pSWa5. Informational masking in first- and second-language speech recognition. Kristin J. Van Engen (Dept. of Linguist., Northwestern Univ., 2016 Sheridan Rd., Evanston, IL 60208, k-van@northwestern.edu)

Human speech recognition in noisy conditions is modulated by cognitive factors such as language background. For example, noise is more detrimental to non-native listeners than native listeners (e.g., van Wijngaarden *et al.*, 2002), and when noise is a speech signal, native-language noise is more detrimental than foreign-language noise for listeners attending to native-language speech targets (e.g., Van Engen and Bradlow, 2007). It is not clear, however, whether this increased interference is primarily due to the native status of the noise or to the greater similarity between target and noise. To address this issue, English speech recognition in the presence of English and Mandarin babble was assessed for monolingual English listeners and L2 English listeners whose L1 is Mandarin. Results showed that intelligibility for both groups was lower in English versus Mandarin babble; that is, L2 listeners experienced more difficulty in same-language noise versus native-language noise. However, monolingual English listeners showed a greater release from masking in Mandarin noise than did L1 Mandarin listeners. The informational masking imposed on speech targets by interfering speech noise, therefore, is dependent both on the linguistic and/or acoustic similarity between the noise and the target and on the listeners' experience with the languages involved.

6pSWa6. Discrimination of English, French, and Spanish liquids by Japanese listeners. Tomohiko Ooigawa (Graduate School of Foreign Studies, Phonet. Lab., Sophia Univ., 7-1 Kioi-cho, Chiyoda-ku, Tokyo, Japan, ooigawaferchichi@gmail.com)

The present study examines the discrimination of English, French, and Spanish intervocalic liquids' contrasts (English /l/-/r/, French /l/-/r/, and Spanish /l/-/r/, /l/-/rr/, /l/-/rr/) by native speakers of Japanese. The results show that the Japanese listeners discriminated the contrasts of French liquids and Spanish trill versus lateral/tap at the rate of more than 95%. On the other hand, they poorly discriminated the contrasts of English liquids and Spanish tap versus lateral. This study discusses whether the current models on second language speech perception account for the phenomena. It has been said that native speakers of Japanese have difficulty in distinguishing the contrasts of liquids both productively and perceptually. A lot of empirical studies on the perception of English liquids by Japanese listeners have been carried out so far. However, there are few empirical studies on the perception of other languages' liquids by Japanese listeners. This is the first study which compares the discrimination of the liquids of the three languages by native speakers of Japanese. In the experiment, utterances of /peCV/ were recorded from the native speakers of the three languages. AXB task was used for the perception experiment.

6pSWa7. Discrimination of four English vowel contrasts by Catalan learners varying in language experience. Lucrecia Rallo Fabra (Univ. of the Balearic Islands, ctra. Valldemossa, km. 7,5, 07122 Palma de Mallorca, Spain)

PAM-L2 (Best and Tyler, 2007) hypothesizes that discrimination of L2 sounds can be predicted from the perceptual relatedness of L2 categories to L1 categories. Catalan EFL learners encounter serious difficulties to discriminate some English vowel contrasts, partly because Catalan has a smaller vowel inventory than American English. This study presents data from a perceptual discrimination test in which three groups of EFL learners varying in experience with English were asked to discriminate a series of potentially difficult English vowel pairs. The discrimination task consisted in picking the odd item out of three stimuli which were heard one after the other at 1.3-s intervals. The target vowel stimuli occurred in CVC syllables produced by six native English talkers. Four vowel contrasts were tested: /*opena-/invv*/, /*eh-/aelig*/, /i-/*smallI*/, and /u-/*smallU*/. As predicted by PAM-L2, "category-goodness" contrasts /i-/*smallI*/ and /u-/*smallU*/ were fairly well discriminated, the "single-category" contrast /*opena-/invv*/ was poorly discriminated. The "uncategorized" contrast /*eh-/aelig*/ failed to meet PAM-L2 predictions, learners failed to distinguish these two vowels although the contrast was predicted as relatively easy to discriminate. Language experience did not have a significant effect on ease of discrimination. These results suggest that PAM-L2 assimilation patterns can also be extended to EFL learning.

6pSWa8. Language preference in monolingual and bilingual infants. Linda Polka, Ayasha Valji (School of Commun. Sci. and Disord., 1266 Pine Ave. W., McGill Univ., Montreal, QC H3G 1A8, Canada, linda.polka@mcgill.ca), and Karen Mattock (Lancaster Univ., Fylde College, Bailrigg, Lancaster LA1 4YW, UK)

Previous research shows that infants in single-language families have some basic language discrimination abilities at birth which improve rapidly over the first 6 months of life, and that attention to the rhythmic properties of language supports these skills. Babies in monolingual families also prefer listening to their native language over an unfamiliar language when presented samples produced by one bilingual or two monolingual talkers. In this study we investigate the emergence of language-specific speech processing in bilingual infants by comparing language preference patterns in monolingual English, monolingual French, and bilingual English-French infants using a three-way language preference test. Listening times were measured to passages of adult-directed speech from three rhythmically different languages (English, French, Japanese; three talkers per language). Ten-month-olds in the monolingual groups listened equally to all three languages. However, 10-month-old bilinguals showed a significant preference for each native language over Japanese; listening times to English and French were not different. Individual bilingual 10-month-olds preferred the more prevalent native language in their input. These findings indicate bilingual infants listen more selectively when they encounter different languages. The implications of these findings for understanding speech processing in early bilingual acquisition will be discussed. [Work supported by SSHRC.]

6pSWa9. The perception of Georgian ejective stops by native English speakers. Christopher S. Doty and Susan G. Guion (Dept. of Linguist., 1290 Univ. of Oregon, Eugene, OR 97403-1290, cdoty@uoregon.edu)

The present study examined the perception of Georgian voiced, voiceless aspirated, and ejective stops by native speakers of English. It was motivated by the observation that languages with three stop-manner series often borrow voiceless aspirated stops as ejectives in a systematic manner. This is likely due to the perceptual similarity between aspirated stops in source language and the ejective stops in the borrowing language. To test the hypothesized perceptual similarity between aspirated and ejective stops, five English speakers were asked to listen to stops which varied in manner of articulation (voiced, voiceless aspirated, ejective) that were produced by a speaker of Georgian. Participants heard three productions at the same place of articulation, one of which differed in manner, and were asked to identify the the oddball stop. The results indicated that the contrast between voiceless aspirated and ejective stops was correctly identified less often than the other two contrasts (voiced versus aspirated, voiced versus ejective) [$p<0$ .05]. No significant difference was found for the other contrasts. These data are supported by the results from a second task, in which the same participants performed a forced-choice identification and goodness rating task with the same productions.

6pSWa10. Perception-production relationship in French vowel learning in adulthood. Erika S. Levy (Speech-Lang. Pathol., Biobehavioral Sci., Teachers College, Columbia Univ., 525 W. 120th St., Box 180, New York, NY 10027, elevy@tc.columbia.edu) and Franzo Law, II (City Univ. of New York-Grad. Ctr., New York, NY 10016-4309)

The present study examined the extent to which perceptual performance by American English (AE) individuals predicted their accuracy in producing second-language (L2) Parisian French (PF) vowels. Three groups of AE participants (no, moderate, and extensive French-language experience) participated in two perceptual tasks (categorial discrimination and perceptual assimilation), and a production (repetition) task involving PF /y-œ-i-a-u/ in bilabial /rabVpa/ and alveolar /radVta/ contexts within a phrase. Results from perception tasks correctly predicted overall production difficulties and effects of language experience and consonantal context in L2 production. Paralleling their perceptual patterns, front rounded vowel productions by AE participants were mislabeled more often as back rounded vowels than as front vowels by native-French speakers. PF /œ/ was produced more accurately with greater L2 experience. Production accuracy of /y/ was also

greater with extensive experience, a finding not expected based on minimal language-experience effects on /y/ perception. Productions of PF /u/ were identified approximately twice as accurately in bilabial context as in alveolar, in a pattern consistent with discrimination performance. Thus, PF /u/ may be considered a "similar" vowel in alveolar context, but not in bilabial, suggesting an allophonic level of representation in L2 learning, both in perception and production.

6pSWa11. Time-course of perception of Mandarin Chinese tones. Chiung-Yun Chang and Robert Allen Fox (Speech Percept. and Acoust. Labs., Speech and Hearing Sci. The Ohio State Univ., Columbus OH 43210-1002, chang.553@osu.edu)

The current study examines the effects of dialect variation on the time-course of lexical tone identification by native and non-native listeners of Mandarin Chinese. Listeners were asked to identify the tone of an isolated Chinese word presented without a precursor phrase. All stimuli were exemplars of V, CV, or CVC combinations that represented real words in Mandarin when produced with any of the four possible lexical tones. Words were produced by multiple talkers with a wide range of F0 values. The dialect of the talkers was also systematically varied. Half were native speakers of Beijing Mandarin, and the other half were native speakers of Taiwanese Mandarin. Preliminary acoustic analysis showed significant differences in tonal realization of the four lexical tones, especially Tone 3. There were three groups of listeners: native speakers of Beijing Mandarin and Taiwanese Mandarin and native English speakers who were learning Beijing Mandarin. A gating task was utilized to determine the temporal location in the token when the lexcial tone was correctly identified and to examine the nature (and time course) of tone confusions. Results will be discussed in terms of the effects of dialect and F0 variation of the stimuli and the native language of the listener.

6pSWa12. Perception or production? Training effects on cross-language phonological awareness tasks in Mandarin-speaking children. Pi-Yu Chiang and Susan Rvachew (School of Commun. Sci. and Disord., McGill Univ., 1266 Pine Ave. West, Montreal QC H3G1A8, Canada, piyu.chiang@mail.mcgill.ca)

This study investigated training effects of perception-based and production-based English activities on the acquisition of phonological awareness of English sound structures by 58 Mandarin-speaking kindergarten-aged children in Taiwan. Children were randomly assigned to one of two experimental conditions or a control condition. Experimental groups participated in a learning session of four English words: band, nest, brick, and stool, with a perceptual or articulation focus on clusters, which do not exist in Mandarin. Outcome measures examined subjects' ability to match words on the basis of shared onset or coda, and to elicit common units in both Mandarin and English before and after training. Significant gain in English onset common unit test scores was observed for the production training group, relative to the control group, especially in trials containing the trained clusters: br- and st-. Perception group however did not show an improvement over time across all measures. Between-group differences were not observed for English codas, Chinese onsets, or Chinese codas. Findings revealed that clearly articulating non-native words with unfamiliar syllable structures could assist children to isolate onsets in explicit phonological awareness tasks, independent of exposure to alphabetic orthography, generally thought to be critical in explicit phonological awareness (e.g., Gombert, 1992).

6pSWa13. Learn to Listen (L2L): Perception training system for learners of English as a second language. Diane Kewley-Port (Commun. Disord. Technol., Inc. and Indiana Univ., Bloomington, IN), Kanae Nishi (Commun. Disord. Technol., Inc. and Boys Town Natl. Res. Hosp., Omaha, NE), Hanyong Park, James D. Miller, and Charles S. Watson (Commun. Disord. Technol., Inc. and Indiana Univ., Bloomington, IN)

Computer software (L2L) is being developed for comprehensive perception training of English by second language learners. Our goal is to facilitate generalization of post-training improvement of phoneme perception to the perception of running speech. Three studies are reported for two groups of adult listeners, one Korean and the other Spanish. In study 1, large sets of confusable phonemes were identified from an assessment task for each group. Then training sets for consonants in CV nonsense syllables and vowels in familiar real words were selected and recordings from multiple talkers were obtained. Materials for the word-in-sentence (WIS) task were developed with a single low-context carrier phrase which contained three words from the vowel training. In study 2 new Korean and Spanish listeners were trained using a protocol that included a pre-test, eight hours of training, a post-test, and one hour using the WIS task. Training results showed: (1) both Korean and Spanish listeners improved from pre- to post-tests for vowels and consonants; (2) in vowel identification, Koreans outperformed Spanish by 34% (3) vowel identification in the WIS task appeared easier than in word-only task, a result confirmed by a study using the WIS task without training (study 3). [Work supported by NIH.]

6pSWa14. Effects of linguistic and musical experience on non-native perception of Thai vowel duration. Angela Cooper and Yue Wang (Dept. of Linguist., Simon Fraser Univ., 8888 Univ. Dr., Burnaby, B.C. V5A 1S6 Canada, akcooper@sfu.ca)

Previous research has suggested a relationship between musical experience and L2 proficiency. The present study investigated the influence of musical experience on non-native perception of speaking-rate varied Thai phonemic vowel length distinctions. Given that musicians are trained to discern temporal distinctions in music, we hypothesized that their musical experience would enhance their ability to perceive non-native vowel length distinctions as well as their sensitivity to temporal changes as a function of speaking rate. Naive native English listeners of Thai, with and without musical training, as well as native Thai listeners, were presented with minimal pairs of monosyllabic Thai words differing in vowel length at three speaking rates in an identification task and a discrimination task. For identification, participants were asked to identify whether a word contained a long or short vowel. For discrimination, participants heard three successive words and were asked to indicate whether the second word had the same vowel length as the first or last word. The results show significant group differences in identification and discrimination accuracy within and across speaking rates, suggesting that listeners' perception of phonetic categorical versus temporal acoustic variations differs as a function of linguistic and musical experience.

6pSWa15. Increased second-language vocabulary size is associated with more consistent second-language vowel categorization and better discrimination. Rikke L. Bundgaard-Nielsen (MARCS Auditory Lab., Univ. of Western Sydney, Bankstown Campus, Bldg. 1, Locked Bag 1797, Penrith South DC, NSW 1797, Australia, r.bundgaardnielsen@uws.edu.au), Catherine T. Best, and Michael D. Tyler (Univ. of Western Sydney, NSW 1797, Australia)

Improvement in second-language (L2) perception has been posited to asymptote early in L2 learning when the L2 vocabulary is still small, whereas a large L2 vocabulary curtails perceptual learning [PAM-L2: Best and Tyler (2007)]. We extend this proposition by suggesting that early L2 lexical development facilitates establishment of phonological categories in a manner analogous to toddlers' L1 acquisition before versus after the vocabulary explosion. According to this revised view, L2 speech should be assimilated more consistently to phonological categories, and cross-boundary contrasts discriminated more accurately, by learners with large versus small L2 vocabularies. We applied a novel whole-system approach to evaluate perception of L2 vowels with respect to the L1 vowel system. Japanese learners of Australian English with under 12 weeks of L2 immersion completed labeling and goodness ratings on all Australian vowels, using all mono- and bi-moraic Japanese vowels and vowel combinations. They also completed discrimination tasks on four L2 vowel contrasts, representing a range of PAM-L2 contrast types, and a L2 vocabulary size assessment. Learners with larger vocabularies had more consistent vowel assimilation and more accurate cross-boundary discrimination than those with smaller vocabularies, supporting the proposition that lexical development supports L2 phonological acquisition. [Work supported by NIH and MARCS/UWS.]

6pSWa16. The perception of Norwegian word tones by second language speakers. Wim A. van Dommelen and Olaf Husby (Dept. of Lang. and Comm. Studies, NTNU, N-7491 Trondheim, Norway, wim.van.dommelen@hf.ntnu.no)

The present study is concerned with the perception of Norwegian word tones by second language speakers. The phonological system of Norwegian involves two different tones that are used to distinguish a relatively large

number of word pairs. Earlier studies have shown that native speakers of Norwegian are able to identify the word tones almost error-free. The aim of the present study was to investigate word tone perception by speakers of a tonal language (Mandarin Chinese) and a non-tonal language (German). These two groups as well as a control group of native listeners identified manipulated stimuli with tonal contours varying between tone 1 and tone 2. It appeared that the L2 users had less sharp transitions than the natives, the Chinese subjects performing somewhat better than the Germans. In addition, native speakers categorized tokens of tone 1 and tone 2 words produced by the L2 speakers and indicated on a five-point scale how sure they were in their judgment. In an acoustical analysis the fundamental frequency contours of the L2 test words were analyzed and subsequently used for comparison with native categorization results. The implications of the found correlations between production and perception are discussed.

6pSWa17. Prominence perception: Conflicting cues and linguistically encoded bias. Miran Kim (Dept. of Linguist., State Univ. of New York at Stony Brook, S201 SBS Bldg., Stony Brook, NY 11794, mrkim@ic.sunysb.edu)

Beyond the commonly known fact that prominent syllables are greater in amplitude, higher in F0, and longer in duration, this study examines cross linguistic patterns in the perception of prominence. Particularly, identification of stress placement is tested in a situation where F0 and duration happen to be in conflict (e.g., H+L* bitonal pitch accent). Three languages are selected considering their prosodic characteristics such as phonological role of prominence and rhythm (stress-timed/syllable-timed): English, Spanish, and Korean. A new-language-learning setting is devised to collect production data based on which the patterns of phonetic realization of stress are directly compared among the language groups. CVCVCV pseudowords, where C=m, n, k, s and V=a, (e, i), are used for both production and perception experiments. F0 and duration are manipulated in order to create conflicting cues that are suitable for the purpose of the perception experiment. Stressed syllables are consistently realized with higher F0 together with longer duration across the groups, though to different extents. The perceptual sensitivity to the durational manipulation is found to vary among the groups. Linguistic implications are discussed referring to the phonological role(s) of F0 and duration in each language as well as to the relationship between production and perception.

6pSWa18. Perceptual attunement in infants at risk of reading disabilities. Christine Kitamura and Anna Herald (MARCS Auditory Lab., Bldg. 5, Bankstown Campus, Univ. of Western Sydney, Locked bag 1797, Penrith South DC, NSW, 1797, c.kitamura@uws, edu.au)

Impaired phonological processing has been found to have a reciprocal casual association with the reading ability of people with reading difficulties. Further, there is growing evidence that problems in phonological processing are present at birth as research shows that infants with a family history of these disorders have atypical neural electrical responses (ERPs) to speech stimuli. However, the nature of the phonological deficit is not clear. This study examined the phonological development of at-risk 9- to 12-month-old infants (n=18) and a control group (n=18). Their discrimination performance was evaluated using the habituation-dishabituation task to test their ability to discriminate the confusable native contrast, /fa-tha/ and the non-native contrast, /k'i-q'i/ from Werker and Tees (1984). In line with core phonological deficit hypothesis and hereditary accounts of reading difficulties, infants' attunement to their native language was significantly correlated with parental phonological ability measured using Pseudoword Decoding Test of the WIAT-II. The at-risk infants easily discriminated both native and non-native contrasts, whereas the control infants discriminated the native contrast but could not discriminate the non-native one. These results indicate that at-risk infants do not attune to their native language at the same rate as their peers.

6pSWa19. Effects of visual cues and phonetic contexts in perception of non-native contrasts by Cantonese learners of english. Bin Li (Dept. of Chinese, Translation & Linguist., City Univ. of Hong Kong, Hong Kong SAR, China)

Visual articulatory information, in addition to audio features, is integrated in L1 and L2 speech perception automatically and unconsciously [McGurk and MacDonald (1976); Rosenblum *et al.* (1997); Hardison (2003); Hazan *et al.* (2005)]. Previous literature on consonant perception has reported that visual aid is most significant with places of articulation, and that with manners, except with /r/ and /l/, has received little attention due to lack of research significance. Contrary to the commonly held idea, however, that the articulation of [l] and [n] is visually similar, our examination on video recording of three native English speakers' production of words contrasting [l] and [n] syllable initially suggests visual differences in advancement of tongue tips. This study investigates effects of such visual information in the identification of the non-native contrast by Cantonese learners of English. Results show that the relatively more distinct visual information can only help Cantonese speakers better perceive the two sounds in certain contexts, and in others cause more confusion.

6pSWa20. Do words in the native language influence second-language speech perception? Evidence from Japanese listeners' perception of English words that exist as Japanese loanwords. Keiichi Tajima (Dept. of Psych., Hosei Univ., 2-17-1 Fujimi, Chiyoda-ku, Tokyo 102-8160, Japan, tajima@hosei.ac.jp)

It is well known that native-language (L1) sound structure influences adult learners' perception of second-language (L2) speech. However, it is not as clear whether L2 speech perception can also be influenced by L1 mental lexicon. Specifically, L2 words may be inaccurately perceived if familiar loanword counterparts exist in L1 and if these loanwords have different sound patterns from the original words. To examine this, the present study took advantage of Japanese loanwords from English (e.g., Japanese /sutoresu/ from English "stress"), which typically undergo syllable structure changes, and investigated whether Japanese listeners can accurately perceive the syllable structure of English words even when loanwords exist in Japanese. Thirty native Japanese listeners were asked to count syllables in 189 English words spoken by a native English talker, and rate their subjective familiarity with the English words and their loanword counterparts transcribed in Japanese katakana orthography. Results indicated that syllable-counting accuracy (65% on average) was not influenced by familiarity with the English words nor with the Japanese loanwords. Results suggest that even though loanwords resemble the original words in their sound and meaning, knowledge of such words in L1 does not necessarily influence perceptual processing of L2 words. [Work supported by MEXT and JSPS.]

6pSWa21. Predicting second language (L2) identification rates from first language (L1) mapping data: Similarity patterns for English and Korean obstruents in pre- and poststressed intervocalic, and postvocalic positions. Hanyong Park (Speech Res. Lab., Indiana Univ., 1101 E. 10th St., Bloomington, IN 47405, hanypark@indiana.edu) and Kenneth J. de Jong (Dept. of Linguist., Indiana Univ., Bloomington, IN 40405)

Park and de Jong [J.Phon, **36**, 704–723 (2008)] found that listeners' identification rates of second language (L2) categories can be predicted from mapping data, provided the L2 category has a high degree of subjective correspondence to native language (L1) categories. The current study examines whether identification rates can be predicted for consonants in different prosodic locations, and hence, whether the reliance on L1 categories is the same, regardless of prosodic position. Forty native Koreans identified /p b t d f v θo/ in pre- and poststressed intervocalic, and postvocalic positions, in nonsense English words, using both Korean and English labels, and also gave gradient evaluations of their identifications. The mapping data were used to predict confusion rates for the L2 identification data, finding results for prestress intervocalic consonants similar to the previous study for word-dinitial consonants; stop identification rates were well-predicted, but fricatives are systematically much better than predicted. In poststress position, however, fricative identification rates were very well predicted, suggesting that fricatives were treated as "similar" to L1 categories. These results indicate that the degree of assimilation of an L2 to an L1 category is heavily dependent on prosodic location. [Work supported by NSF BCS-04406540.]

6pSWa22. Perception of foreign accent in Japanese and Brazilian Portuguese: Prosodic and segmental factors. Masahiko Komatsu (School of Psychol. Sci., Health Sci. Univ. of Hokkaido, Ainosato 2-5, Sapporo, 002-8072 Japan, koma2@hoku-iryo-u.ac.jp)

Japanese sentences read by Japanese-descent Brazilians (L2) and native Japanese speakers (L1) were rated by native Japanese speakers, and Portuguese sentences read by native Japanese speakers learning Portuguese (L2)

and Japanese-descent Brazilians (L1) were rated by Brazilians. The raters evaluated three types of samples: (a) sounds without spectral properties (representing prosodic features); (b) *F*0-flattened sounds (representing segmental features); and (c) unmodified sounds. In both languages, the perceptual scores of L1 and L2 samples were separated most clearly in (c), followed by (b) and (a). Both the scores of (a) and (b) showed strong correlations with (c) in L2. These suggest that both prosodic and segmental features play a role in the detection of foreign accent, but the latter has a greater effect. *F*0 characteristics varied between speaker groups rather than languages. The speaking rate in L2 was correlated with the perception scores. The effect of segmental features was greater in L2 Portuguese than in L2 Japanese, i.e., greater in less fluent speech. Foreign accents in both languages share common properties although having some differences. [This work is the revised version of Komatsu and Kimoto (2008) and Komatsu (in press), and partially supported by KAKENHI (20242010) and HSUH Kotaisa grant.]

6pSWa23. Acquisition of new phonetic categories by bilingual and monolingual groups: Role of metalinguistic awareness and feature generalization. Divya V. Gogoi (Linguist. Program, Univ. of Florida, P.O. Box 115454, Gainesville, FL 32611) and James D. Harnsberger (Dept. of Commun. Sci. Disord., Univ. of Florida, Gainesville, FL 32611)

The present study examines the role of feature generalization and metalinguistic awareness in the perception and learning of novel non-native speech contrasts by 40 bilingual speakers (Bengali–English and Spanish–English) and 20 monolingual speakers of American English. Bilinguals, unlike monolinguals, employ certain cognitive and linguistic skills during lexical processing and word learning attributed as metalinguistic awareness. This awareness in turn, can be applied in mastering unfamiliar phonetic features in a third language. A second issue concerns the role that native phonetic features may play in the development of new phonetic categories involving same phonetic features (feature generalization hypothesis). To explore both factors, a high variability perception training paradigm was used to examine the acquisition of novel non-native speech contrasts (containing dental/alveolar-retroflex place distinction in various manners) from a target language, Malayalam. A consonant identification procedure was used throughout the training and testing phases of the experiment to examine post-test and generalization performance across groups. Productions of the stimuli were also recorded at the pretest and posttest phases. In addition, perceptual assimilation patterns were analyzed from consonant assimilation and discrimination scores before and after training.

6pSWa24. Dutch listeners' perception of Korean stop triplets. Mirjam Broersma (Radboud Univ. Nijmegen, Donders Inst. for Brain, Cognition and Behaviour, Ctr. for Cognition, P.O. Box 9104, 6500 HE Nijmegen, The Netherlands, mirjam@mirjambroersma.nl)

This study investigates Dutch listeners' perception of Korean stop triplets. Whereas Dutch distinguishes prevoiced and voiceless unaspirated stops, Korean distinguishes fortis, lenis, and aspirated stops. Here, perception of fortis, lenis, and aspirated bilabial (/pp/-/p/-/ph/), alveolar (/tt/-/t/-/th/), and velar (/kk/-/k/-/kh/) stops is investigated. In Dutch, VOT is the most important perceptual cue for initial stop voicing. Korean fortis stops fall within the VOT range of Dutch voiceless stops; VOTs of lenis and especially aspirated stops are longer than Dutch VOTs. Therefore, Dutch listeners were expected to distinguish fortis stops more accurately from the other two than lenis and aspirated stops from one another. In a phonetic categorization experiment, Dutch listeners categorized Korean stops in naturally recorded CVs as fortis/lenis, lenis/aspirated, or fortis/aspirated. Indeed, for all places of articulation, fortis stops were distinguished relatively accurately from the other two stops. The most difficult distinction was between lenis and aspirated stops (both outside the Dutch VOT range), the easiest distinction between fortis and aspirated stops (the former within the Dutch VOT range, the latter the most remote from Dutch VOTs). Thus, although all Korean VOT category boundaries are outside the Dutch VOT range, the distance from Dutch VOT values affected Dutch listeners' categorization.

6pSWa25. Effects of native language and amount of experience on crosslinguistic perception. Juli Cebrian (Dept. Filologia Anglesa, Fac. Filosofia i Lletres-Edifici B, Univ. Autonoma de Barcelona, Bellaterra 08193, Spain, juli.cebrian@uab.es)

Models of second language (L2) speech learning draw on the notion of perceptual similarity to make predictions about L2 perception and production difficulty. Crosslinguistic perceived similarity is commonly assessed by means of perceptual assimilation tasks involving identification of target stimuli and goodness of fit ratings. Further, experience with an L2 may affect the perception of not only target language vowels but also native vowels. This paper reports the results of a crosslinguistic perception study involving English and Catalan vowels and diphthongs. The study assessed the perceived similarity of the two vowel systems by testing native speakers of each language on sounds from both their native language and the foreign language. Vowels were presented in CVC syllables. The effect of learning a second language was investigated by comparing the performance of language learners and monolingual speakers on the same task. The comparison between the two monolingual groups indicated a symmetry in the pattern of crosslinguistic perceived similarity while the effect of experience was found to vary with different vowels. The results are discussed in light of current theories and their predictions for second language perception and production. [Work supported by Grants HUM2005-02746/FILO (Spanish Ministry of Education) and 2005SGR00864 (Catalan Government).]

6pSWa26. Experience effects on the categorization of a native vowel contrast in highly proficient Catalan-Spanish bilinguals. Joan C. Mora (Dept. Filologia Anglesa, Universitat de Barcelona, Gran Via 585, 08007-Barcelona, Spain, mora@ub.edu) and Marianna Nadeu (Univ. of Illinois at Urbana-Champaign, Urbana, IL 61801)

The present study investigated the effect of experience on highly proficient adult Catalan-Spanish bilinguals' ability to categorize two contrastive native vowel categories, /e/ and /ɛ/. Experience was operationalized as self-reported amount of use of Catalan on a daily basis. Because Spanish has a single mid front vowel /e/ in the area of the perceptual vowel space of the Catalan mid vowels /e/ and /ɛ/, categorization and discrimination speed and accuracy was hypothesized to vary as a function of amount of use of Catalan and Spanish, more experienced Catalan speakers performing faster and perceiving the contrast more categorically. All participants ($N=43$) were L1-Catalan bilinguals, but differed as regards the amount of use of Catalan ($N=14$, $M=62.1$, range 40–70 vs $N=29$, $M=91.4$, range 80–100). Experience effects were assessed through the categorical perception paradigm: categorization and AXB discrimination tasks based on stimuli drawn from a 10-step vowel continuum (/e/-/ɛ/). Response latency data revealed that the high-use-of-Catalan group outperformed the low-use-of Catalan group, suggesting that greater use of Catalan on a daily basis improved bilinguals' ability to categorize and discriminate this vowel contrast. These results are interpreted as being consistent with the view that L1 and L2 experience affects the perception of L1 sounds.

6pSWa27. The influence of lexical access and linguistic context on second-language (L2) speech perception. Mara Haslam (Dept. of Linguist., Univ. of Utah, 255 S. Central Campus Dr., Rm. 2300, Salt Lake City, UT 84112, m.haslam@utah.edu), Albert Jarvi (Univ. of Illinois Urbana-Champaign, Urbana, IL 61801), and Rachel Hayes-Harb (Univ. of Utah, Salt Lake City, UT 84112)

Research on the perception of novel phonemic contrasts by second language (L2) learners typically employs tasks such as identification and discrimination. These tasks allow researchers to study L2 speech in a highly controlled setting. However, they differ in important ways from natural communication, which normally requires learners to (1) access lexical representations of words containing novel contrasts, and (2) interpret linguistic context (e.g., syntax, semantics, discourse) while simultaneously perceiving /producing novel contrasts. This study investigated whether learners/ perceptual performance with respect to novel contrasts is mediated by whether or not tasks require lexical access (LA) and/or the simultaneous interpretation of linguistic context (SILC). Native English speakers learned Ukrainian auditory nonword pairs differentiated by palatalization contrasts along with pictured "meanings." An ability to distinguish the words was tested in tasks differing on the two dimensions (LA and SILC). Performance was most accurate in the noLA + noSILC task, least accurate in the LA + SILC and noLA + SILC tasks, and intermediate in the LA + noSILC task, indicating that both LA and SILC appear to depress perceptual accuracy. However, the effect of SILC is stronger than that of LA. Future directions and implications for the study of L2 perception/production will be discussed.

6pSWa28. Word-level rhythm in non-native English. Rachel E. Baker (Dept. of Linguist., Northwestern Univ., 2016 Sheridan Rd., Evanston, IL 60208-4090, r-baker2@northwestern.edu), Laurent Bonnasse-Gahot (Ecole des Hautes Etudes en Sci. Sociales, Paris 75006, France), Kristin J. Van Engen, Melissa Baese-Berk, and Midam Kim (Dept. of Linguist., Northwestern Univ., Evanston, IL 60208-4090)

Motivated by traditional rhythm class typologies, studies of language-learners' rhythm typically focus on the syllable or segment level. Studying word-level rhythm lets us explore the effects of lexical features (e.g., part of speech, predictability) on word durations in non-native speech. This study examined whether native and non-native English can be distinguished by variation in the realization of English lexical features, and whether non-native-like word-level rhythm leads to a stronger foreign accent. Word durations were measured in English paragraphs read by 12 native American English (AE), 20 native Korean, and 20 native Chinese speakers. AE listeners rated the "accentedness" of these speakers. AE speakers showed greater within-speaker word duration variance than non-natives, and non-native speakers with greater variance received more native-like accent ratings. Increased AE variance had two causes. AE speakers had shorter relative durations for function words than non-natives. AE speakers also showed greater variance in their content word durations than non-natives, perhaps due to differences between words with and without pitch accents. However, both AE and non-native speakers produced shorter second mentions of words than first mentions, showing sensitivity to lexical predictability. Overall, these findings implicate word-level rhythm as an important and complex feature of foreign-accented English.

6pSWa29. English vowel contrast perception on monolingual and bilingual 4- to 7-year olds: Behavioral and neurophysiological evidence. Yan Yu, Nancy Vidal, Hia Datta, Jennifer Gerometta, and Valerie Shafer (Speech-Lang.-Hearing Sci., the Graduate Ctr., City Univ. of New York, New York, NY 10016)

The role of simultaneous bilingual language exposure on speech perception development has been far from definitive. Behavioral literature has been controversial in terms of whether bilingual children keep pace with their monolingual peers [Burns *et al.* (2007); Sundara *et al.* (2006)]. The purpose of the current study is to: (1) investigate whether bilingual exposure to Spanish and English affects processing of speech stimuli that are phonemic only in English in children from 4–7 years of age; (2) whether the event-related potential (ERP) measures correlate with the behavioral measure (e.g., phoneme identification). Phonetically similar vowel contrasts (I versus E) were presented in an oddball paradigm while ERPs were collected from 65 scalp sites. Vowel discrimination and vowel identification were carried out using I-E vowel continuum. Preliminary analyses suggest that there is no difference in how monolingual and bilingual children behaviorally identify this vowel contrast. In terms of the ERP responses, children in both groups showed vowel discrimination as indexed by the presence of mismatch responses (MMRs). Younger children tended to still have a positive MMR that preceded the adult-like negative MMR. Individual patterns of response will be discussed in relation to amount of English versus Spanish exposure.

6pSWa30. Using voice quality to learn non-native tonal categories. Kristine M. Yu (Dept. of Linguist., Univ. of California, Los Angeles, 3125 Campbell Hall, Los Angeles, CA 90095, krisyu@humnet.ucla.edu)

An artificial language learning experiment will be used to study if voice quality can be used to learn tonal systems. Cross-linguistically, tone, and voice quality can co-vary in different ways. For instance, Mazatec (Jalapa de Diaz), has three phonation types (modal, breathy, creaky) fully crossed with three level tone levels [Ladefoged *et al.* (1988)], while Mandarin has creaky phonation in Tone 3 and Tone 4, which are also distinguished from one another and Tone 1 and 2 by f0 contour [Davison (1991); Belotel-Grenié and Grenié (2004)]. The goal of the study is to investigate if English listeners unfamiliar with tone languages can use phonation-type contrasts to learn tonal contrasts in artificial tone languages differing in how tone and voice quality co-vary. There will be a comparison of how learners generalize from training to novel stimuli for artificial languages where voice quality and tone contrasts are correlated and uncorrelated cues.

6pSWa31. Intelligibility of Spanish-accented English words in noise. Jonathan Dalby (Dept. of Audiol. and Speech Sci., Indiana Univ.-Purdue Univ., Fort Wayne, 2101 E. Coliseum, Ft. Wayne, IN 46805, dalbyj@ipfw.edu) and Catherine L. Rogers (Univ. of South Florida, Tampa, FL 33620)

The intelligibility of Mandarin-accented English sentences, even those spoken by highly proficient non-native speakers, is degraded more than is native speech when presented to native listeners in noise [Rogers *et al.* (2004)]. Comprehension of accented speech may require more processing time than native speech even when presented in quiet [Munro and Derwing (1995)]. These effects are similar to effects found by Pisoni and his colleagues for synthetic, as compared to natural speech [Winters and Pisoni (2003)] and together suggest that the ability of native listeners to adapt relatively quickly and effectively to accented speech [Bradlow and Bent (2008); Clark and Garrett (2004)] may come at the expense of increased cognitive effort. The present study examines the effects of noise on the intelligibility of Mandarin-accented isolated words from speakers representing a wide range of oral English proficiency based on connected-speech measures. A subset of these words, those with the highest open-set identification scores as rated by a jury of 10 native listeners, will be presented for identification to a second jury at four signal-to-noise ratios: quiet, +10, 0, and −5 dB. Results are compared to those found for connected speech from the same group of talkers. [Work supported by NIH-NIDCD.]

6pSWa32. Infant dialect discrimination. Jennifer Phan and Derek M. Houston (Dept. of Otolaryngol., Indiana Univ. School of Medicine, 699 West Dr., Indianapolis, IN 46202, jphan@iupui.edu)

To understand speech, infants must differentiate between phonetic changes that are linguistically contrastive and those that are not. Research has shown that infants are very sensitive to fine-grained differences in speech sounds that differentiate words in their own or another language. However, little is known about infants' ability to discriminate phonetic differences associated with different dialects of their native language. Using a visual habituation procedure, 7-, 11-, 18-, 24-, and 30-month olds were tested on their ability to discriminate two linguistically equivalent variants of the diphthong (/aI/)—one produced in their native dialect (North Midland American English) versus one produced in a non-native dialect (Southern American English). Seven-month olds discriminated the variants but 11-month olds did not. Infants from 18–30 months of age did not demonstrate statistically significant discrimination, but they did show a trend toward discrimination with increasing age. The findings suggest that dialect discrimination follows a U-shaped course of development. Because 11-month olds demonstrated the poorest dialect discrimination performance, we are currently assessing their ability to discriminate linguistically different speech sounds varying in degree of acoustic similarity. Preliminary findings suggest that both language experience and acoustic differences may influence infants' discrimination of phonetic contrasts in the native language. [Work supported by NIH-NIDCD Grant (R01DC006235), an IUPUI Educational Enhancement Grant, and grants from the IUPUI UROP and SROP Programs.]

6pSWa33. Perception of second-language (L2) production by first-language (L1) speakers of different dialectal backgrounds: The case of Japanese-speaking learners' /u/ perceived by French and Quebec native speakers. Marie-Claude Tremblay (Dept. of Linguist., Univ. of Ottawa, 70 Laurier Ave. E., Ottawa, ON Canada, K1N 6N5, mtrem075@uottawa.ca) and Takeki Kamiyama (CNRS/Sorbonne Nouvelle, 75005 Paris, France)

The high back rounded /u/ of Parisian French (PF) is characterized by a concentration of energy in the low frequency zone (< 1000 Hz) due to the grouping of the first two formants, while Quebec French (QF) has a "lax" variant [ʊ] in closed syllables (as in "*soupe*"), with its F2 amounting to 1000–1100 Hz [P. Martin, "Le système vocalique du français du Québec. De l'acoustique à la phonologie." *La linguistique*, **38**(2), 71–88 (2002)]. Japanese-speaking learners of French (JSL) tend to produce French /u/ with high F2 as in Japanese /u/, which in turn tends to be perceived by PF lis-

teners as /ɸ/. Do QF listeners show different behavior because of their lax variant of /u/? Our perception experiment using 18 tokens each of /u y ɸ/ produced by five JSL showed that the 16 PF listeners examined perceived those stimuli of /u/ with F2 between 1000 and 1100 Hz as /u/ and /ɸ/ almost equally often, but considered as very poor exemplars of either of them. By contrast, the 16 QF listeners tested identified the same stimuli of /u/ almost always as /u/ with a better goodness rating than NF listeners'. These findings suggest that native speakers' judgment about non-native speakers' production might depend on the native dialect of the listener.

6pSWa34. Adapting second language phonemic perception training to common instructional situations: Pitfalls and progress. Thomas R. Sawallis and Michael W. Townley (English Dept., Univ. of Alabama, Box 870244, Tuscaloosa, AL 35487, tsawalli@bama.ua.edu)

Adult language learners improve both perception and production of difficult target language phonemic contrasts through high variability phonetic training (HVPT) on minimal pairs. This training entails two alternative forced choice identifications with feedback of a corpus encompassing multiple talkers, tokens, and phonological contexts. This technique, refined most notably by Pisoni and colleagues [Bradlow *et al.* (1999)], has been little used in real pedagogical situations, due partly to inconvenient protocols (e .g., 1 h, 3 days per week, for 3 weeks) and partly to the difficulty of developing a robust presentation routine attractive to students. We have attacked these problems, and after two semesters of pilot work refining the training presentation (of English /r-l/ to Japanese, Korean, and Chinese native learners), we expect this semester to have students who receive a full complement of training at ~15 min, 2–3 days per week, throughout the term. Results will be presented and compared with previous research, and we will discuss some of the difficulties (technological, practical, and especially social) that were overcome for the sake naturalistic pedagogical application.

6pSWa35. Effects of first-language (L1) voicing assimilation rules on the second-language (L2) perception of English word-final consonants by Polish and Hungarian listeners. Marisa A. Monteleone (Dept. of Linguist., The Graduate Ctr., City Univ. of New York, 365 Fifth Ave., New York, NY 10016)

This study explores whether knowledge of a L1 regressive voicing assimilation rule interferes with perception of word-final voicing contrasts in an L2. Due to a regressive voicing assimilation rule, voicing in word-final consonants is neutralized in both Hungarian and Polish. American English (AE) maintains a voicing contrast in this same context. In a perception task, 11 native Hungarian and 12 native Polish listeners identified AE word-final consonants (e.g., [s]-[z]) followed by voiced versus voiceless consonants. In a separate task, they identified the same consonants with the following consonantal context removed. The Hungarian and Polish listeners performed less accurately when the following context was present than when it was removed, suggesting that word-final perception was influenced by the interference of the L1 rule.

6pSWa36. Cross-language differences in the uptake of place of articulation. Anita E. Wagner (Dept. of Speech, Hearing and Phonetic Sci., Univ. College London, London, UK)

There are cross-language differences in the use of coarticulatory cues for fricative identification. Listeners with spectrally similar fricatives in their native phoneme inventories rely more on the information in the surrounding vowels than listeners with spectrally distinct fricatives. The present study examined whether such cross-language differences result in differences in the temporal uptake of information specifying fricatives. In a gating study native listeners of Dutch and Italian, both languages with spectrally distinct fricatives were compared with Spanish and Polish listeners. The Spanish fricative inventory contains the spectrally similar labiodental and dental fricatives. The Polish fricative repertoire contains postdental, alveolar, and alveolopalatal fricatives. The questions addressed were whether the presence of spectrally similar fricatives leads to: (1) reliance on cues, which are secondary for listeners with distinct fricatives; (2) an uptake of information specifying place of articulation in particular for fricatives; (3) an uptake of information from coarticulatory cues preceding or following the consonant. Listeners identified fricative and stop targets in gated CV and VC syllables. The results show that listeners optimize their uptake of information to the demands of their native phoneme inventories and rely on more sources of information only for distinctions between several similar places of articulation.

6pSWa37. Coarticulatory influences on the perception of nasal vowel height and the role of language experience. C. Elizabeth Goodin-Mayeda (Dept. of Spanish and Portuguese, Univ. of California, Los Angeles, 5310 Rolfe Hall, Los Angeles, CA 90095, cegoodin@ucla.edu)

That a listener's first language affects the perception of a second language is generally undisputed. In addition to linguistic experience, acoustic effects of coarticulation have been shown to influence speech perception [Abramson *et al.* (1981); Krakow *et al.* (1988); Mann (1986) and others]. For example, nasalization of vowels has been shown to affect the perception of vowel height due to its spectral consequences in the region associated with vowel height [Beddor and Strange (1982); Krakow *et al.* (1988); Ohala (1986); Wright (1975)]. While some effects of coarticulation appear to produce the same perceptual shifts crosslinguistically [Mann (1986)], it is not clear that all coarticulatory influences are language independent [Krakow *et al.* (1988)]. The current study seeks to investigate the relationship between acoustic effects of coarticulation and linguistic experience. Since Portuguese has allophonic and (surface) contrastive nasalization [Wetzels (1997)] and Spanish does not have phonological nasalization in any context [Solé (1992)], adult speakers of these languages were tested, using synthetic stimuli, for perception of contextualized nasal vowels (i.e., nasal vowels adjacent to tautosyllabic nasal consonants) and noncontextualized nasal vowels (i.e., nasal vowels with no adjacent nasal consonant). Results indicate that coarticulatory influences of nasalization are language dependent.

6pSWa38. Perception of consonant length by Russian and American listeners. Olga Dmitrieva (Dept. of Linguist., Stanford Univ., Margaret Jacks Hall, Bldg. 460, Stanford, CA 94305, dmitro@stanford.edu)

An experimental investigation of Russian geminates revealed that intervocalic, post-stress, and word-initial geminates have an earlier perceptual boundary in relation to the average singleton duration in these positions. This provides an articulatory and perceptual advantage for geminate production and discrimination, which may explain cross-linguistic preference for these types of geminates. The proximity of the boundary to the average singleton means that a smaller articulatory effort is needed to reach the geminate status; its greater distance from the average geminate means that fewer intended geminates are misperceived as singletons, hence less danger of perceptually driven neutralization. To confirm that this generalization holds across languages a group of monolingual American English listeners was tested in addition to Russian listeners. The results strongly suggest that perception of the contrast between geminates and singletons has a linguistically universal basis. Speakers of American English—a language without phonemic consonant length—showed a pattern of responses very similar to that of the Russian listeners, in particular for post-stress and intervocalic geminates. The consistency of the results in both languages further supports the hypothesis that the observed shift in perceptual boundary is responsible for cross-linguistic dominance of intervocalic and post-stress geminates.

6pSWa39. Cross-linguistic perception of the epenthetic vowel in obstruent + liquid clusters in Spanish. Carlos Ramirez (Dept. of Hispanic Lang. and Lit., Univ. of Pittsburgh, 1301A Cathedral of Learning, Pittsburgh PA 15260, cjramirez@hotmail.com)

This research explores the perception of the epenthetic vowel (EV) that occurs in the obstruent + liquid clusters in Spanish. The perceptibility of EV and its effect in the cluster is analyzed in Spanish native speakers and English native speakers learning Spanish at different levels: beginners; intermediate; and advanced. For this study, two tests were used: a perceptual identification test and a discrimination test (AXB protocol). The study explores the effect of linguistic and prosodic variables such as place and manner of articulation, voicing, type of liquid, and stress. The statistical analysis was conducted using mixed logit models, which can better account for subject and item random effects. This procedure, in contrast to other analyses, builds a model that predicts the effect of each factor. The results show that the different groups use different cues. For English speakers, place, voicing, and stress are predictors for the beginner and intermediate group (WaldZ $= 0.000 p < 0.000$) whereas only voicing is a predictor for the advanced group (WaldZ $= 0.008 p < 0.01$). For the Spanish native speakers voicing

and stress are predictors (WaldZ = 0.02$p < 0.05$). The results suggest that perceptual cues vary according to L1 and proficiency level.

6pSWa40. Language background influences the emergence of voice onset time production and perception. Andrea A. N. MacLeod (Pavillon Vandry, Univ. Laval, PQ, QC G1S 3H3, Canada), Susan Rvachew, and Linda Polka (McGill Univ., Montreal, QC H3G 1A8, Canda)

This study investigates the production and perception of voice onset time (VOT) among preschool children who acquired English and French simultaneously compared to monolingual peers of these two languages. Children participated in this study at the age of 18 months and returned at 24 months for a second session. During each session the children took part in a visual habituation procedure to evaluate discrimination of VOT using edited natural /b/+ vowel and /p/ + vowel syllables in a task format developed by Houston et al. (2007) to assess individual performance. In this task, three VOT values (produced by several talkers) were presented to the children: one within adult norms of the language for voiced bilabial consonants; one within the adult norms of the language for voiceless bilabial consonants; and one between the means for the voiced and voiceless consonants. The children also participated in a structured play session, and their spontaneous productions of word initial stops were acoustically analyzed to measure VOT. Preliminary analysis indicates that accuracy in discriminating VOT precedes production of voicing contrasts for all groups, and monolinguals appear to have developed adultlike perception and production of voicing at a younger age than their bilingual peers.

6pSWa41. Perception of Moroccan Arabic geminates by native English speakers. Bozena Pajak (Dept. of Linguist., Univ. of California San Diego, 9500 Gilman Dr. #108, La Jolla, CA 92093, bpajak@ucsd.edu)

Adult listeners often have difficulty perceiving phonetic distinctions that are not contrastive in their native language (e.g., Lisker and Abramson 1970, Miyawaki *et al.* 1975, Trehub 1976, MacKain *et al.* 1980, Werker *et al.* 1981, among others). However, the same contrast may be perceived with more or less difficulty depending on the environment in which it is embedded. This study investigated the perception of geminate consonants in Moroccan Arabic by native English speakers who had not had previous exposure to the geminate-singleton contrast. The geminates [ss] and [zz] were paired with singleton counterparts in four different environments: medial-intervocalic ([assa]-[asa], [azza]-[aza]); medial-consonant-adjacent ([assta]-[asta], [azzda]-[azda]); initial-vowel-adjacent ([ssa]-[sa], [zza]-[za]); and initial-consonant-adjacent ([ssta]-[sta], [zzda-[zda]]). The words were recorded by a native Moroccan Arabic speaker, and subsequently used as stimuli in a perception experiment (AX discrimination task; 80 participants). The sensitivity to the geminate-singleton contrast was measured by calculating A-prime scores (Grier 1971) and performing an ANOVA. The analysis showed a significant main effect of environment [$F(3,237)=28.7$; $p<0.001$]. The participants performed above chance, and their perception of the geminate-singleton contrast was best in the medial-intervocalic environment ($A'=0.83$), worse in the medial-consonant-adjacent ($A'=0.73$) and initial-vowel-adjacent environments ($A'=0.74$), and worst in the initial-consonant-adjacent context ($A'=0.58$).

6pSW42. Stop-like modification of dental fricatives in Indian English: A preliminary study to perceptual experiments. Chi D. Chu (Dept. of Linguist., Dartmouth College, 4954 Hinman, Hanover, NH 03755, chi.chu@dartmouth.edu) and Nancy F. Chen (MIT, Cambridge, MA 02139)

Stop-like modification of dental fricatives occurs in both American English and foreign accents of English (Zhao, Ph.D. thesis, 2007). This study examines stop-like word-initial /ð/ in Indian English to determine its frequency and compare it with American English. Acoustic analysis on unscripted telephone recordings of 40 Indian English speakers showed that of 161 total word-initial /ð/ instances, 61% were stop-like. The modification occurred most frequently in utterance-initial contexts, after stops, and after fricatives, and least after vowels and liquids. The variable occurrence of the modification across many contexts suggests that it may result from physiological conditions rather than from a phonological rule. If the modification is physiologically conditioned, differences in modification frequency between dialects may indicate dialectal differences in articulation. For example, comparison with American English showed that stop-like /ð/ was more common in Indian English across all contexts, particularly after fricatives, consistent with the tendency of Indian English to substitute bilabial stops for labiodental fricatives (e.g., /f/ and /v/), which provides a context more conducive to stop-like /ð/. Further investigation of varying cross-dialectal frequencies of stop-like modification could uncover additional dialectal differences in articulation and determine how such articulatory differences might affect cross-dialect perception.

SATURDAY AFTERNOON, 23 MAY 2009 SKY BRIDGE AUDITORIUM, 3:15 TO 4:45 P.M.

Session 6pSWb

Speech Workshop: Development of Speech Perception: Shaping the Acquisition of Spoken Language

Terry L. Gottfried, Chair
Dept. of Psychology, Lawrence Univ., Appleton, WI 54912-0599

Contributed Papers

3:15

6pSWb1. Newborn infant perception of vowels is affected by ambient language. Christine Moon (Pacific Lutheran Univ., Dept. of Psych., Tacoma, WA 98447, mooncm@plu.edu), Hugo Lagercrantz (Karolinska U. Hospital Solna, S-171 76 Stockholm, Sweden), and Patricia K. Kuhl (Univ. of Washington, Seattle, WA 98195)

Behavioral research has shown that by 6 months of age, infants show an effect of experience with native language vowels. In a previous study of category organization, infants in Sweden and the United States treated a vowel prototype as equivalent to variants of the vowel in the native, but not the non-native language. In the current behavioral study of Swedish and U.S. neonates, results were consistent with those of the 6-month-olds. Eighty infants ($M=32.8$ h since birth) in Washington State and Stockholm participated in a procedure in which non-nutritive sucking activated one of 17 stimuli (a prototype and 16 variants) from the same vowel category. Twenty infants in each country heard their native vowel, and 20 the non-native vowel. The vowels were English /i/ and Swedish /y/. Stimuli were serially and randomly activated by the onset of a sucking bout, and once a stimulus was activated, frequency of presentation was infant-controlled. The dependent measure was number of sucks for each stimulus. For the non-native vowel only, the mean number of sucks was significantly higher for the prototype than the mean for the 16 variants. This suggests that category organization of vowels begins *in utero*.

3:33

6pSWb2. Visual speech information improves discrimination of non-native phonemes in late infancy. Robin K. Panneton (Dept. of Psycholoty, Virginia Tech., Blacksburg, VA, panneton@vt.edu)

Initially, human infants are able to discriminate a change from one speech phoneme to another, whether or not the speech contrasts are native or foreign. By the end of the first postnatal year, the ease with which infants discriminate non-native phonemes diminishes, indicating a progressive attunement toward language-relevant speech. However, studies in this area have employed procedures lacking dynamic bimodal information (e.g., faces and voices). Given rapid improvements in visual perception across the first postnatal year, as well as a strong propensity to look at and process faces, it is possible that infants would benefit from visual speech in both native and non-native perception. Across two experiments, discrimination of auditory plus visual Hindi phoneme contrasts was studied in 11-month-olds (English-learning, using digital movies of female Hindi speakers). Several conditions were contrasted: (a) face plus voice using infant-directed speech (IDS); (b) face plus voice using adult-directed speech (ADS); (c) nonface plus voice with IDS; and (d) nonface plus voice with ADS. Overall, infants discriminated non-native contrasts when accompanied by a dynamic face, and especially if delivered in IDS. These results suggest a developmental pattern toward increasing use of multimodal information by infants in their processing of speech, and that early phonological representations for native language may include visual speech information.

3:51

6pSWb3. Brain, behavioral, and sociocultural factors in bilingual language learning. Adrian Garcia-Sierra, Maritza Rivera-Gaxiola, Barbara Conboy (I-LABS, Univ. of Washington, Fisheries Ctr. Bldg., Box 357988, Seattle, WA 98195-7988), Harriet Romo (Univ. of Texas, San Antonio, San Antonio, TX 78201), Lindsay Klarman, and Patricia Kuhl (Univ. of Washington, Seattle, WA 98195-7988)

Previous behavioral studies have shown improved sensitivity to native-language contrasts and reduced sensitivity to non-native phonetic contrasts when comparing 6–8- and 10–12-month-old monolingual infants. It has been argued that exposure to language dedicates neural networks to the acoustic properties of native-language speech, and that, in adulthood, this commitment interferes with nonnative speech processing [native language neural commitment or (NLNC)]. There are very few studies on how early speech perception in bilinguals relates to future language advancement. Recently it has been shown that infants' early native-language speech perception skill predicts their later success at language acquisition. In the present investigation, we examined how brain measures of speech perception in bilingual infants and socio-cultural factors of their environment predict later vocabulary growth. Our results showed excellent neural discrimination of both English and Spanish phonetic contrasts in 12-month-old infants, distinguishing them from monolingual infants. To our knowledge, this is the first study of bilingual infants using a brain measure to show that bilingual infants' speech specialization includes both languages by the end of the first year of life.

4:09

6pSWb4. Bilinguals mind their language (mode): Vowel perception patterns of simultaneous bilingual and monolingual speakers. Monika Molnar, Linda Polka (McGill Univ., 1266 Pine Ave. W, Montreal, H3G 1A8 Canada; monika.molnar@mcgill.ca), Lucie Menard (Univ. du Qubec à Montréal, Montreal, Canada), and Shari Baum (McGill Univ., Montreal, H3G 1A8 Canada)

It is well-established that the speech perception abilities of monolingual speakers are highly tuned to the sounds of their native language, and that this language specificity affects how monolingual speakers distinguish the sounds of a non-native language. The present study addressed how the speech perception skills of simultaneous bilingual speakers, who are native speakers of two languages, may be affected by control of active language mode. We tested monolingual (English and French) and simultaneous bilingual (English/French) adults in an identification and rating task with 42 vowels along a continuum from a high back rounded vowel (/u/) to a high front rounded vowel (/y/) that are both phonemic in French, with only the back vowel represented in English. Bilinguals completed the task in three language modes: English, French, and bilingual. As expected, monolingual speakers demonstrated a language-specific perceptual pattern for the vowels. Bilingual participants displayed different perceptual patterns in each active language mode to accommodate the vowel categories relevant in the target language. These findings indicate that simultaneous bilinguals rely on a finely detailed perceptual space and are flexible as they adapt their perception to different language environments.

4:27

6pSWb5. Korean-English bilinguals' perception of phonetic contrasts in their two languages. Jessica Maye (Commun. Sci. and Disord., Northwestern Univ., 2240 Campus Dr., Evanston, IL 60208, j-maye@northwestern.edu), Jenna Luque (Northwestern Univ., Evanston, IL 60208), Thomas Farmer (Cornell Univ., Ithaca, NY 14850-2824), Yubin Lee, and Midam Kim (Northwestern Univ., Evanston, IL 60208)

Korean speakers are known to find English /r/-/l/ difficult to discriminate, and English speakers have trouble discriminating Korean voicing contrasts. We tested Korean-English bilinguals' perception of these difficult phonetic contrasts to examine the effects of age of acquisition and language dominance on bilinguals' perception in their two languages. All bilingual participants were native Korean speakers but varied in age of English acquisition. Some reported English to be their dominant language, while others were Korean-dominant. Participants completed a 2AFC task in which they were asked to click on one out of a pair of pictures. On key trials the pictures formed a minimal pair (e.g., rock versus lock). The same task was completed once in English (key items contained the /r/-/l/ contrast) and once in Korean (key items contained the plain versus tense voicing contrast). Earlier exposure to English led to greater accuracy and faster response on the English task. However, neither age of acquisition nor language dominance affected performance on the Korean task. These results suggest that earlier exposure to a second language improves perception in that language, but that loss of dominance in a first language does not impair phonetic processing of that language. [Work supported by NIH#1R03HD048538 to JM.]

Session 6pSWc

Speech Workshop: Closing Address

Linda Polka, Chair
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Chair's Introduction—5:00

Invited Papers

5:05

6pSWc1. Looking back to see where we're going. James Jenkins (Dept. of Psych., Univ. of South Florida, Tampa, FL 33612, J3cube@aol.com)

A brief sketch of the origins of the field of cross-language speech perception will be presented. This will be followed by comments on the current state of research as reflected in the workshop and suggestions as to future directions.