2014 Student Research Day

Friday April 25
1:00-4:15 pm
Bioinformatics Auditorium (1131) and Lobby, UNC-CH

Division of Speech and Hearing Sciences, Department of Allied Health Sciences, University of North Carolina at Chapel Hill

Sixth Annual
Division of Speech and Hearing Sciences
Student Research Day

Friday April 25, 2014
1:00 – 4:15 pm
University of North Carolina – Chapel Hill
Bioinformatics auditorium and lobby

Welcoming Remarks

Dr. Jackson Roush 1:00 – 1:10

Oral Presentations

1. Nancy Quick (1st year Ph.D. Student) 1:10 – 1:30
   Tense productivity in children with and without hearing loss: The influence of parent input and developmental variables

2. Marziye Eshghi (1st year Ph.D. Student) 1:35 – 1:55
   Perceptual and nasal ram pressure evaluation of stop consonant production by children with repaired cleft palate

3. Tyson Harmon (1st year Ph.D. Student) 2:00 – 2:20
   Listener attitudes and perceptions of simulated fluent speech in nonfluent aphasia: a mixed-methods approach

4. Nicole Corbin (1st year Ph.D. Student) 2:25 – 2:45
   Effects of Unilateral Hearing Loss on Children's Speech Perception and Spatial Release from Masking under Complex Listening Conditions

Poster Session 2:45 – 4:15

1. Thomas Page
   Associations Among Child and Family Characteristics in Language Outcomes of Young Children with Hearing Loss
2. Frances Albanese and Keri Brown Kirschman
   Health Belief Model and Risk-Seeking Behavior as Indicators of Chosen Listening Levels of Youth

3. Adara Blake
   Breastfeeding Knowledge and Clinical Management among Speech-Language Pathologists
4. Jenna Browning, Emily Buss, and Lori Leibold
   Development and Verification of a Two-Interval, Forced-Choice Infant Behavioral Testing Procedure
5. Andrea Bucker, Margaret Dillon, Marcia Adunka, English King, Harold Pillsbury, Craig Buchman, and Oliver Adunka
   Effect of Charge Levels on Residual Hearing in EAS Subjects
6. Andrea Bucker, Margaret Dillon, Marcia Adunka, English King, Harold Pillsbury, Craig Buchman, and Oliver Adunka
   Long-Term Speech Perception Outcomes of Electric-Acoustic Stimulation (EAS)
7. Hannah Burris and Adam Jacks
   Effects of Rhythmic Stimulation on Aphasia and Apraxia of Speech
8. Rob Cavanaugh and Katarina Haley
   Accounting for Aphasia-Related Language Deficits in Verbal Working Memory Assessments: A Literature Review.
9. Petros Pravasilis, Lúcia Fischer, and Katarina Haley
   Κατάλαβες τι είπα; ¿Me entendiste?: Adapting the CHMIT into Greek and Spanish
10. Hannah Hodson, Meredith Spratford, Marc Brennan, Lori Leibold, Ellen Hatala, and Ryan McCreery
    Effects of Linguistic Environment on Detection of /s/ and /z/
11. Jessica Kinard and Elizabeth Crais
    Use of Family-Centered Principles with Culturally and Linguistically Diverse Families
12. Sarah Obarowski, Margaret Dillon, English King, Ellen Pearce and Marcia Adunka
    Optimization of FSP and HDCIS: Influence on Speech Perception
13. Sadie Schwarz, Lauren Calandruccio, & Emily Buss
    Development of a Pediatric Vowel-Discrimination Task
14. Ashley Wellons & Nancy McKenna
    Wideband Acoustic Immittance: Screening for Middle Ear Function: A Review of the Literature and Considerations for Future Studies

Nancy Quick

Tense productivity in children with and without hearing loss: The influence of parent input and developmental variables

Purpose or Research Questions

The purpose of this study is to examine the relationship between parent input informativeness and tense productivity in children with hearing loss compared to children with normal hearing. The specific questions are as follows: 1) Do children with hearing loss differ from children with normal hearing in tense productivity? 2) What is the relationship between parent input and child tense productivity for children with hearing loss and children with normal hearing? 3) Do parent input, developmental abilities and hearing levels predict child tense productivity in 3-year-old children?

Background

Children who are hard of hearing are at risk for the development of verb morphology, even with mild to moderate levels of hearing loss (Brown, 1984; Koehlinger, Van Horne, & Moeller, 2013; McGuckian & Henry, 2007; Moeller et al., 2010; Norbury, Bishop, & Briscoe, 2001a). Studies indicate a wide range of outcomes in verb morphology among hard of hearing children, but the sole explanatory variable identified is pure tone average, accounting for only 5% of the variance (Koehlinger et al., 2013; Norbury, Bishop, & Briscoe, 2001b). Among 30-month-old typically developing children, parent input informativeness (the proportion of unambiguous sentence contexts) has explained 23% of the variation in tense productivity and developmental ability remains a potential explanatory variable given a sufficient sample size (Hadley, Rispoli, Fitzgerald & Bahnsen, 2011). Based on the above research findings, examining the predictive nature of parent input, developmental abilities and parent input is important for explaining between-child differences in verb morphology use among children with hearing loss.

Methods

A retrospective video analysis of 24 randomly selected 3-year-old participants (12 with hearing loss, 12 with normal hearing) will be completed from a larger pool of 185 three-year-old participants from the Outcomes of Children with Hearing Loss project. Parent input and child language data were gathered from a five-minute parent-child language sample modeled after the Art Gallery procedure described by Adamson, Bakeman, and Deckner (2004) and a 15-minute language sample with Play-Doh® and kitchen toys including the parent, child and examiner. Parent input informativeness will be measured by coding parent verb forms for +/- Tense (Hadley & Short, 2005). Child tense productivity will be measured by coding differential productions of verb forms across five morpheme categories (Hadley & Short, 2005). The Number of Different Words and Mean Length of Utterance generated by conventional Systematic Analysis of Language Transcripts (SALT) procedures will be used as indices of language development.

Anticipated Results

Children with hearing loss are expected to differ from children with normal hearing in tense productivity. Parent input informativeness is expected to correlate with tense productivity scores, irrespective of hearing level status. Parent input, hearing levels, and developmental abilities are anticipated to predict tense productivity among 3-year-old children.

Discussion

With the completion of this study, we will be able to contribute new information regarding the role of parent input in predicting verb tense production in children with hearing and with hearing loss, which may lead to the design of more effective early grammatical interventions for children at risk for finite verb morphology.

Marziye Eshghi

Perceptual and nasal ram pressure evaluation of stop consonant production by children with repaired cleft palate

Purpose

This study is part of a larger project titled “Development of Stop Consonants in Children with Repaired Cleft Palate” pursuing two questions: 1) When do stop consonants emerge in infants with cleft palate (CP) following surgery, and 2) Do children exhibit complete velopharyngeal (VP) closure for stops when they emerge as determined by nasal ram pressure (NRP) monitoring. The objective of this study is to determine the sensitivity and specificity of NRP in classifying VP status of stop consonants.

Background

Velopharyngeal inadequacy (VPI) is referred to coupling of oral and nasal cavities during speech due to the inability of the velum as well as posterior and lateral pharyngeal walls to separate the oral and nasal cavities. High-tech instrumentation such as videofluroscopy, nasoendoscopy, and pressure flow technique are usually applied clinically to evaluate the status of VP mechanism. However, each of these tests is potentially expensive and/or invasive. Furthermore, they demand children old enough to show high degree of cooperation during the test. On the other hand, NRP monitoring is relatively easy and requires minimum cooperation of the child. NRP provides binary information relative to VP status as open versus closed. Krochmal et al. (2013) reported good sensitivity and specificity of NRP measures. However, there is limited information on the clinical utility of NRP measures for young children less than 3 years of age.

Methods/Proposed Methods

As part of the larger study, speech samples of children with and without repaired CP will be obtained during NRP monitoring. The children will be 12 to 16 months of age. Speech samples will consist of isolated CV or CVC syllables containing at least one stop. A stop will be considered VP closed if the NRP corresponding to its audio signal is zero (a flat line). Ten experienced speech-language pathologists (SLPs) will perceptually judge approximately 50 speech samples from 5 children with repaired CP and 5 controls (5 samples per child). They will judge the VP mechanism to be “definitely closed”, “definitely opened”, or “not sure”. Intra- and Inter-judge reliability of perceived VP adequacy will be determined. Sensitivity and specificity calculations for NRP will be conducted using the perceptual judgments as the gold standard. “Not sure” judgments will be excluded from analysis and/or collapsed into the other categories.

Results/Anticipated Results

It is anticipated that specificity will be higher than sensitivity due to the fact that NRP provides only a binary determination of VP status (i.e., open versus closed) and not a magnitude estimate.

Discussion

NRP measurement is a non-invasive, cost effective technique which provides objective evaluation of VP function as being either open or closed. If sensitivity and specificity are high during production of stop consonants, then NRP determination of VP status may facilitate early diagnostic decisions for children with repaired cleft palate. If sensitivity is low, then arbitrary levels of NRP relative to nasal consonants (i.e., 15%, 10%, or 5%) may improve VP status classifications and sensitivity.

Tyson Harmon

Listener attitudes and perceptions of simulated fluent speech in nonfluent aphasia: a mixed-methods approach

Purpose: The purpose of this study is to determine the impact of increased speech fluency on listener attitudes of persons with aphasia (PWA) and to evaluate differences between the perceptions of experienced and inexperienced listeners.

Background: Nonfluent aphasia (NFA) is a neurological language disorder that includes reduced grammatical structure, flow of speech, and laborious articulation, reflecting a combination of language and motor speech programming impairments. Consideration of disfluency (i.e., behaviors that prohibit the forward motion of speech) and how it affects communication in aphasia is important because of its potential to inform intervention strategies. Fluency may affect how listeners perceive PWA in regards to their speech, their personality, and how comfortable they are to interact with, which may impact communicative success. The effect of disfluencies on listener perceptions has received substantial attention in the stuttering literature. Several studies have shown that listener perceptions of persons who stutter become more negative as disfluencies increase (Evans, Healey, Kawai, & Rowland, 2008; Panico, Healey, Brouwer, & Susca, 2005; Susca & Healey, 2001, 2002; Von Tiling, 2011). While increased fluency has a positive effect on listener perceptions of persons who stutter, its effect in PWA is yet to be investigated.

Method: The participants in this pilot study were twelve student listeners from the University of North Carolina at Chapel Hill. Four of these were graduate students in the speech and hearing sciences department. The remainder were undergraduate students from varying majors. Forty total participants are anticipated for the complete study. Nine narrative monologue language samples obtained from the "AphasiaBank" database (http://talkbank.org/AphasiaBank/) were used as audio samples: six aphasic speech (AS) samples and three from neurologically healthy (NH) speakers. Each AS samples was modified to create a corresponding simulated fluency (SF) sample by extracting all pauses, filled pauses, repetitions, revisions, and fillers. Listeners heard nine audio samples (AS and SF samples were counterbalanced across groups so no listener heard the same speaker under different fluency conditions) and immediately responded to nine 7-point Likert statements and three open-ended questions.

Pilot Results: Descriptive statistics revealed most positive listener perceptions of NH speakers for all nine Likert statements. Listener perceptions of SF samples were more positive than AS samples for all statements with one exception. Pairwise comparisons were completed for the SF and AS samples using Welch's t-test due to unequal variances in the two groups. This analysis revealed that listener attitudes were significantly more positive for SF compared with AS samples for listener patience ($t = 3.09$, $p < .01$), listener effort ($t = 3.13$, $p < .01$), ease of story telling ($t = 3.94$, $p < .01$), and speaker confidence ($t = 3.92$, $p < .01$). Preliminary analysis comparing eight graduate to four undergraduate listeners showed more favorable perceptions in the graduate listeners. On completion of data collection we anticipate using ANOVA to evaluate differential ratings by the graduate and undergraduate listeners and potential interactions with the different speaker groups. We will also perform qualitative analysis of data obtained from open-ended responses.

Discussion: Results from pilot data indicate that listener attitudes are more positive for NH compared with aphasic speech and that increased fluency of aphasic speech improves listener attitudes and perceptions. These findings have implications for treatment, AAC, and listener education.

Nicole Corbin

Effects of Unilateral Hearing Loss on Children's Speech Perception and Spatial Release from Masking under Complex Listening Conditions

Purpose

The proposed study aims to investigate the extent to which a simulated or permanent unilateral hearing loss affects children's ability to benefit from binaural cues to speech perception in complex listening environments.

Background

Children with unilateral hearing loss are at an increased risk for academic, cognitive, social-emotional, speech, and language problems relative to their peers with normal hearing (McKay, Gravel, & Tharpe 2008; Bess & Tharpe 1986). Clinicians are uncertain regarding the audiologic management of this population of children with hearing loss (Fitzpatrick, Durieux-Smith, & Whittingham 2010). There is a lack of evidence regarding which children with unilateral hearing loss have the greatest need for intervention and at what time such intervention is necessary.

Since listeners rely on binaural hearing for accurate speech perception in everyday listening environments, performance on a measure of speech perception in complex backgrounds may provide insight into why some children with unilateral hearing loss experience more challenges than others. Previous studies investigating the speech recognition abilities of children with unilateral hearing loss have not consistently demonstrated a benefit of the provision of hearing assistive technology for these children. However, the majority of studies have used relatively simple maskers such as speech-shaped noise and multi-talker babble, which might not accurately capture children's performance in natural listening environments. Increasing evidence suggests that binaural cues are particularly helpful to listeners in complex listening situations where competing speech is present.

Proposed Methods

Participants will include: (1) children and adults with normal hearing in both ears, and (2) children (5-17 years) with permanent unilateral hearing loss. For the proposed investigation, unilateral hearing loss is defined as the presence of normal hearing sensitivity in one ear and a moderate to profound sensorineural hearing loss in the other ear. Participants will complete word and sentence recognition tasks in the presence of collocated or spatially separated (1) two-talker speech, (2) multi-talker babble, and (3) speech-shaped noise in a sound booth. The group of normal hearing listeners will complete the speech recognition tasks in two listening conditions: (1) binaural, with access to both ears, and (2) monaural, with one ear occluded.

Anticipated Results

Children and adults with normal hearing are expected to show a decrement in performance in all monaural compared to binaural listening conditions. It is expected that children with unilateral hearing loss will perform worse than their age-matched peers with normal bilateral hearing in the binaural listening conditions until adolescence, when neural maturation and compensation for the unilateral hearing loss may occur. Furthermore, it is predicted that children with unilateral hearing loss will not demonstrate a significant spatial release from masking.

Discussion

The results of this study will provide information regarding the ability of children with unilateral hearing loss to benefit from spatial release from masking and understand speech in complex listening environments. This information will inform best practice for the audiologic management of children with unilateral hearing loss.

Thomas Page and Melody Harrison

Associations Among Child and Family Characteristics in Language Outcomes of Young Children with Hearing Loss

Purpose

The purpose of this study is to examine the potential relationship of early environment, audibility, and socioeconomic characteristics in communication outcomes of toddlers with mild to severe hearing loss.

Background

Children with permanent hearing loss are at higher risk for language and academic delays. Considering that hearing loss is the most commonly occurring birth defect, affecting 1 to 6 infants per 1000 newborns (Kemper & Downs, 2000), the ramifications of these delays are substantial. Despite implementation of universal newborn hearing screening, advances in assistive technology, and earlier intervention, children with any degree of hearing loss continue to be at higher risk for lasting language and learning problems compared to their normal hearing peers (Delage & Tuller, 2007). Unfortunately, very little is known regarding the contributors that lead to success and vulnerability in children with mild to severe hearing loss. Recent outcomes research has begun to expose areas of resilience and risk in this population's development. Yet to be resolved is the influence that child and family variables may have on outcome performance for young children who are hard of hearing.

Methods

Extant data from the Outcomes of Children with Hearing Loss (OCHL) study was utilized in this investigation. Receptive and expressive language measures were administered to 2 and 3 year olds with permanent mild to severe hearing loss. In addition, caregivers were interviewed to collect information about family characteristics, including an array of questions regarding indicators of socioeconomic status and childcare placement. As part of the OCHL protocol, a speech intelligibility index (SII) was calculated, and served as a numerical representation of audibility. Correlation analyses will be conducted to explain the relations between individual variables. In addition, bivariate correlations will be calculated between the two instruments, including their receptive and expressive subtests. Moreover, a series of analyses will be conducted to explore the total variance contributed by the combination of the variables as well as the amount of unique variance explained by each.

Results/Anticipated Results

At the time of this submission, all data had been collected, but not yet analyzed. Outcome data from the OCHL study indicate that maternal education and SII are significantly, positively correlated with better speech and language outcomes in young children at 3 years of age. Child placement characteristics have yet to be described or included in analyses within OCHL or the greater body of literature on children who are hard of hearing.

Discussion

A methodical examination of the role of such variables will lead to a deeper understanding of the emerging literature regarding outcomes of children with mild to severe hearing loss. Results from the proposed study have implications for policy development, intervention, audiological management, as well as guidance for future research in pediatric hearing loss.

Frances Albanese and Keri Brown Kirschman
Health belief model and risk-seeking behavior as indicators of chosen listening levels of youth

Purpose or Research Questions: This undergraduate thesis project expands upon research that asks not *if* one can develop hearing loss from a Personal Listening Device (PLD), but rather why individuals choose to listen at high volumes and whether general concern and preventive measures are necessary (Fligor 2009). The hypotheses of this study were four-fold: First, there was no predicted difference between Chosen Listening Levels (CLLs) of boys and CLLs of girls due to the personal nature of iPod use. Second, also because of this personal nature, the CLLs of those with rules at home and without rules at home about PLD use would be similar. Third, the Health Belief Model as a whole was hypothesized to be a significant predictor of CLLs and finally, the inclination for risk-seeking behavior and CLLs would be positively correlated.

Background: Noise-induced hearing loss (NIHL) is the second most common form of hearing loss, a result of acute and extremely loud sounds or long exposure to moderate sound levels. Its damage is irreversible.12.5% of American children 6-19 yrs old possess a hearing loss. Children aged 12-19 have a significantly higher prevalence of hearing loss than children aged 6-11 years old, suggesting that something is responsible for that change within this time period (Niskar et al 2001).There is an abundance of research linking PLDs to NIHL. Apple had sold 275 million iPods by 2010 and guidelines for safe listening habits for children are very general (AAP 2010). Furthermore, listening to a PLD is a private experience, such that listeners are not accountable to anyone else when they have earbuds in, which may contribute to children turning up the volume despite having rules about listening safely.

Methods/Proposed Methods: Participants included 84 children (mean age 11.4 yrs). Children listened to a song on an iPod for 60 sec. and the volume was converted to reported and recorded Chosen Listening Levels via a re-wired sound level meter and mannequin with silicone ear. Participants completed a brief demographic survey, Global Risk Taking Assessment, and two-part Listening Habits Questionnaire related to the Health Belief Model. Data analysis included descriptive statistics, Pearson correlations, linear regression, and independent samples t-test.

Results/Anticipated Results: There was no significant difference in CLLs of boys and girls and children with rules at home listened at significantly quieter volumes. The Global Risk Taking Assessment did not correlate with CLLs. The Health Belief Model as a whole is a significant predictor of CLLs; three individual aspects of the model (perceived barriers, susceptibility, and benefits) also significantly predicted CLLs.

Discussion (e.g., interpretation of results; potential contribution of anticipated results): This research has important implications for our ability as SLPs, Audiologists, or parents to take preventative action against NIHL. The lack of significant correlation between Global Risk Taking Assessment and CLL could be evidence of a lack of understanding that listening at high volumes is a risky behavior. Children need to be given rules from home about how to safely listen and have a meaningful discussion about the risk of loud volumes.

Adara Blake

Breastfeeding Knowledge and Clinical Management among Speech-Language Pathologists

Purpose

This study had three goals; to describe the breastfeeding knowledge and skills of speech-language pathologists who provide pediatric swallowing and/or feeding services, to describe the quality of collaboration between speech-language pathologists and other professionals regarding breastfeeding management, including lactation consultants, and to describe the current state of professional development, including ideal roles of the American Speech-Language-Hearing Association in promoting and facilitating breastfeeding competence among speech-language pathologists.

Background

As breastfeeding rates in the United States continue to rise, competent medical professionals are needed to address concerns that may arise. With a scope of practice that includes management of dysphagia, speech-language pathologists are uniquely positioned to collaborate with other providers in order to address these issues. There is currently very little discussion of the management of disordered breastfeeding by SLPs, both in the literature and in official statements published by the American Speech-Language-Hearing Association. As a result, resources for pre-service and continuing education in this area are very limited.

Methods

A Qualtrics survey consisting of multiple choice questions, with opportunity to provide qualitative responses, was completed by 86 speech-language pathologists who currently provide pediatric dysphagia services throughout the country.

Results

Knowledge of breastfeeding information relevant to speech-language pathologists was variable among participants. The majority of participants indicated that they frequently encounter breastfeeding issues in their practice, but many felt that they did not have adequate knowledge and skills to address these issues themselves. They had a personal interest in increasing their breastfeeding competence and felt it would benefit their practice, but indicated that there were not enough resources for education and that ASHA does not adequately promote professional development in this area. Most participants desired increased collaboration with other professionals when managing clients experiencing breastfeeding difficulty.

Discussion

Responses to this survey indicate that there is a need and desire for professional development in breastfeeding management among speech-language pathologists. Recognition of the importance of breastfeeding competence from ASHA would establish a precedent for the availability of pre-service and continuing education in this area. Filling these gaps in knowledge will help better serve the growing number of families experiencing breastfeeding difficulty. Future research should focus on the outcomes of implementing breastfeeding education, describing the breastfeeding interventions of SLPs in greater detail, and differentiating the roles of SLPs and other professionals who manage breastfeeding concerns.

Jenna Browning, Emily Buss, and Lori Leibold
Development and verification of a two-interval, forced-choice infant behavioral testing procedure

Purpose or Research Questions
The purpose of this study was to develop and validate a two-interval forced-choice (2IFC) infant psychophysical test procedure for measuring hearing sensitivity.

Background
Current behavioral methods used to test infants' hearing sensitivity in the clinic or laboratory can be influenced by response bias on the part of the listener and/or the examiner. Visual Reinforcement Audiometry provides some control for examiner bias when controls trials are used, but does not account for listener bias. Olsho et al. (1987) developed a single-interval, observed-based procedure for infant testing in the laboratory in which the examiner does not know whether or not a signal is presented on a given trial. Although examiner bias is controlled using this procedure, listener bias remains a potential issue that can limit comparisons in adaptive threshold estimates between infants and adults. Specifically, adults are more conservative listeners than infants (e.g., Leibold & Werner, 2006). Infant-adult differences in response bias are an issue when thresholds are estimated adaptively because they can result in differences in d' at threshold between the two age groups. The specific objective of this study was to develop a procedure that controls for both examiner and listener response bias by using a two-interval forced-choice (2IFC) paradigm in which the examiner is blinded to the interval containing the signal.

Methods
Eleven infants (7-9 mo) and fifteen adults (20-26 yr) with no risk factors for hearing loss participated. All listeners passed screening tympanometry on each test date.
A 2IFC implementation of the observer-based psychoacoustic procedure described by Olsho et al. (1987) was used to determine the number of trials required to achieve a criterion of 80%-correct detection of a 50-dB SPL noise band in quiet. During the two-interval forced-choice (2IFC) infant psychophysical test procedure, the signal is presented during one of two temporal windows. The examiner is blind to which interval contains the signal and must make their decision based solely on the subject's behavior. The examiner receives feedback on a computer monitor about which temporal window contained the stimulus after every trial. In a second experiment, an adaptive, 2-down, 1-up procedure was used to estimate hearing sensitivity (Levitt, 1971) for 15 adults using the new 2IFC procedure and the conventional single-interval task, with test order randomized.

Results
Ten infants reached the criterion in a single session, with infants requiring an average of 10.9 trials (range= 8-17 trials). All fifteen adults reached criterion in the minimum number of trials. Estimates for adults were lower in the 2IFC compared to a single-interval procedure.

Discussion
The results of this study suggest that the 2IFC procedure is feasible and more efficient for use with infants, reducing the number of trials to criterion related to single-interval procedures. Consistent with previous studies, threshold estimates for adults were lower using the 2IFC compared to a single-interval task.

Andrea Bucker; Margaret Dillon; Marcia Adunka; English King; Harold Pillsbury; Craig Buchman; Oliver Adunka,
Effect of Charge Levels on Residual Hearing in EAS Subjects

Purpose or Research Questions
Postoperative hearing preservation with Electric-Acoustic Stimulation (EAS) has been documented, however the amount and progression of further hearing loss is variable and the cause for this loss is relatively unknown. Understanding potential contributors to loss of residual hearing is necessary as candidacy criteria continues to expand to include patients with greater amounts of residual hearing. Little is known regarding whether electric current levels can influence postoperative hearing preservation rates as well as aided speech perception outcomes. The aim of this study is to investigate the potential relationship between electric stimulation levels and EAS subjects' postoperative residual hearing and speech perception abilities after cochlear implantation and within the first few months of listening experience.

Background
EAS combines hearing aid and cochlear implant technologies in an ipsilateral listening condition. The ability to utilize electric and acoustic stimulation in the same ear relies on hearing preservation in the surgical ear postoperatively. This is accomplished by utilizing a shorter and more flexible electrode array which aids in the preservation of cochlear structures. EAS provides electric stimulation in the basal region of the cochlea and acoustically stimulates the apical region. This combination has been shown to provide improved speech perception. The risks associated with EAS are similar to that of conventional cochlear implantation, including the partial or complete loss of residual hearing.

Methods/Proposed Methods
All subjects were participants in the FDA regulated EAS clinical trial. Enrollment in the EAS clinical trial was dependent on the following criteria: English as a primary language, age at implantation between 18-70 years, documentation of stable residual hearing, normal middle and inner ear anatomy, aided monosyllabic word scores of 60% or less, and residual hearing within candidacy guidelines. The current levels, postoperative residual hearing preservation, and aided speech perception scores were reviewed for twenty-nine subjects. Speech perception materials included CNC words in quiet. Assessment intervals for all subjects included the preoperative evaluation, initial cochlear implant activation, and 3-months post-activation. Data were analyzed to determine whether there was a correlation between current levels and hearing preservation and/or aided speech perception when listening with EAS.

Results/Anticipated Results
Results suggest there is no correlation between electric current levels and postoperative hearing preservation or aided speech perception within the first few months of listening experience.

Discussion
The EAS population reviewed here experienced variability in postoperative hearing preservation, however this appears to be unrelated to electric current levels. Despite the loss in residual hearing sensitivity, all subjects experienced improved speech perception over their preoperative performance that remained stable over time. EAS appears to be a viable treatment option for patients with substantial residual low-frequency hearing and severe-to-profound high frequency thresholds who do not benefit from appropriately fit amplification. Further research is needed to identify contributing factors to the loss of residual hearing.

Andrea Bucker; Margaret Dillon; Marcia Adunka; English King; Harold Pillsbury; Craig Buchman; Oliver Adunka
Long-Term Speech Perception Outcomes of Electric-Acoustic Stimulation (EAS)

Purpose or Research Questions
Traditionally, the treatment options for individuals with steeply sloping mid-to-high frequency hearing loss have been limited. Advances in electrode array insertion techniques have allowed for postoperative hearing preservation, and thus the ability to utilize cochlear implant and hearing aid technology in the same ear. Ipsilateral bimodal stimulation, known as Electric-Acoustic Stimulation (EAS), has been shown to provide improved speech perception as compared to preoperative abilities. This study examines whether the improvements in speech perception abilities are maintained over 3 years of listening experience.

Background
EAS combines hearing aid and cochlear implant technology in an ipsilateral listening condition. The ability to utilize electric and acoustic stimulation in the same ear relies on hearing preservation in the surgical ear. Advances in electrode array design and soft surgical techniques have allowed for postoperative hearing preservation. EAS electrically stimulates the basal region of the cochlea and acoustically stimulates the apical region. The brain then combines the electric and acoustic signals for improved perception of sound. Potential benefits include improvements in speech perception and music appreciation. Risks entailed are similar to traditional cochlear implantation concerns in addition to the partial or complete loss of residual hearing.

Methods/Proposed Methods
All subjects in this study were participants in the FDA regulated EAS clinical trial. Enrollment in the EAS clinical trial was dependent on the following criteria: English as a primary language, age at implantation between 18-70 years, documentation of stable residual hearing, normal middle and inner ear anatomy, aided monosyllabic word scores of 60% or less, and residual hearing within candidacy guidelines. Objective outcomes of fifteen EAS subjects with over 3 years of listening experience were reviewed. Subjects were assessed preoperatively, at 3, 6, and 12 months and then annually. The objective test battery included CNC words in quiet and CUNY sentences in noise at a signal-to-noise ratio of 0. Subjects were seated 1 meter from the sound source at 0 degrees azimuth with recorded materials presented at 70 dB SPL.

Results/Anticipated Results
Variability in residual hearing preservation rates was observed. One subject lost hearing completely. All subjects, irrespective of residual hearing status experienced statistically significant improvement on speech perception tasks in both quiet and noise as compared to their preoperative listening condition. This marked improvement was maintained after 3 years of listening experience.

Discussion
Patients with preserved low-frequency residual hearing experienced improved speech perception from utilizing hearing aid and cochlear implant technology in an ipsilateral listening condition. EAS is a viable treatment option for patients with severe-to-profound high frequency thresholds who do not benefit from appropriately fit amplification.

Hannah Burris and Adam Jacks
Effects of Rhythmic Stimulation on Aphasia and Apraxia of Speech

Research Question: The purpose of this study was to examine the effects of metronomic stimulation on disfluencies in aphasia, especially nonfluent aphasia, and apraxia of speech, as compared to speaking with no auditory feedback, auditory masking feedback, and delayed pitch-shifted feedback.

Background: Aphasia is a disorder that can involve difficulties in producing and understanding language. Nonfluent aphasia often involves intact language comprehension abilities, but limited production (Fridriksson et al., 2012; Stahl, Kotz, Henseler, Turner, & Geyer, 2011). Apraxia of speech is a motor programming disorder that can affect the prosody, articulation, and rhythmicity of speech, and often co-occurs with nonfluent aphasia (ASHA, 2013; Ogar, Slama, Dronkers, Amici, & Gorno-Tempini, 2005). One treatment for nonfluent aphasia includes auditory masking, the use of static noise to block the auditory feedback mechanisms, and has been shown to lead to an increase in fluency (Jacks, Haley, & Truong, 2013). Rhythmic stimulation is also known to lead to increased fluency in speakers who have nonfluent aphasia and apraxia of speech (Stahl et al., 2011; Wambaugh, & Martinez, 2000). We hypothesize that speakers with aphasia will respond to rhythmic stimulation with an increase in fluency as compared to control conditions, and that those who respond positively will be speakers with nonfluent aphasia and/or AOS.

Methods: Five adults (M_{age} = 58 years, age range: 49-69 years) participated. Of the five, participants 1 and 3 had AOS and nonfluent aphasia. Speakers produced 20 sentences, with two practice sentences, in each of seven conditions in an ABACADA treatment introduction and withdrawal design, where A = control conditions, B/C = counterbalanced auditory masking and altered auditory feedback, and D = rhythmic stimulation. The metronomic stimulus was delivered at a rate of 25% above the baseline syllables/minute rate as measured during the first control condition. Sentence productions were analyzed for disfluencies using Praat software.

Results: Results were analyzed using the Wilcoxon Rank-Sum Test, a nonparametric test that did not require for normal distribution. Three measures were collected, including disfluent time (in seconds), and fluent speech rate and syllable rate (in syllables per second). Participant 3 responded significantly ($Z = -3.26$, $p = .001$) with a decrease in disfluent time to the rhythmic stimulation, while Participant 1 had an almost significant positive response. No significant change was found for auditory masking, and all participants showed a non-significant decrease in fluency in altered auditory feedback, with Participants 2 and 5 significant. Results for syllable rate were similar, with Participant 3 responding positively to the rhythmic stimulation.

Discussion: Speakers 1 and 3 responded to the rhythmic stimulation, and these speakers were the only participants with AOS and nonfluent aphasia. Because auditory masking has been proven effective previously but showed no significance here, rhythmic stimulation may serve as a more robust method of inducing fluency in this population. These results are important in directing the treatment of nonfluent aphasia and AOS. In the future, an fMRI study would be very interesting in determining the mechanism by which rhythm induces fluency in speakers, with special focus on left hemisphere peri-lesional basal ganglion activation, as this is a locus of rhythmic control.

Rob Cavanaugh and Katarina Haley

Accounting for Aphasia-related language deficits in Verbal Working Memory Assessments: A Literature Review.

Purpose or Research Questions

The purpose of this study is to review methods of controlling for language deficits while testing verbal working memory in persons with aphasia.

Background

Alan Baddeley and colleagues first conceptualized working memory in 1974 by as a form of short-term memory that requires simultaneous processing and recall of information. The number of working memory models has since expanded, but nearly all rely on this central dual-task notion. Within the past 25 years, the research looking at working memory ability in persons with aphasia (PWA) has greatly expanded, generally finding significant deficits in PWA, especially with increasing task difficulty. Some authors assert that the language problems in aphasia may be largely a result of working memory deficits rather than language specific processes, though this is fairly controversial. Language deficits may create complications when testing working memory abilities in PWA. To avoid these complications, some studies have attempted to assess working memory with non-verbal constructs. However, many researchers have argued that working memory is domain specific to language, and that non-verbal measures have poor construct validity for measuring language-specific working memory in PWA. As a result, other studies have demonstrated significant impairments specific to verbal working memory, but resolving whether tasks are truly measuring deficits in verbal working memory or whether they simply reflect deficits in languages processes inherent to aphasia is problematic. Numerous studies have taken various precautions to control for this language deficit effect specific to testing verbal working memory in the aphasia population. This review aims to organize and assess the strength and validity of these control strategies.

Methods/Proposed Methods

A review of the literature was conducted in March 2014, searching three databases (PubMed, CINHAL, and Google Scholar) using the key words “aphasia”, “working memory”, “dual task”, “span,” language,” and “cognition.” Only peer-reviewed articles using tasks specific to verbal working memory and persons with acquired aphasia were included. Studies including tasks of short-term memory, but not working memory were excluded. Twenty-two articles were selected based on inclusion criteria.

Anticipated Results

Control strategies will likely fall into two categories: participant selection and task modification. Within task modification, it is likely that strategies will focus on stimulus presentation, response to stimulus, or both. Differences within these categories will be included.

Discussion (potential contribution of anticipated results)

There will likely be a high degree of variation, some successful and some not as successful in attempting to isolate measuring verbal working memory in persons with aphasia. Success may or may not depend on whether or not the control strategies focused on the participants or tasks. It is essential to understand the need to control for deficits in language processes when assessing verbal working memory in PWA. The results of the review will provide a resource for future studies, detailing previously used methods. Furthermore, this review will provide a stepping-stone for understanding how control strategies may affect results between studies.

Petros Pravasilis, Lúcia Fischer, and Katarina Haley
Κατάλαβες τι είπα; ¿Me entendiste?: Adapting the CHMIT into Greek and Spanish

Purpose
Current methods for measuring intelligibility in speakers with aphasia and apraxia of speech are not readily available in multiple languages. The purpose of this project is to create Greek and Spanish versions of the Chapel Hill Multilingual Intelligibility Test (CHMIT), which is designed to quickly and equivalently assess intelligibility in various languages.

Background
Some notable features of aphasia and apraxia of speech (AOS) include phonetic errors, such as syllabic distortions, substitutions, and distorted substitutions on consonants and vowels (Haley, Bays, & Ohde, 2001; Odell et al, 1991), which affect intelligibility. Intelligibility is defined as "The accuracy with which a message is conveyed by a speaker and recovered by a listener" (Klasner & Yorkston, 2005, p.127). Currently, measuring intelligibility in languages other than English is difficult due to a lack of available tests in multiple languages.
The Chapel Hill Multilingual Intelligibility Test (CHMIT) (Haley et al, 2001) is a tool designed to measure how intelligible the speech produced by individuals with aphasia and/or AOS is perceived to be by listeners of the language, as measured by a listener's ability to correctly identify the word the speaker is producing. The test is used to calculate a percentage of intelligible words (i.e. words that are understood/total words produced) through listeners who speak the language (Haley, 2011). So far, tests have been developed in English, Finnish, French, German, Hindi, Russian, and Swedish. The adaptation of the CHMIT into the Greek and Spanish languages will be discussed in this presentation.

Methods/Proposed Methods
The criteria for the English disyllabic word test was adapted for use in Greek and Spanish. The criteria applied crosslinguistically was that word frequency had to be at least 1 per million as given by a subtitle-based corpus. Additionally, functor words were avoided, and only one instance of a noun or verb was included.

Anticipated Results
Each test will have 50 sets of 12 words each, being composed of a total of 600 different words.

Discussion
The CHMIT can be used to determine baseline speech intelligibility and also monitor progress over time. It can be re-administered multiple times with minimal learning effects, since only one randomly selected word from a set of twelve words is presented each time. Once it has been normed, there should be cut-off scores for the various languages for comparisons with patient scores.

Hannah Hodson, Meredith Spratford, Marc Brennan, Lori Leibold, Ellen Hatala, Ryan McCreery
Effects of linguistic environment on detection of /s/ and /z/

Purpose or Research Questions
The goal of this project was to determine the effect of linguistic environment (targets embedded in low context sentences versus in isolation), lexical word type, and open versus closed-set tasks on children's ability to detect high-frequency morphemes /s/ and /z/ in the word final position.

Background
Previous studies have shown that children's ability to recognize high-frequency speech sounds is influenced by signal bandwidth (e.g. Stelmachowicz et al. 2001). This concept has motivated researchers to use plurals detection as a quantitative measure of the effects of high frequency audibility with frequency lowering technology (e.g. Wolfe et al. 2009). High-frequency morpheme recognition may also be influenced by other cues including linguistic, visual, task-related (open vs. closed set), and acoustic duration; however, little is known about how children use these cues to support speech recognition.

Methods
Participants were 25 children with normal hearing (NH) and 12 children who were hard of hearing (HH) ages 5-12 years. Open-set word and sentence lists and the UWO Plurals Test were used as stimuli. All stimuli were presented in noise (+10 dB SNR) to prevent possible ceiling effects. NH participants listened to 4 and 8 kHz low pass filtered lists. HH participants listened to the 8 kHz filtered materials and wore their own hearing aids.

Results
Linguistic context was shown to influence detection accuracy for both NH and HH listeners. Both groups were better able to detect singular and plural isolated targets in the 8 kHz condition. Listeners with NH were better able to detect singular and plurals for embedded targets compared with targets in isolation in the 4 k Hz condition. Word type was not shown in influence detection of /s/ and /z/. Listeners who were HH performed near ceiling on the closed-set UWO Plurals test.

Discussion
Results suggest differences in the use of acoustic cues and listening strategies between NH and HH groups. Additionally, plurals testing was not shown to be challenging for HH listeners. Further study is necessary to determine the influence of specific cues and strategies used to support real-world and clinical measures of speech perception.

Jessica Kinard and Elizabeth Crais

Use of Family-Centered Principles with Culturally and Linguistically Diverse Families

Purpose: This purpose of this presentation is to describe how family-centered principles can be applied to culturally-linguistically diverse (CLD) families. The following issues are discussed: (a) principles of family-centered systems of care; (b) application of these principles with CLD families in early intervention services; and (c) application of these principles with CLD families in research settings.

Background: Family-centered care is a powerful way to improve the outcomes of children with disabilities and their families. When practitioners implement family-centered principles, they take into account families' priorities, resources, and strengths, and empower families to participate and make decisions about their child's care (Trivette, Dunst, & Hamby, 2010). Practitioners may consider some principles to be "common sense," but find others to be difficult to implement (Harry, 2008, p. 375). To complicate matters, behaviors that practitioners view as "common sense" could be interpreted differently by families from diverse backgrounds (Harry, 2008). Barriers to successful care are evidenced in practitioners' attempts to research and provide services for diverse populations. For example, researchers and clinicians have had difficulty encouraging Hispanic families to participate in research and early intervention services, despite the growing numbers of this population (Harry, 2008; Humes, Jones, & Ramirez, 2011; Olivares & Altarriba, 2009). The limited participation of these families in clinic and research settings may be due, in part, to lack of family-centered and culturally-relevant care (Rodriguez & Olswang, 2003). To address these issues, this presentation will discuss the application of family-centered care principles with diverse families in early intervention services and research studies with diverse families. Hispanic culture will be used as an example throughout the presentation.

Methods: Literature was reviewed from the years 1988 to the present, focused on the following topics: (a) use of family-centered principles in early intervention; (b) influence of culture on early intervention services, particularly related to Hispanic culture; and (c) cultural competency among early interventionists.

Results: Over several decades, researchers have refined models of family-centered care for use with children with disabilities and their families. Two current practices include: (a) the Family-Systems Intervention model (Trivette et al., 2010) and (b) Skilled Dialogue (Barrera & Corso, 2002). In the current presentation, these two models will be described in detail, and will be used to formulate recommendations for working with culturally and linguistically diverse families. The Family-Systems Intervention and Skilled Dialogue principles of (a) pre-helping attitudes, beliefs, and respect, (b) helping behaviors and reciprocity, and (c) post-helping responses and responsiveness will be discussed in the context of Hispanic families' (d) concerns and priorities, (e) supports and resources, and (f) strengths (Barrera & Corso, 2002; Dunst et al., 1988; Trivette et al., 2010). It is important to remember that, in this presentation, information discussed about the Hispanic culture represents generalizations from the literature. The Hispanic population is highly heterogeneous, and each family should be considered on an individual basis (Langdon, 2009; Van Kleeck, 1994; Westby, 2009).

Discussion: Hispanic families frequently have low participation in early intervention services and research studies (Harry, 2008; Olivares & Altarriba, 2009). Family-centered principles provide excellent tools for bridging these gaps by encouraging active participation from families, increasing their sense of well-being and empowerment, and enhancing the development of children with disabilities.

Sarah Obarowski, Margaret Dillon, English King, Ellen Pearce and Marcia Adunka
Optimization of FSP and HDCIS: Influence on Speech Perception

Purpose or Research Questions
The purpose of this study is to evaluate speech perception performance of cochlear implant recipients listening exclusively to either the HDCIS or FSP coding strategy within the first six-months post-initial activation.

Background
In the US, there are currently two signal coding strategies offered by MED-EL: Fine Structure Processing (FSP) and High-Definition Continuous Interleaved Sampling (HDCIS). Traditionally, cochlear implants have provided only the envelope or loudness contour of a signal to the user. The aim of FSP is to deliver both amplitude and fine structure information. Theoretically, providing a patient with both of these cues should result in improved speech perception, especially in the presence of challenging background noise. Studies comparing FSP to HDCIS performance, using an intersubject design with experienced listeners, have reported mixed results. Arnoldner and colleagues (2007) found that speech perception scores improved in noise using FSP; however, Magnusson (2011) found no statistical difference in speech scores or patient preference between the two strategies long-term. Currently, it is unclear whether a specific strategy is optimal to listening experience at initial activation.

Methods/Proposed Methods
Adult subjects implanted with a MED-EL standard, medium, or Flex28 internal array, were randomly assigned to either the HDCIS or FSP signal coding strategy. The mapping procedure included loudness balancing, as well as evaluation of stimulation rate, maplaw, sensitivity, and threshold and comfort levels. The audiologist completing speech perception testing was blinded to the specific signal coding strategy. Speech perception testing was completed at the one, three and six-month post-initial activation intervals. Recorded materials were presented in sound field at 60 dB SPL. The test battery included: CNC words in quiet, HINT sentences in quiet and noise (SNR+10), AzBio sentences in quiet and noise (SNR+10, +5) and BKB-SIN.

Results
Initial analysis (n=21) was conducted by comparing the performance of each cohort at the six-month post-initial activation interval. At this time, speech perception performance was similar between the two cohorts. Though there appeared to be a trend for better performance with the FSP coding strategy on the AzBio sentences in noise and BKB-SIN tasks, this was not significantly different.

Discussion
This project is ongoing with a target enrollment of 35 subjects. Data will be evaluated to determine if there are differences over time in speech perception abilities when all subjects achieve the six-month follow-up interval. Additionally, changes to individual mapping parameters as well as music perception and appreciation will be reviewed.

Sadie Schwarz; Lauren Calandruccio; Emily Buss
Development of a Pediatric Vowel-Discrimination Task

Purpose or Research Questions
The goal of the current project is to develop a closed-set, picture-pointing pediatric vowel-discrimination task. A secondary goal is to revise the Word Intelligibility by Picture Identification (WIPI) to align with the new vowel-discrimination task.

Background
The importance of vowel perception has been studied extensively in adults. However, less is known about vowel perception in children. To better understand the importance of vowel discrimination in young children, an easy to administer, pediatric vowel discrimination task is needed. Closed-set, picture pointing paradigms such as the Word Intelligilibility by Picture Identification (WIPI: Ross & Lerman, 1970) are effective for pediatric word discrimination tasks (ASHA, 2012). Most WIPI word sets share a vowel but vary by initial and/or final consonant, such that discrimination relies on consonant information. The goal of the current project is to develop a pediatric vowel-discrimination task. The vowel discrimination task should include target words that vary by central vowel only, are within a pediatric lexicon, and are easily imaged.

Methods/Proposed Methods
Ultimately, 75 target words were selected for the vowel-discrimination task. All words were present on the Storkel & Hoover (2010) database of spoken English. Words were arranged in 25 sets of 3-word pairs that varied by central vowel only. The three lists were balanced according to imageability, lexical frequency, and phonetic distribution. The WIPI was revised from 100 target words to 75. The target words were then arranged into 25 sets of 3-word pairs that varied by beginning and/or ending consonant sound. The lists were balanced for lexical frequency, imageability, and phonetic distribution. New images were created for each unique target word for both the vowel-discrimination task and the revised-WIPI. Children from a local daycare center participated in spontaneous- and closed-set identification tasks.

Results/Anticipated Results
Selected words and images created for the vowel-discrimination task were easily identified by a pediatric population. Results from the open- and closed-set identification tasks indicate that the new task is more difficult than the revised-WIPI. This result is not surprising due to limitations in target word options (i.e. sets of three words that varied only by central vowel and could be imaged within a child's lexicon). It is intended that this task be used to further our understanding of auditory development with respect to vowel discrimination.

Discussion
A successful pediatric vowel-discrimination task was created. Future directions include testing of normal and hearing impaired listeners in various types of background noise.

Ashley Wellons & Nancy McKenna

Wideband Acoustic Immittance: Screening for Middle Ear Function: A Review of the Literature and Considerations for Future Studies

Purpose or Research Questions: The purpose of this study was to review the literature on Wideband Acoustic Immittance (WAI) to evaluate its effectiveness in identifying abnormal middle ear function specifically for school-age children. The authors hoped to determine the benefits and feasibility of replacing 226 Hz tympanometry with WAI during mass school hearing screenings.

Background: 63.4% of children under the age of five visited their primary care physician for OME from 2005-2006. (Grijalva et al. 2009). 226 Hz tympanometry, the tool widely used to check middle ear function in audiology, has been shown to have relatively good sensitivity (70-80%) and specificity (98-100%) (Harris, Hutchinson, & Moravec, 2005, Kazanas & Maw, 1994). However, by only analyzing the middle ear's response to one frequency, it is possible that the true extent of a conductive component is left unknown. At this point, WAI has been used primarily in research instead of in clinic but manufacturer literature indicates that it may be more sensitive to Otitis Media with effusion (OME) than 226 Hz tympanometry, a statement which has not been definitively proven yet in the literature.

Methods/Proposed Methods: A thorough search of the literature (PubMed, Google Scholar) was conducted in Fall 2013 using the key words "Wideband reflectance" "Wideband tympanometry", "Wideband acoustic immittance", "school-age", and "children". References of relevant articles were also reviewed to locate other articles not found through the initial search. A survey was conducted on 9 first year AuD students at the University of North Carolina at Chapel Hill who in Fall 2013 used Interacoustics Titan to conduct WAI during mass school hearing screenings to gather information on their experience.

Results: This review found that very little literature exists concerning the use of WAI. Most research has examined the use of WAI in infant and adult populations and only a few have looked at school-aged children. There is evidence to suggest that WAI is more sensitive to the presence of OME but as of yet, there has been no research project large enough to formulate usable normative data for a pediatric population. It has been shown that middle ear reflectance and immittance changes with age, indicating that the WAI also changes with age.

Discussion: More research is required to fill in this gap to provide norms for school-aged children before WAI can be used to replace 226 Hz tympanometry in school screenings. A large scale study comparing results of pneumatic otoscopy, 226 Hz tympanometry, and WAI to determine sensitivity and specificity of each to detect OME would be ideal. The students surveyed indicated that they felt that WAI equipment was more "finicky" to use than the 226 Hz tympanometry and did not feel as comfortable using it. The students did receive a more thorough training on 226 Hz tympanometry than on WAI which may explain their preferences. However, this can also serve to show that WAI equipment may take time to adjust to and would require extra training before implementing in a clinical practice. While more research is needed, WAI shows promise as a tool to detect OME and other conductive hearing losses.