

Motor Speech Conference  
Friday, February 21, 2020

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Efficacy of a home-based treatment paradigm, EMST and SpeechVive, to  
improve communication in Parkinson's Disease  
B. Kiefer

While 90% of individuals with Parkinson's disease (PD) develop hypokinetic dysarthria, only 3-4% seek treatment from speech-language pathologists due to treatment accessibility obstacles. The primary aim of this study is to investigate the impact of a combined home-based treatment modality, SpeechVive and EMST, for improved speech and quality of life outcomes for people with PD and their caregivers. We hypothesize that EMST will increase the force generating potential of the respiratory muscles, and SpeechVive will improve coordination of the speech mechanism, together which will increase communicative gains. Implementing the paradigm via tele-health is hypothesized to lessen the burden that caregivers and individuals with PD experience. Preliminary data analysis of speech acoustics and respiratory kinematics from 8/24 participants shows that the treatment paradigm is effective and attainable for speakers with PD.

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Investigating Intelligibility Gains for a Slowed Rate Using Hybridization  
F. van Brenk, A. Kain, K. Tjaden

Studying the speech characteristics underlying intelligibility gains in dysarthria is critical for shaping targeted behavioral treatment techniques including rate reduction. The current study used the analysis-resynthesis approach of hybridization to investigate acoustic variables causing increased intelligibility for sentences produced at a slowed rate by speakers with dysarthria secondary to Multiple Sclerosis. Intelligibility measures indicated that hybridized and resynthesized spectral and durational characteristics explained increased intelligibility associated with rate reduction. Acoustic analyses of speech stimuli further suggested that increases in vocal quality and articulatory movement range were linked to increased intelligibility. Collectively, findings suggest that hybridization is a powerful technique to systematically manipulate and identify acoustic variables explaining intelligibility gains of global dysarthria treatment techniques.

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Acoustic and Kinematic Contrastivity in Speakers with Parkinson's disease: Focusing on Variability  
Y. Kim, A. Thompson, E. Kennedy

In this study, acoustic and kinematic contrastivity was examined in speakers with Parkinson's disease (PD) with an emphasis on data variability across speakers and repetitions. Twenty participants (10 PD, 10 healthy controls) were asked to repeat two phrases three times that contain vowel contrasts (/i/-/u/) and consonant contrasts (/t/-/k/). Acoustic and kinematic data were simultaneously obtained using an electromagnetic articulography system. Preliminary data to date support our hypotheses that speakers with PD show reduced contrastivity with greater inter- and intra- speaker variability compared to healthy controls. In addition, the reduction was more prominent for vowel contrasts as compared to consonant contrasts and for kinematic contrasts as compared to acoustic contrasts. In the presentation, the findings will be further discussed especially focusing on cumulative distribution functions of each measure with respect to their relation to speech intelligibility ratings.

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Dual-Task Speech Performance in Multiple Sclerosis  
L. Feenaughty

**Purpose:** This study investigated whether decrements in speech performance are pronounced when a cognitive-linguistic and speech-motor task are performed simultaneously among 20 individuals with MS and 17 controls.

**Method:** A total of 37 speakers were audio-recorded reading aloud sentences in two conditions: 1) speech only and 2) a dual-task condition. The Sentence Intelligibility Test (SIT) measured dysarthria severity. Various acoustic and cognitive measures were obtained. Group, condition, and interaction effects were examined with ANOVA. Within speaker condition effects were also explored.

**Results:** The dual-task condition yielded slower speech rates, longer total sentence and silent pause durations, and fewer silent pauses compared to the speech only condition with pronounced differences for most speech measures for participants with MS experiencing impaired cognition.

**Conclusion:** Overall, dual-task effects suggest that imposing a second cognitive-linguistic task while speaking may have clinical importance to delineate cognitive-speech motor interactions for individuals with MS that conceivably lead to prominent speech production problems during more ecologically valid contexts.

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Factor Analysis of Signs of Childhood Apraxia of Speech  
K. Chenausky

A major challenge in the field of childhood apraxia of speech (CAS) is the lack of universally accepted signs of CAS, though three criteria have gained consensus: inconsistent errors, disrupted coarticulation, and inappropriate prosody. To investigate latent factors underlying observable signs of CAS, we coded the speech of 57 children, varying in age and severity, for 12 signs of CAS. The number of times each sign appeared in a child's speech sample was normalized and entered into a factor analysis. A 3-factor model was the best fit to the data. Syllable segmentation, slow rate, and stress errors loaded most heavily onto Factor 1. Groping, addition of phonemes, and difficulty with transitional movements loaded most heavily onto Factor 2. Variable errors loaded most heavily onto Factor 3. These three factors are consistent with the ASHA consensus criteria, providing independent support for them and for pauses as a quantitative biomarker of CAS.

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Developmental courses and communicative abilities in childhood dysarthria - a longitudinal study  
E. Haas, T. Scholderle, W. Ziegler

Knowledge on the developmental courses of childhood dysarthria and its impact on communication is limited. 14 children with neurological conditions were assessed three times (within 18 months). Perceptual analyses of the elicited speech samples were age-normalized relative to 144 typically developing children, enabling us to differentiate between impaired (dysarthric) and age appropriate (physiological) speech dimensions in each child. A listening experiment was conducted to measure intelligibility and naturalness of speech.

Independent of the clinical features and severity of dysarthria we observed three different patterns of developmental trajectories: (1) children who showed only marginal improvement, (2) children who presented with significant improvement, and (3) single cases who displayed changes that resembled the developmental courses of the typically developing children. The effects of specific speech symptoms on perceived intelligibility and naturalness will be discussed.

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Is Voicing Encoded in Speech Motor Representations? Evidence from Transfer of Learning  
H-S. Cheng, I. Grzebyk, A. Buchwald

Previous studies have demonstrated that speakers can learn novel speech sequences after structured practice. However, the content and specificity of the learned speech-motor representations remains incompletely understood. Here we investigate whether voicing is encoded in speech motor representations by examining transfer of learning in the context of non-native consonant clusters. Specifically, we investigated whether American English speakers who learn to produce either voiced or voiceless stop-stop clusters (e.g. /gd/ or /kt/) exhibit transfer to the other voicing pattern. Thirty-four participants were trained on nonwords beginning with either voiced or voiceless stop-stop clusters and were tested on both voiced and voiceless clusters. The results of both cluster accuracy and burst-to-burst duration of the cluster suggested bi-directional transfer across voicing categories. This indicates that voicing is not encoded in speech motor representations.

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Effects of Verb Network Strengthening Treatment (VNeST) on hallmark clinical features of Apraxia of Speech  
K. Nealon, L. Edmonds

**Purpose:** This preliminary study evaluated the effects of Verb Network Strengthening Treatment (VNeST) on hallmark symptoms of apraxia of speech (AOS) in participants who exhibited post-treatment lexical retrieval improvements.

**Methods:** Naming responses from 4 participants with aphasia and AOS who previously participated in VNeST studies were coded for correct number of syllables per word, segmental speech errors, fluency, and prosody.

**Results:** All participants demonstrated significant gains in production of correct number of syllables per word; three demonstrated decreases on segmental speech errors. Three participants showed significant reduction on syllable segmentation, and one participant demonstrated significant reduction on false starts and pauses.

**Conclusions:** Despite the varied presentations of the participants, there was a reduction in hallmark AOS symptomology within the context of reduced lexical retrieval difficulty post-treatment.

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Exploring the psychosocial impact of botulinum toxin type-A injections for individuals with  
oromandibular dystonia: a qualitative study of patients' experiences  
A. Page, N. Elhayek, C. Baylor, S. Adams, & K. Yorkston

This study explored the psychosocial impact of botulinum toxin (BoNT) injections for OMD and explored how participants judge the success of this treatment. Eight participants with OMD participated in a single semi-structured interview. Phenomenological methods were used to analyze the interview data. Two themes and six subthemes emerged from the analysis. The first theme, "Botox has changed me and my experiences," explored the participants' perspectives of receiving BoNT injections and its psychosocial impact. The second theme, "What communication is like for me," explored the psychosocial impact of BoNT on speech production and participation. Our results suggest that BoNT has a variable impact on domains related to QoL, satisfaction with treatment, speech production and participation. This study adds novel information related to the psychosocial consequences of BoNT injections for treating OMD and builds on a literature that studies the consequences and experiences of living with OMD.

Generalization Outcomes of Sound Production Treatment (SPT) for Acquired  
Apraxia of Speech: Relationship to Treatment Dosage  
L. Kallhoff, J. Wambaugh, C. Nessler

This study was a retrospective analysis of response generalization effects of treatment for acquired apraxia of speech (AOS) relative to dosing. Changes in articulation accuracy for untrained items were examined for 20 speakers with AOS and aphasia who had received Sound Production Treatment (SPT). The number of treatment sessions needed to reach the following metrics of change were calculated: 1) improvements over baseline levels, 2) clinically important change, and 3) mastery. A secondary aim was to determine if findings varied for blocked versus random practice schedules of SPT. Improvements in articulation of untrained items above baseline levels (and that exceeded 2SD of the baseline mean) were achieved in eight-nine treatment sessions on average. The number of sessions needed for mastery varied. Maintenance performance was moderately, negatively correlated with the number of sessions required for observation of change. No differences were found between practice schedules.

Functional brain connectivity during orofacial pneumotactile stimulation: a fMRI study  
Y. Wang, F. Sibaii, R. Custead, H. Oh, S. Barlow

The cortical representation of orofacial pneumotactile stimulation involves a complex network, which is still unknown. This study aims to identify the cortical network during unilateral orofacial pneumotactile stimulation with various velocity settings using functional magnetic resonance imaging. Functional connectivity of twenty-one neurotypical adults was examined using a region of interest (ROI) based approach. The left primary and secondary somatosensory cortices were chosen as sources, and 30 other ROIs were selected as targets based on literature. Our results show more functional connectivity in the primary somatosensory cortex than the secondary somatosensory cortex for all velocity settings. The fast velocity elicited the most connections in the contralateral hemisphere among all velocity settings. The difference of functional cortical network among three velocity settings may indicate the optimal stimulation setting for better therapeutic effects on stroke recovery.

The relation of nasal coupling area to the perception of stop versus nasal consonants  
B. Story, K. Bunton

The two classes of consonants, stops and nasals, are both produced by occluding the vocal tract in the labial, alveolar, or velar regions, and then releasing the constriction. The difference, of course, is that the oral occlusion during a nasal consonant coincides with a lowering of the velum, creating a port that couples the main vocal tract to the nasal passages, allowing for air flow and sound to exit at the nares. Although coupling is required for a nasal consonant to be produced, the minimum magnitude of the coupling (i.e., cross-sectional area) that is necessary for a listener to identify a consonant as a nasal rather than a stop is not well understood. The specific aim of this study is to determine the nasal port coupling area at which the perception of a stop consonant switches to its nasal cognate.

Identification and classification of motor speech disorders in primary  
progressive aphasia: a blinded retrospective cohort study  
A. Staiger, M. Schroeter, W. Ziegler, T. Scholderle, J. Diehl-Schmid

Motor speech disorders (MSD), particularly progressive apraxia of speech (PAOS), are considered typical in nonfluent primary progressive aphasia (PPA). However, knowledge about how frequently MSDs occur is mainly derived from studies with a priori knowledge of PPA subtype. Regarding MSD syndromes, attention is largely directed towards PAOS, while much less is known about dysarthria syndromes.

The present retrospective cohort study aims at providing data on the prevalence and types of MSDs in German speaking patients with different PPA subtypes. Expert raters blinded for PPA subtype independently evaluated speech samples of 164 patients according to MSD syndrome (no MSD, PAOS, dysarthria syndrome, reduced speech drive, mixed, non-classifiable) and severity.

The results confirmed that MSDs are common in PPA, although they are not primarily restricted to the nonfluent variant. This paper presents and discusses the results of the distribution characteristics of MSDs in the PPA subtypes.

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Functional impact of speech disorders in patients treated for oral or oropharyngeal cancer,  
assessed by perceptual and automatic measurement  
M. Balaguer, T. Pommee J. Farinas, J. Piquier, V. Woisard

Treatment of oral and oropharyngeal cancer affects the anatomical regions involved in speech production. It has a major impact on patients' quality of life because it degrades communicational functions [1]. Despite this observation, little research is currently carried out on the functional impact of speech disorders. Previous studies have only found moderate correlations between quality of life and speech disorder severity scores, derived from a perceptual assessment [2]. This might be explained by the biases associated with standard perceptual speech evaluation, in terms of intra- and inter-rater reliability. In this context, the development of tools for automatic speech signal processing seems to be fully relevant [3].

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Development of Intermuscular Coherence between Mandibular Muscles in Young Children  
E. Usler, B. Richburg, J. Green

The development of the neural control of mandibular muscles, which refines protractedly in early childhood, is essential for age-appropriate masticatory and speech-motor skills. Despite the importance of chewing to child development, little is known about how the neural control of this behavior develops. The purpose of this study was to identify developmental changes in intermuscular coherence (IMC) and parameters of EMG activation across mandibular muscle pairs. Fifty-three typically developing children were assessed cross-sectionally at five ages: 9-, 12-, 18, 24-, and 36-months. EMG was obtained from the right/left masseter and ABD muscles during 20 chewing cycles. Findings revealed beta/gamma IMC between mandibular muscles to exhibit increasing strength between agonist muscles and a U-shaped developmental pattern between antagonist muscles. Early childhood involves a protracted development in the neural control of mandibular muscles.

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Intermuscular coherence as a physiological marker of bulbar motor involvement in amyotrophic lateral sclerosis  
P. Rong

This study aims to determine the pathophysiological underpinnings of slowed jaw movement – a common motor deficit in bulbar amyotrophic lateral sclerosis (ALS) that occurs early in the disease. As a neuromuscular disorder, ALS is characterized by progressive loss of muscle control leading to abnormal movements. To quantify the deficits in jaw muscle control, the beta-band intermuscular coherence (betaIMC) of six pairs of jaw muscles were derived and correlated with the speed of jaw movement during speech in individuals with ALS and healthy controls. The results revealed that the betaIMC of an antagonistic muscle pair (i.e., masseter and anterior belly of digastric) significantly contributed to the speed of jaw movement. Moreover, the betaIMC of this muscle pair was significantly reduced in individuals with ALS relative to the healthy controls. The findings provide preliminary evidence showing that betaIMC may be a physiological marker of bulbar motor involvement in ALS.

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pTACS: A New Platform for Neurotherapeutics and Neuroprotection in Large Vessel Ischemic Stroke  
J. Greenwood, S. Barlow

Sensory stimulation has been used for driving plasticity in humans leading to improvements in recovery from stroke. This stimulation has also been shown to provide a neuroprotective effect against large vessel ischemia and infarct in rodents. The neuroprotective effects of stimulation have yet to be studied in humans with hyperacute large vessel ischemia. Studies of this nature in humans could lead to new interventions to reduce infarct volume and improve overall outcomes for speech motor control, manipulation, gait and locomotion after an ischemic event. Our previous studies have shown the ability to produce large cerebral and cerebellar activations and modulation of blood flow velocity using fMRI, fNIRS, and fTCD which is critical for stroke care. Current systems for somatosensory stimulation are not compatible with emergency critical care settings. A new stimulator system is described here with multiple improvements over previous systems including portability and operational noise.

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Examining Acoustic-Kinematic Relationships of Articulatory Movement in Sentence-Level Productions  
S. Holdosh, J. Whitfield, C. Dromey

The purpose of the current investigation was to examine the relationship between formant trajectories and speech kinematics in a sentence length utterance. Audio recordings and kinematic data of the lips and tongue were collected from sentence repetitions from sixteen adult participants. Several metrics were computed for formant and kinematic segments to assess the strength of the relationship between F1 and F2 movement to the x and y movement of each kinematic marker. Compared to the lips, tongue tip movement contributed the greatest proportion of variance in formant distance traveled within each segment. Furthermore, both the x and y dimensions of the lingual marker trajectories were strongly associated with both the F1 and F2 trajectories. These data provide empirical evidence of a strong association between changes in tongue position and formant frequency movement during speech production.

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Effects of lexical familiarity and neuropsychological status on articulation duration in multiple sclerosis  
J. Rogers, L. Feenaughty

The present study investigated how lexical familiarity (real words vs. nonsense words) and individual differences in information processing efficiency (IPE) affect articulation duration in people with MS (n = 11) and healthy controls (n = 10) during a maximal performance speech task. People with MS produced real words with shorter durations than the control group. No group differences were found for nonsense word durations. Articulation duration was moderated by IPE, but the effect of IPE differed between groups. Durations increased with IPE in the MS group, but decreased in the control group. Results are interpreted in the framework of hyper- and hypo-speech theory (Lindblom, 1990). People with MS may still hyper-articulate unfamiliar words, but experience a greater pull towards hypo-articulation when linguistic load decreases. People with MS may allocate cognitive resources differently than healthy speakers during demanding speech tasks.

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Effects of Feedback Type on Retention of a Novel Speech Task  
A. Thakar, L. Bislick

Motor learning theory (Schmidt, 1988) identifies principles, conditions of practice and feedback, shown to enhance learning and retention of trained skills. Feedback type is one principle that has significant implications for speech learning and treatment success (Newell, 1976; Schmidt, 1988). This study examines the effects of three feedback conditions, knowledge of results (KR), knowledge of performance (KP), and a combination (KP+KR), on the retention of a novel speech task in 30 neurologically healthy young adults. Specifically, participants were taught phrases in Hindi by a native speaker. Retention testing was performed at one day and one week post training. Raters, native Hindi speakers, judged participant productions for naturalness, precision, and intelligibility. Preliminary results suggest greater benefit of KP+KR on the retention of trained speech skills. Findings will help to inform the type of feedback most effective in the treatment of motor speech disorders.

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Effectiveness of LSVT in treating people with hereditary ataxia: speech outcomes and patient perceptions  
A. Lowit, A. Egan

Communication difficulties have considerable impact on people with hereditary ataxia, yet there are currently no evidence based treatments. This study aimed to investigate whether Lee Silverman Voice Treatment (LSVT) can improve communication effectiveness in these speakers.

20 patients were recruited to the study, with 19 completing treatment. Sessions were administered over Skype in the LSVT-X format. Assessments included two baseline and two post-treatment measures.

Results indicate significant improvements in patient perceived outcomes for most participants, both in the speech and psychosocial domains. Acoustic data furthermore demonstrate significant improvements in prolonged vowel duration, shimmer and jitter values. Voice quality, intelligibility and naturalness evaluations are ongoing.

The study provides a clear indication that speech treatment can have positive impact on communication skills in people with hereditary ataxia.

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Gradient Change in Lingual Gestures in Children with Motor Speech Delay  
J. Cleland

This study is an ultrasound investigation of the acquisition of velars in children with persistent velar fronting. We selected six children aged 6-15 unable to produce an accurate velar consonant from a larger project looking at a wide variety of speech disorders. For each child a probe wordlist was recorded, along with minimal pair words. We report the magnitude of the dorsal velar gesture in each session using linear and area-based differential measures between /t/ and /k/ tongue surface splines, which is compared to child and adult norms. Four of the children achieved a perceptually correct dorsal articulation in the 1st or 2nd session and two children achieved it in the 7th session. Articulatory analysis of the ultrasound shows a range of strategies for achieving the new movement including initial undershoot or overshoot.

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Feedback from automatic speech recognition software to induce clear speech  
S. Gutz, J. Green

The purpose of the current work is to evaluate the feasibility of using feedback from automatic speech recognition (ASR) to induce clear speech. Since ASR systems are widely available on consumer devices, ASR-based feedback may be able to facilitate at-home practice of dysarthria treatment. In this study, we describe our methods for creating a more challenging ASR system to encourage speech changes in healthy participants. Our findings, which compare speech produced with ASR to clear speech and habitual speech, demonstrate the potential of ASR to engender acoustic features of clear speech.

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Examining Intelligibility and Naturalness Changes in French-Speaking Children with Cerebral Palsy:  
A Small-Scale Randomized Controlled Trial  
G. Moya-Gale, E. Levy

Speech treatment efficacy studies in children with dysarthria due to cerebral palsy (CP) are scarce, especially in languages other than English. Our small-scale randomized controlled trial examined whether Speech Intelligibility Treatment increased speech intelligibility and naturalness of Belgian-French speaking children with CP. Ten children with CP were randomized to one of two treatment groups: speech or movement. Ease-of-understanding and naturalness ratings of the children's pre- and post-treatment speech were completed by 60 adult listeners. Results from the French validated version of Intelligibility in Context Scale (ICS) were also examined. Significant post-treatment improvements in intelligibility and naturalness were observed in the speech group although effect sizes were small. ICS revealed variable results. Preliminary findings suggest SIT may improve overall communicative function in some children with CP. Further investigation with a larger population is warranted.

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Investigating a neural marker of speech intention  
J. Kidwai, J. Brumberg

We investigated whether changes in brain activity related to speech motor preparation preceding spoken words can be used as a neural marker of speech intention. Three experimental protocols were evaluated for eliciting a contingent negative variation (CNV) during a spoken word task. A CNV reflecting anticipation of motor speech processing is observed as a negative change in potential between an early warning stimulus and late imperative stimulus. Eighteen fluent speakers of English were included over three paradigms that vary the content of task instructions at each stimulus that were expected result in differences in resultant CNV waveforms. The CNV area under the curve (AUC) was evaluated between Go and NoGo trials. A significant AUC difference prior to the imperative stimulus was found for two protocols, with one protocol eliciting the greatest neural response. The present findings suggest that CNV can be explored as an objective neural marker of speech intention.

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Differences in Implicit versus Explicit Motor Learning between Adults who do and do not Stutter  
F. Höbler, T. Bitan, L. Tremblay, L. De Nil

During speech and language development, we adapt to our linguistic environment through implicit learning, before developing a greater reliance on explicit learning as adults. This study investigated a hypothesised motor learning deficit in adults who stutter, focusing on the domain-general processes that motor skill relies upon.

Adults who stutter (AWS) or do not stutter (ANS) completed two separate implicit and explicit finger-sequencing tasks. Both groups showed improved performance under explicit conditions on Day 1, which was retained on Day 2, with no significant between-group differences. However, AWS were significantly slower on measures of implicit learning, but demonstrated similar trends in improvement to ANS.

These results highlight the importance of implicit learning in motor control, its potential role in speech fluency disorders, and underscore the need to further investigate how such learning processes influence treatment outcomes and issues of relapse in speech fluency.

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Intralingual Coupling in Parkinson's Disease: Effects of Phonetic Complexity  
M. Kuruville-Dugdale, A. Mefferd, M. Hakenewerth, A. Linderer

This study sought to determine phonetic complexity effects on intralingual coupling in persons with Parkinson's disease (PD). Tongue tip (TT) and tongue dorsum (TD) movements were examined in 15 people with PD and 15 healthy controls during word productions that ranged in phonetic complexity. Using the framework by Kent (1992), phonetic complexity scores were calculated and 10 target words representing either low or high phonetic complexity levels were selected for the study. Intralingual coupling was estimated from a covariance index comprising the average pairwise correlation and standard deviation of TT and TD movement for each word. Preliminary results show highly coupled intralingual movements for high complexity words in controls. By contrast, in PD, regardless of phonetic complexity, weak intralingual coupling was observed. The study findings will provide an improved understanding of the articulatory mechanisms contributing to speech imprecision in PD.

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Improving functional communication outcomes for children with cerebral palsy  
J. Korkalainen, P. McCabe, A. Smidt

The main communication interventions for children with cerebral palsy (CP) are motor speech intervention (MSI) and augmentative communication intervention (AAC-I). There is currently limited evidence on which intervention produces functional communication and is more suitable for milder and more severe CP. The aim of this pilot study was to investigate which intervention MSI or AAC-I, or a combination of these produce functional communication with children with CP. Single case experimental design across four children with CP, aged 8-14 who use an AAC system was used. Repeated measurements during all phases were collected. Children received three 6-week intervention blocks; MSI, AAC-I and a combination of these. The results suggest that MSI improves speech skills in children with a range of dysarthria severity and CP. AAC-I improves expressive language skills in the same children. Both interventions are required to produce functional communication.

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Modelling of Individual Differences in Speakers' Responses to Auditory Feedback Perturbation using SimpleDiva  
F. van Brenk, H. Terband, B. Maassen

Auditory feedback plays an important role in speech motor learning, yet little is known about the strength of motor learning and feedback control in speech development. In a previous study, we investigated compensatory and adaptive responses to sustained auditory in children compared to young adults, and found children to show stronger effects within both the counteracting and following behavioral categories. In this proposal we use SimpleDiva to perform computer simulations to evaluate compensatory behavior to auditory feedback perturbation by estimating gains in auditory feedback control, somatosensory feedback control, and feedforward control/learning rate. Results indicate similar auditory and somatosensory feedback gains, but higher learning rates in children. Modelling of individual speakers with following or neutral responses fail to yield explanatory data, suggesting the need for model adjustments to understanding varied participant performance in perturbation experiments.

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Effect of noise on speech intelligibility and perceived listening effort in head and neck cancer  
T. Eadie, H. Durr, C. Sauder, K. Spencer, M. Kapsner-Smith, K. Nagle

This study examined the effect of background noise on speech intelligibility and perceived listening effort in speakers with impaired and intact speech following treatment for head and neck cancer (HNC). Ten speakers with nasal, oral, or oropharyngeal cancer provided speech samples. Thirty listeners transcribed sentences and rated listening effort in quiet and two levels of background noise. Significant group x noise interactions were found for speech intelligibility and perceived listening effort. Individuals treated for HNC who present with imprecision are penalized to a significantly greater extent by background noise in comparison to those with intact speech. Results highlight the vulnerability of those with mild communication disorders secondary to HNC in relatively low levels of background noise and have implications for speech evaluations, counseling, and intervention.

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A Complexity-Based Approach for Automatic Diadochokinesis Analysis in Amyotrophic Lateral Sclerosis (ALS)  
C. Tanchip, Y. Yunusova, A. Waito, C. Cui, D. Guarin, J. Green

The objectives of this study were (a) to test a complexity-based approach using sample entropy (SampEn) for DDK speech segmentation; and (b) evaluate the accuracy of this approach in comparison to manual segmentation. 1117 DDK recordings from 351 patients with ALS were analyzed. An amplitude envelope-based method was applied to segment the DDK speech into syllables. The SampEn algorithm was applied to signals not accurately segmented by the previous algorithm. Segmentation accuracy was determined by the number of detected syllables. No statistically significant difference was found between the number of syllables detected by the SampEn algorithm ( $M = 56.5$ ,  $SD = 52.6$ ) and manual segmentation ( $M = 56$ ,  $SD = 52.6$ ),  $t(118) = -0.98$ ,  $p = 0.29$ . Combining amplitude-based and SampEn algorithms yielded a segmentation accuracy of 97.8%. The results established that SampEn augmented DDK analysis. This work supports the development of software tools for more accurate quantification of DDK metrics.

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Acoustic features of vowel and sibilant productions during natural speech:  
Implications for sensorimotor control  
K. Reilly, D. Casenhiser, B. Rafferty

The present study investigated vowel and sibilant acoustics from a large corpus of conversational speech. Vowel and sibilant analyses from hour long samples of natural speech by 16 speakers in the corpus are presented here. Vowel analyses revealed that, for each speaker, first and second formants did not exhibit the clustering for individual vowels that is observed during word and sentence production tasks. Analysis of spectral moments during sibilant productions revealed greater acoustic separation between sibilants and suggested that sibilant articulation was more distinct than vowel articulation. Additional analyses examine the effects of coarticulation, word and vowel/sibilant duration, and lexical factors on vowel and sibilant acoustic features during conversational speech. Together, these findings address questions related to the categorical vs. continuous nature of targets for speech production and the relevance of distinct phoneme articulations to speech comprehension.

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Influence of Prime-Target Mismatch on Lip and Jaw Kinematics  
Z. Kriegel, L. Kalinowski, A. Fullenkamp, J. Whitfield

The current investigation examined the effects of experimentally induced speech program competition on lip and jaw kinematics. Participants produced the carrier phrase "Bob likes \_\_\_ more" completed with a target word. In each trial, a prime word (50 ms), visual mask (e.g., #####; 100-115ms), and target (1000ms) were presented. The prime-target relationships were either congruent (70%; e.g., bike, bike) or incongruent (30%; e.g., peak, pike). Analysis revealed a smaller range of motion for trials with the rhyme -eak compared to -ike ( $p < .01$ ). Differences in movement were observed between congruent and incongruent trials, with incongruent trials resulting in longer movement durations compared to congruent trials,  $p < .05$ . These data suggest that competition induced by a prime-target mismatch may destabilize the speech motor system and delay execution of target word productions.

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**Chest Wall Intermuscular Coherence Associated with Non-speech and Speech Tasks Across the Lifespan**  
A. Reed, J. Cummine, D. Bremmekamp, A. Tam, C. Boliek

Speech breathing kinematics across the lifespan have been well documented. However, little is known about age-related changes in the muscle activity of the chest wall during speaking activities. Intermuscular coherence (IMC) provides an indirect measure of neuromuscular modulation by using the frequency content of the electromyographic activity between muscle groups. The present study examined changes in IMC of chest wall muscles during non-speech and speech tasks in 114 healthy individuals ages 6-77 years. Four tasks designed to manipulate lung volume and tracheal pressure were used. No age-related changes were found in IMC, however the strength of IMC changed as a function of lung volume and tracheal pressure targets. Our results further inform models of speech production by facilitating our understanding of IMC in the speech mechanism. These results provide the foundation for using IMC in individuals with neurogenic communication disorders within a neurorehabilitation context.

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**Vocal Pitch Perception and Production in Children and Adults**  
E. Heller Murray, C. Stepp

The study purpose was to examine the relationships between vocal pitch discrimination abilities and vocal responses to auditory pitch-shifts. Children 6 – 12 years of age and adults completed a listening task to determine auditory discrimination abilities to vocal fundamental frequency ( $f_0$ ) as well as two vocalization tasks in which the  $f_0$  of their auditory feedback was shifted. These pitch-shifts were either unexpected, providing information on auditory feedback control, or sustained, providing information on sensorimotor adaptation. Children were subdivided based on whether their auditory discrimination abilities were adult-like or immature. Children with immature auditory pitch discrimination had significantly larger vocal response magnitudes to unexpected pitch-shifts and significantly smaller vocal response magnitudes to sustained pitch-shifts. These results suggest that children with immature auditory pitch discrimination abilities also have immature vocal motor control.