Motor Speech Conference
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Variability in CAS: An investigation of practice effects

J. Case, M. Grigos

Variability has been interpreted in differing ways for development (Smith & Zelaznik, 2004), speech impairment (Grigos et al., 2015), and motor learning (Walsh et al., 2009). In learning tasks, high variability suggests flexibility while exploring movement parameters (Walsh et al., 2009). Conversely, in children with motor speech disorders, such as childhood apraxia of speech (CAS), high variability reflects underlying motor deficits (Grigos et al., 2015). A challenge arises when interpreting variability in the context of motor learning for CAS and if high variability reflects the underlying motor deficit or flexibility in a habitually variable system (Kent, 1992). This study thus examined within-session changes in variability in children with CAS as compared to those with typical development and other speech sound disorders. Changes in speech performance were examined between initial and later word productions. Theoretical and clinical interpretations of variability are discussed.

Agreement of childhood apraxia of speech diagnosis using two objective measures: Syllable Repetition and Maximum Performance Tasks
J. Preston

There is a need for objective measures that can be used to identify motor speech disorders in children, and a need for independent replication of objective measures that are currently in use. This study sought to determine whether two objective measures identified similar children with speech sound disorders as having childhood apraxia of speech of CAS. The Syllable Repetition Task (SRT) and Maximum Performance Tasks (MaxPT) were administered to 69 school-age children ages 7-16 years with speech sound disorders to evaluate the diagnostic reliability with respect CAS. The two tasks were in agreement that 10 children had CAS and 31 did not have CAS, but there was disagreement on the remaining 28 participants (whereby the SRT identified 10 as having CAS that the MaxPT did not, and the MaxPT identified 18 as having CAS that the SRT did not). Caution is recommended in relying on a single measure for identification of CAS.

Speaking the same language? Developing a rating form for speech features of Childhood Apraxia of Speech for an international reliability study.
E. Murray, S. Velleman, J. Preston, P. McCabe, R. Heard

Diagnostic accuracy of childhood apraxia of speech (CAS) from other speech sound disorders using expert clinical judgment is currently limited by a lack of operational definitions of distinguishing speech features. The reliability and validity of expert judgment and whether it can be operationalized remains unknown. The aim of this study was to develop a rating form including a feature list of discriminative, theoretical and/or frequently used CAS characteristics used for diagnosis. The feature list and operational definitions were informed by the best available research evidence. The form was pilot rated with children's speech samples and refined using a modified Delphi technique. Consequently, changes to stress, resonance, and structural error features were made. The final pilot achieved substantial inter-rater reliability (Landis & Koch, 1977) suggesting the rating form is robust. The form will be used to test the reliability of expert CAS diagnosis of children aged 2-18 years.

Levels of Communicative Participation with Botox Intervention for Spasmodic Dysphonia:A Qualitative Study
K. Yorkston, C. Baylor, M. Kapsner-Smith

Botox injections are a longstanding intervention for spasmodic dysphonia and typically bring measurable improvement in voice quality. This presentation summarizes the themes reported in qualitative interviews with participants receiving Botox treatment for spasmodic dysphonia (N=27). Depending on level of participation restriction as measured with the Communicative Participation Item Bank (Baylor et al, 2013), outcomes of treatment varied, as did the strategies used to cope with the condition. This presentation will provide insight into the experiences and coping strategies of these patients, and related implications for SLPs in developing effective interventions.

Perception-production relationships in weighting phonetic cues of vowel contrasts
H. Terband, T. Lentz

The present study combines measurements of perceptual acuity for spectral and durational differences and perceptual weighting of acoustic cues for the Dutch /ɑ/-/a/ vowel contrast with measurements of the production of the contrast to unravel what influences how phonetic cues for phonological contrasts are being weighed in production and perception. We investigated the effect of normalization for individual perceptual acuity on the correlations between cue weighting and produced contrast in a dataset from 47 young adults. The results showed a significant effect of normalization and a pattern of negative correlations (if a cue is more important in perception, it is expressed less in production) turned into a pattern of positive correlations after normalization. This suggests that production and perception are balanced based on relative perceptual acuity. If speakers are perceptually more sensitive to changes on a dimension, they produce objectively smaller differences on that dimension.

Reliability of SLP's phonetic accuracy and nasality judgments for children with dysarthria

K. Allison, M. Russell, K. Hustad

This study examined inter-rater reliability among practicing speech-language pathologists (SLPs) for perceptual judgments of phonetic accuracy and hypernasality in children with and without dysarthria. Ten SLPs rated children's degree of hypernasality and judged the accuracy of a set of target phonemes from recordings of sentenced produced by 20 children with dysarthria and 20 children with typical development. Six child speech characteristics were examined with regard to their ability to predict reliability of SLPs' judgments. Results showed that reliability of both phonetic accuracy and nasality judgments among SLPs was lower for children with dysarthria than for children with typical development. Among children with dysarthria, segmental accuracy predicted reliability of SLPs' perceptual judgments at both segmental and suprasegmental levels.

Perioral and Digit Vibrotactile Threshold Estimation in Neurotypical Children

E. Hoffman, J. Lee, J. Greenwood, S. Barlow

Data are limited on vibrotactile sensitivity of the perioral face and glabrous hand in neurotypical children. Fundamental knowledge of vibrotactile detection thresholds (VDT) in neurotypical children would advance current understanding of tactile perception and somatosensory development across the lifespan. Potential applications of VDT estimation include diagnostics for neurological disorders affecting somatosensory function in the hands and face, and assessment of movement disorders. An adaptive single interval up-down tracking algorithm (Lecluyse and Meddis, 2009) was used to assess VDTs at 5, 10, 50, 150, 250, and 300 Hz for the glabrous hand (L/R index finger) and perioral face (L/R oral angle) in a cohort of 34 pre-adolescent children age 10-13 years, and a cohort of 43 young adults age 19-35 years. Male and female participants were included. GLM ANOVA revealed significant main effects for stimulus frequency ($p<.001$), skin site ($p<.001$), age ($p<.01$), and sex ($p<.05$).

PSA-DBS effects on speech and voice in persons with essential tremor

L. Sandström, E. Schalling, F. Karlsson, P. Blomstedt, L. Hartelius

This study aimed to investigate to what extent overall speech function, in particular, articulation and voice, was affected by deep brain stimulation (DBS) in the posterior subthalamic area (PSA).
Method: Fourteen persons with essential tremor were recorded: off DBS, on habitual DBS, and at high-amplitude unilateral stimulation. Two speech-language pathologists made consensus ratings of speech and voice using a visual sort and rate method.
Results: High-amplitude stimulation had small, but significant negative effects on articulation. The group with affected articulation (n=9) had more medially placed electrodes than did the group with no change (n=5). No significant effects were found on overall speech function and voice.
Conclusions: Although PSA-DBS had small effects on voice and speech in general, negative effects on articulation were noted at high-amplitude stimulation. Worsened articulatory function may be associated with stimulation from a more medial location within the PSA.

Reduced Auditory Motor Compensation in Response to Large Formant Perturbations

A. Daliri, S. Chao, L. Fitzgerald

The speech motor system (SMS) relies on its predictions and incoming sensory feedback to estimate potential errors in its output. The SMS learns from errors in the current trial to produce more accurate production in future trials. Additionally, the SMS closely monitors its speech output, and when there is an error, it generates a compensatory response to reduce the error in the current trial. However, it is unclear whether error evaluation processes that are involved in auditory motor adaptation are also used for generating compensatory responses during production. Here, we examined within-trial compensatory responses to different magnitudes of formant perturbations. Similar to results of adaptation studies, we found larger normalized compensatory responses to smaller formant perturbations. These results suggest that similar error evaluation and correction processes are involved in generating both the adaptive and compensatory responses.

Sequencing Lexical Tone In Children With Childhood Apraxia Of Speech: Preliminary Results
E. Wong, Y. Sheung, K. Lee, C. Fai, M. Tong

Preliminary data suggested difficulties of sequencing lexical tones in children with CAS but not in children with speech delay (Wong, Lee, & Tong, 2019). The potential of using tone sequencing as an objective measurement for CAS has been discussed. This study compared the performances of sequencing lexical tones in children with and without CAS to examine whether the task can reflect the underlying deficits of motor speech control in children with CAS.

Robustness of Acoustic Measures of Voice to Background Noise During Clinical Recordings
C. Tanchip, Y. Yunusova, D. Guarin

The objective of this study was to investigate the effects of background noise on acoustic measures of voice. We hypothesized that sex would significantly affect acoustic measures; age and the presence of background noise would not. 196 recordings were obtained from 103 healthy individuals and analyzed using Multi-Dimensional Voice Program (MDVP) and Analysis of Dysphonia in Speech and Voice (ADSV). Age did not significantly affect results. In contrast, most of the analyzed measurements were significantly affected by sex and the presence of background noise in the speech signal. Signals corrupted by background noise presented significantly different acoustic measurements ($p < 0.01$) than signals without background noise. The results showed that many acoustic measures of voice were affected by background noise. The results of this study offer a rationale for the implementation of signal quality control and further for accounting for background noise in automatic acoustic analysis.

Parent-Rated Functional Outcomes of Treatment for Childhood Apraxia of Speech:
Preliminary Findings from a Randomized Controlled Trial
E. Maas, S. Caspari, M. Beiting, C. Gildersleeve-Neumann, R. Stoeckel, J. Wu

The goal of many treatments for childhood apraxia of speech (CAS) is to improve communicative function in daily life. However, few treatment studies include outcome measures of activity or participation levels of the World Health Organization model. The present study examines the effect of integral stimulation-based treatment for CAS using two parent-rated functional outcome instruments. Measures were obtained from a randomized controlled trial with a delayed treatment control group. Children with CAS (N=17) participated in a summer camp during which children engaged in group activities (not focused on speech/language) and received 16 hours of individual speech treatment. Preliminary findings indicate significant improvement in the treatment group on one measure but no significant differences between treatment and no-treatment groups. Implications will be discussed relative to outcome measures, effects of treatment, and possible benefits of a camp environment. [funded by R01 DC017768]

Relationship among Perceptual and Acoustic Measures of Habitual and
Clear Speech in Individuals with Parkinson Disease
A. Gravelin, J. Whitfield

Studies of clear speech in Parkinson disease (PD) have demonstrated clarity-related benefits in perceptual speech severity ratings. The purpose of the current proposal is to examine the relationship among clarity-related changes in overall severity and severity of specific dimensions in speakers with PD. Sixteen individuals with PD completed readings in habitual and clear speech conditions, and Master's students in speech-language pathology served as listeners. Listeners rated Voice Quality, Resonance, Articulatory Precision, Speech Rhythm, Intonation, and Overall Speech Severity using a visual analog scale. Clarity-related decreases in speech rate and increases in speech-to-pause ratio and Articulatory Acoustic Vowel Space were observed. Additionally, correlation analysis of the listener data revealed significant moderate-to-strong relationships among clarity-related changes in Overall Speech Severity and all dimensions except Resonance.

Performance of forced-alignment algorithms on children's speech
T. Mahr, K. Kawabata, V. Berisha, S. Tang, H. Vradelis, J. Liss, K. Hustad

To perform acoustic measurements on speech sounds, recordings must be segmented into separate intervals for individual phones. This process is time-consuming, so forced-alignment algorithms aim to automate this task. We asked

which of four available aligners performed best, compared to manual alignment, on speech samples from 42 children between 3 and 6 years of age. We evaluated four forced aligners: Penn Phonetics Lab Forced Aligner, Prosodylab Aligner, Montreal Forced Aligner, and alignments from the Kaldi speech recognition system. The Montreal Forced Aligner was the most accurate with 84% of intervals containing the midpoint from intervals by human aligners, followed by Kaldi (75%), Penn (66%), and Prosodylab (57%). The same ranking held when data were aggregated by speech sound type (plosives, vowel, fricatives). Implications are discussed.

Social Interaction and Communicative Participation Experiences of Youth with Congenital Dysarthria
K. Connaghan, C. Barylor, M. Romanczyk, J. Rickwood, G. Bedell

Little is known about the communicative participation experiences of adolescents and young adults with congenital dysarthria. Communicative interactions for social purposes are particularly critical during this developmental period, when peer dynamics are increasingly significant. Successful social interactions and robust communicative participation are key predictors of positive developmental, health, and quality of life outcomes. The current study was designed to understand these experiences through person-reports. Youths and parents participated in semi-structured interviews where they were invited to describe their (or their child's) experiences living with dysarthria and interacting with various communication partners across social settings. The goal of this work is to support the development of patient-centered interventions that promote successful communicative participation for adolescents and young adults with dysarthria.

Perceptual predictors of speech intelligibility in Parkinson's disease across listening conditions
Y-F. Chiu, A. Neel

The purpose of the study was to investigate whether perceptual scaling of speech parameters were predictive of speech intelligibility in quiet and in noise. Speech samples from 10 speakers with Parkinson's disease (PD) and 5 healthy controls were used in orthographic transcription and perceptual scaling tasks. Speech intelligibility were obtained from a total of 120 young listeners. Half of the listeners transcribed the recorded sentences in quiet and half transcribed in noise. Using visual analog scale (VAS), additional 23 listeners judged speech parameters of articulation, prosody, resonance, voice quality, and ease of understanding. Regression analysis was performed to predict speech intelligibility from the five perceptual ratings. Listeners' judgement of how easy speech is to understand predicted intelligibility in quiet and in noise. Ease of understanding and voice quality ratings were the strongest predictors of intelligibility in noise for speakers with PD.

Recovery patterns in patients with apraxia of speech, aphasia and hand motor impairment after stroke
H. Hybbinette, J. Plantin, P. Ostberg, E. Schalling, P. Lindberg

Despite the frequent co-occurrence of apraxia of speech (AOS), aphasia and hand motor impairment in left hemisphere poststroke patients, most research has studied recovery in a single domain within selected patient groups. AOS has been proposed as a link between motor and speech-language functions, but few studies have explored the relationship between impaired speech, language and hand function longitudinally. We examined the recovery patterns in fifteen left hemisphere damaged patients with concomitant hand motor impairment, aphasia and AOS by comparing behavioral and brain imaging measurements at two time points; at 2-6-week post stroke onset and at a follow-up after 6 months. A parallel recovery pattern was found, with a significant correlation between hand motor recovery and AOS recovery. No correlations were found between lesion volume, recovery ratio and level of impairments.

Quantitative multi-parameter mapping of basal ganglia in people who stutter
G. Cler, S. Krishnan, D. Papp, C. Wiltshire, J. Chesters, M. Healy, K. Watkins

Theoretical accounts of stuttering implicate dysfunctional cortico-striatal-thalamo-cortical motor loops through the putamen. Multi-parameter mapping using MRI can provide quantification using contrasts that are sensitive to iron content, which may be of particular benefit for assessing the basal ganglia. One of these contrasts is the effective transverse relaxation rate (R2*). R2* was assessed in the basal ganglia of a large sample of adults with persistent developmental stuttering. Multi-parameter maps were acquired in 39 people who stutter and 21 matched controls and were processed with the hMRI toolbox running in SPM12 (Tabelow et al, 2019). Analysis revealed two statistical clusters with higher R2* in people who stutter than controls. These clusters were in the left and right putamen, as predicted by theoretical accounts.

Quantitative contrasts such as R2* may help specify the differences in brain structure that are related to persistent developmental stuttering.

Neuromotor speech recovery across different speaking modes in individuals following facial transplantation
M. Eshghi, B. Perry, K. Stipancic, B. Richburg, H. Ventresca, B. Pomahac, J. Green

This project investigated the effects of speech modifications (loud, fast, and slow) on speech outcomes during the early and late phase of recovery in seven individuals who had undergone facial transplantation. Findings revealed that individuals in the early post-surgery group had limited capacity to adapt to the loud speaking mode and showed a reduced ability to regulate the extent of lower lip movement. Additionally, although individuals in the early post-surgery group demonstrated overshooting of lip movement, as suggested by large working space of the lower lip during the slow speaking mode, individuals in the late post-surgery group exhibited truncation of articulatory displacement, suggesting progressive improvement in neuromotor control.

Measuring the syntactic complexity of Sentence Intelligibility Test sentences
J. McManaman, K. Nagle

The Sentence Intelligibility Test (SIT; Yorkston, Beukelman & Tice, 1996) was created to provide a large corpus of sentences of differing lengths to measure sentence intelligibility for individuals with dysarthria. The SIT sentences are relatively low-context and range from 5 to 15 words in length; they were not designed to meet specific lexical or syntactic criteria. This study compares two methods of indexing syntactic complexity: a fine-grained method derived from research on writing in a second-language (SC) and the Flesch-Kincaid Reading Ease score (FKRE). Pilot data on 30 sentences indicate more variability in syntactic complexity within sentences of the same length using SC than FKRE. In this study we will compare a larger, random selection of SIT sentences (N=220). Results will provide a simple way to characterize SIT and other elicitation stimuli for functional evaluations of comprehensibility.

Perceived Acoustic Working Space Modulates Sensorimotor Learning
J. Berry, M. Johnson

This work presents acoustic data characterizing how auditory feedback scaling in virtual speech modulates the details of formant frequency changes reflecting sensorimotor learning in real speech. "Virtual speech" refers to synthesized speech controlled in real time using electromagnetic articulography. 36 talkers (4 with dysarthria) participated in a learning experiment requiring them to control an articulatory speech synthesizer using articulatory movements. Participants were divided into two experimental conditions: 1) an "unmatched" condition, where all participants received feedback based on a common acoustic working space (acoustic parameters did not mimic talkers spoken acoustics); and 2) a "matched" condition, where acoustic parameters were adjusted to mimic the formant working space and average fundamental frequency of each talker. Results suggest that the acoustic effects of articulatory learning are modulated by perceived acoustic working space.

Measuring the Effects of Repetitive Transcranial Magnetic Stimulation on the Vowel Space Area
P. Ambadi, B. Barragan, V. Berisha, J. Liss

Transcranial Magnetic Stimulation (TMS) and repetitive TMS (rTMS) allow researchers to assess causal relationships between motor areas of the brain and behavior. In speech studies, rTMS can be used to study the effects of virtual lesions on speech production. We propose that changes in the lip muscle's motor evoked potentials (MEPs) arising from rTMS application to the lip motor area can be detected using vowel space area (VSA) measured from speech acoustics. Participants were recorded speaking a passage before and 5 and 15 minutes after rTMS. From these recordings, VSA was calculated and the data was analyzed using a marginal model. We report that VSA significantly decreases 5 minutes after rTMS, following the trend of MEP decrease after rTMS. Our findings suggest that VSA can be reliably used as a speech acoustic measure to detect changes in the primary motor cortex.

Manipulating variability in the baseline phase of speech auditory-motor adaptation tasks
H. Wang, L. Max

Does motor variability affect motor learning? Some studies suggested a facilitatory effect due to exploration of the work space whereas other work showed complex effects depending on the source of variability. We tested how sensory variability affects speech auditory-motor adaptation by artificially eliminating or exaggerating auditory feedback variability prior to a formant shift perturbation. Subjects completed two conditions of an auditory-motor adaptation task. Half of the subjects (Fixed group) received feedback with no variability during the baseline phase in one condition and non-manipulated feedback in the other condition; the other half (Extra group) received feedback with exaggerated variability during the baseline phase of one condition and non-manipulated feedback in the other condition. Initial results show slightly reduced adaptation after the Fixed baseline but no effect after the Extra baseline, highlighting the complex role of feedback variability in motor learning.

Relationships among Objective Measures of Speech Production in Parkinson Disease
A. Alvar, D. Matheron, S. Snyder, K. Richardson, M. Darling-White, E. Stathopoulos, J. Susman, J. Huber

Parkinson's Diseases (PD) results in speech changes that negatively impact communication . There is behavioral evidence that these symptoms respond differently to treatments such as levodopa or deep brain stimulation, some improve while others worsen, indicating that their may be differences in the etiology underlying speech changes. This study uses objective measures of speech production to quantify speech symptoms in 46 individuals with PD and 20 health controls. We will conduct correlations and cluster analyses to understand how these measures relate to one another. The broad aim of this study is to build a model of symptom clusters that can be used to drive future work into shared physiology and shared neural control mechanisms for the clusters of speech symptoms. These findings will drive future research into more targeted interventions based on individual differences and a better understanding of the neural underpinnings of speech changes seen in hypokinetic dysarthria.

Neuroimaging of the Syllable Repetition Task in children with residual speech sound disorder (RSSD)
C. Spencer, J. Vannest, E. Maas, J. Preston, E. Redle, S. Boyce

Research has shown that speech neural networks of children with residual speech sound disorders (RSSD) may be less efficient than those of children with typical speech (TD) during covert tasks. We adapted the Syllable Repetition Task (SRT) for use during fMRI to assess phonological and speech motor network activations in overt speech. We used an “easy SRT” with phonemes /b, d, m, n, ɑ/, and a “difficult SRT” with /ɹ, s, l, tʃ, ɑ/. 14 children with RSSD (/ɹ/ errors) and 12 children with TD completed our study. We created group composite images of children with RSSD and TD controls using a GLM approach. Brain regions with significant activation at $z \pm 2.3$ ($p<0.05$) for RSSD group were: left primary motor cortex, superior temporal gyrus, and basal ganglia on the easy SRT, and right auditory cortex, right inferior frontal gyrus, and cerebellum on the difficult SRT. Results suggest that children with RSSD use more neural resources for processing and motor programming in speech production.

Simulating adaptation in the FACTS model of speech motor control
V. Ramanarayanan, B. Parrell, S. Nagarajan, J. Houde

In previous work, we presented a novel computational model of speech motor control -- FACTS -- that employs a hierarchical state feedback control architecture, including a higher-level control of speech tasks and a lower-level control of speech articulators, to simulate vocal tract articulation and the production of intelligible speech. Our earlier work has shown that FACTS is robust to noise in both the sensory and motor pathways, is relatively unaffected by a loss of auditory feedback but is more significantly impacted by the loss of somatosensory feedback, and responds appropriately to externally-imposed perturbations of auditory and somatosensory feedback. Here we explore extensions to the modelling paradigm to account for learning in the system over time as observed in formant adaptation experiments, and also explore deep learning-based methods to learn the aforementioned process model and examine their efficacy vis-a-vis our existing methods.

Reduced structural connectivity within the speech motor sequence planning network in persons who stutter
M. Heyne, J. Segawa, D. Beal, J. Tourville, F. Guenther

We collected diffusion-weighted MR images from 15 adults who stutter (AWS) and 15 fluent controls to investigate structural connectivity between brain regions involved in speech motor planning. Tract strength was determined by region-to-region probabilistic tractography. Group differences at $p<0.05$ (uncorrected) were noted in the connection between left premotor and pre-supplementary motor cortices and right premotor cortex and posterior superior temporal gyrus. Additional exploratory analyses also found differences to/from left operculum (higher in ANS), and stronger connectivity in AWS in right hemisphere connections between auditory and opercular areas, as well as inferior frontal ROIs. Our results support the hypothesis that stuttering is a system-level disorder (cf. Guenther, 2016), revealing anomalous reduced structural connectivity within the network of brain regions involved in learning, planning, and execution of speech motor sequences.

Treatment of articulation disorders in children. A pragmatic randomised control trial
P. McCabe, M. Leong, B. Butt, J. Cusiter

Traditional articulation therapy (Van Riper, 1958) is the ‘gold standard’ treatment for articulation disorders. However, there is limited evidence which shows it is effective. Over the past 15 years, the principles of motor learning (PML) have emerged as a systematic basis for designing interventions for speech disorders. While these principles are efficacious in treating complex motor speech disorders such as apraxia there is limited research on their use in treating articulation disorders.
We compared the effectiveness of treatment using PML with traditional therapy in a two-arm pragmatic RCT. Children with lisps aged 3-7 were randomly allocated. All children received 8 sessions over 2 weeks. Data was collected pre and post treatment and 4 weeks after completion. Time x group effects were examined after 2 waves of treatment (80 children) with a time effect present but no group effect. Treatment effects were maintained from baseline. Two further waves underway will be presented.

Repeated word production is inconsistent in aphasia and especially in apraxia of speech
K. Haley, K. Cunningham, A. Jacks, J. Richardson, T. Harmon

There is persistent uncertainty about whether sound error consistency is a potentially helpful diagnostic criterion for differentiating between acquired apraxia of speech and aphasia with phonemic paraphasia. In this study we address the problem with a large sample, asking whether speakers who meet diagnostic criteria for AOS produce different error consistency than speakers who meet diagnostic criteria for APP. Participants were grouped into four categories based on the frequency of distortion errors in their speech output and their temporal prosody for multisyllabic words. From these recordings we derived four measures of error consistency. ANCOVA showed that error frequency, as hypothesized, was a predictor of error consistency and that speakers with AOS, on average and for most metrics, produced more consistent errors than the other groups, whereas speakers with APP were more consistent. We are optimistic that these results will lay to rest a longstanding debate about clinical tests.

Maximum Repetition Rate normative data from a large sample of Dutch-speaking children, and its role in speech profiling
B. Maassen, H. Terband, S. Diepeveen, L. van Haaften, L. van den Engel-Hoek, B. de Swart

Maximum repetition rate (MRR) is frequently used for oral-motor assessment in clinical practice, yet there is a lack of standardization of the MRR tasks, and a lack of normative data. In addition, the role of MRR in diagnosing speech sound disorders (SSD) is poorly understood and has been challenged. Normative data were collected with a standardized MRR-protocol from a large [N>1000] sample of Dutch-speaking children aged 3;0 to 6;11 years, which is a crucial age-range for diagnosing speech sound disorders (SSD). The profile of typically developing children was compared to that of a clinical sample of children with SSD. For all MRR-sequences the number of syllables per second increased significantly with age, with no interaction between MRR-sequence and age, which forms a solid basis for interpreting MRR-results. Factor analyses on MRR and other speech tasks revealed different profiles for children with SSD and typically developing children, indicating the clinical relevance.

Comparison of Slow, Loud, and Clear Speech in People with Parkinson's Disease With and Without Deep-Brain Stimulation

I. Nip, M. Burke

Deep Brain Stimulation (DBS) has been used as a treatment for motor symptoms in people with Parkinson's disease (PD). The reported effect of DBS on speech production in this population has been mixed. Further the unique contribution of DBS has not been extensively explored in the speech production of this group. Acoustic measures of speech and voice production has been reported in the literature with the DBS on and off but no study has similarly examined the effect of DBS state on speech movements. The current study examines speech movement characteristics, including duration, speed, distance, and speech movement stability in people with PD and no DBS, PD and DBS, and healthy controls during habitual, slow, loud, and clear speech. Preliminary results demonstrate that the PD and no DBS group had the smallest and slowest lip and jaw movements for both slow and habitual speech. Discussion will focus on the interaction of speaking task with long-term neuromodulation on speech production.

Speech Network Involvement in Bulbar ALS: Structural MRI and Post-Mortem Neuropathology

S. Shellikeri, J. Keith, S. Black, L. Zinman, Y. Yunusova

ALS is a multi-system neurodegenerative disorder with motor and extramotor deficits. Bulbar ALS subtype has been linked to a shorter survival time, a reduced quality of life, and greater cognitive-linguistic deficits. The neural underpinnings of bulbar ALS remain unknown. The speech network (SpN) encompasses motor and extramotor brain regions. This project examines the SpN in bulbar ALS using structural neuroimaging (MRI) and post-mortem neuropathology. The MRI study found left-hemispheric differences of SpN regions in bulbar ALS; Motor speech dysfunction was associated with SpN damage. Neuropathology of SpN regions was noted exclusively in cases with bulbar ALS; Bulbar-onset ALS cases showed more marked and widespread pathology than spinal-onset with bulbar ALS. The work suggests that the left SpN is preferentially affected in bulbar ALS, including regions that also sub-serve cognitive-linguistic functions. The severity and extent of SpN damage may be related to bulbar motor severity.

Spatiotemporal control of articulatory movement and coordination during speech and speechlike tasks in persons with amyotrophic lateral sclerosis

P. Rong

Articulatory involvement occurs early in bulbar amyotrophic lateral sclerosis (ALS) and significantly impacts speech intelligibility. An efficacious articulatory assessment requires selecting of appropriate measures and tasks to reliably detect the articulatory deficits in ALS. This study provided a comprehensive assessment of the spatiotemporal control of articulatory movement and coordination during various speech and speechlike tasks. The aim was to identify clinically-useful articulatory measures and tasks for bulbar assessment in ALS. The results revealed a variety of spatial and temporal changes in tongue and jaw movements as well as the change in spatial tongue-jaw coordination during the speech task, while the speechlike task was more effective in detecting tongue speed reduction in ALS. Among these measures and tasks, the velocity rising time of the jaw during speech was most sensitive (91%) and specific (78%) in differentiating individuals with ALS from the healthy controls.

Impaired sensorimotor integration for the adjustment of phrasal prominence in ataxic dysarthria

A. Hilger, J. Cole, J. Kim, C. Larson

Ataxic dysarthria is a disorder affecting phrasal prosody, characterized by variable pitch and loudness control and ambiguity in phrasal stress production. In this study, we investigate how changes in auditory feedback are integrated into revised motor plans for relative phrasal prominence in ataxic dysarthria. In a previous study, we found that healthy speakers enhance the acoustic production of phrasal prominence after experiencing unexpected pitch perturbations in their auditory feedback earlier in the production of a phrase. We conclude that speakers continually use auditory feedback to scale the production of phrasal prominence relative to words produced prior in the phrase. Findings from pilot data reveal that individuals with ataxia do not make these adjustments to phrasal prominence, suggesting that the ambiguity in the production of phrasal stress may be due to a reduced ability to integrate changes in auditory feedback into revised motor plans for phrasal prosody.

Automating Objective Measures of Change in Speech Intelligibility

J. Liss, Y. Jiao, V. Berisha, A. Lacross

Auditory-perceptual judgments of speech intelligibility are inherently biased, which compromises reliability. To solve this problem, we need an objective measure of intelligibility and its sources. The current study provides a proof-of-concept for the Multidimensional Intelligibility Profile (MIP) using healthy speech in noise. We evaluated whether within-subject changes in speech acoustics--elicited by asking healthy speakers to produce phrases slowly, loudly and clearly--can predict changes in dimensions underlying intelligibility. Phrase transcriptions provided by listeners were coded for words correct and for phoneme and lexical boundary errors to create the MIP. Multiple linear regression models were built to fit the changes in acoustics to the changes in intelligibility. Results support hypotheses that acoustic measures of articulation account for phoneme errors and syllabic contrastivity measures account for lexical boundary errors. Clinical implications will be discussed.

Anodal tDCS targeting left premotor/motor cortices enhances speech motor learning

A. Buchwald, C. Repetti-Ludlow, H-S. Cheng

Recent work has revealed that speech motor learning can be enhanced by combining motor learning protocols with transcranial direct current stimulation. However, it is not yet known how to optimize the use of tDCS to promote speech motor learning, including what regions should be targeted. Here, we report that using tDCS can facilitate learning of nonnative consonant clusters when anodal stimulation is targeted to left premotor and motor cortices. Participants performed a speech motor learning task in several stimulation conditions. We compared anodal stimulation with cathodal stimulation (reversing electrode polarity) and sham stimulation, and evaluated changes in performance with accuracy and in the acoustics of cluster production, and found a benefit only for anodal stimulation targeting left premotor and motor cortices. These findings can inform approaches for using tDCS to enhance speech motor learning in individuals with acquired speech impairment such as apraxia of speech.

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sEMG-to-Voice AAC: Subvocal Recognition & Synthesis of Prosodic Speech

J. Vojtech, M. Chan, B. Shiwani, S. Roy, J. Heaton, G. Meltzner, P. Contessa, G. De Luca, R. Patel, J. Kline

Augmentative and alternative communication (AAC) systems convert physical gestures or text into words that can be acoustically synthesized or visually displayed; yet, most of these devices struggle to clarify lexical ambiguities and convey user intent. We are developing new AAC technology that overcomes these limitations by translating surface electromyographic (sEMG) recordings from articulatory muscles into speech produced by a personalized, prosodic digital voice. When evaluated in subvocal experiments involving n=8 control and post-laryngectomy participants, we achieved >90% accuracy for recognizing lexical content and emphatic stress. When perceptually evaluated by n=12 naïve listeners, sEMG-based voice elicited greater ratings of acceptability, intelligibility, emphatic stress discriminability and vocal association than electrolarynx speech aids. Future work aims to develop an sEMG-to-voice AAC system that restores the personalized and prosodic attributes of natural vocalization.

Using DIVA to understand the speech of minimally verbal children with autism: A preliminary analysis

K. Chenausky

We tested DIVA model predictions that a developmental motor speech disorder will result in highly variable speech, but a motor + auditory processing disorder will reduce speech to schwa. We perceptually coded speech from 38 minimally verbal children with autism for signs of within- and between-token variability and phoneme distortion. K-means clustering revealed two groups. Group 1 had significantly more perceptual within-token variability and nonsignificantly more between-token variability than Group 2; perceptual signs of phoneme distortion were similar. Acoustically, speech of a child from Group 1 also showed significantly more within-token and between-token variability than a child from Group 2. Both showed similar acoustic phoneme distortion, but the vowel space of the Group 2 child was more centralized. These perceptual and acoustic analyses provide preliminary support for DIVA’s predictions and make testable predictions about the speech of minimally verbal children with autism.

Auditory-Motor Perturbations of Voice Fundamental Frequency: Effects of Feedback Delay and Amplification

H. Weerathunge, D. Abur, N. Enos, K. Brown, C. Stepp

Sustained and sudden perturbations of vocal fundamental frequency (fo) auditory feedback, also known as adaptive and reflexive fo perturbations, are techniques to study the influence of auditory feedback on the control of voice. Experimental setups for vocal fo perturbation across different laboratories have had varied intrinsic feedback delays and amplification. Here, we comprehensively investigated the effects of these methodological variations on responses to adaptive and reflexive fo perturbations. Responses were collected in 24 typical speakers under four delay conditions (10, 40, 70, and 100 ms) or three amplification conditions (-10, +5, and +10 dB relative to the microphone). No significant variations in fo response magnitudes were found. The results confirm that experimental equipment delay (<100 ms) and amplification variations (–10 to +10 dB) do not affect fo perturbation response magnitudes.

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tDCS can enhance speech motor learning in AOS by strengthening cortical speech network

A. Buchwald, E. Duncan

Transcranial direct current stimulation (tDCS) has shown promise as an adjunct to stroke rehabilitation in several domains. We report results from three participants using a single-subject experimental design to test whether speech motor learning treatment for AOS can be enhanced with active tDCS targeted at left perilesional tissue. We evaluated changes in speech production as well as functional connectivity (FC) within the cortical speech network. Our behavioral findings from these single-subject experiments indicate preliminary support for adjuvant effects of tDCS paired with speech motor learning intervention, and the neurological findings suggest that active tDCS over left ventral premotor/motor cortices can enhance connectivity in left and interhemispheric components of the cortical speech network.

Tone distortion in ataxic dysarthria associated with spinocerebellar atrophy

L. Kwan-Chen

The current study aimed to show tone distortions in tone-language speakers with ataxic dysarthria associated with spino-cerebellum atrophy. Methods: Ten Cantonese-speaking adults with spinocerebellar atrophy and moderate degree of dysarthria, and another 10 neurologically healthy controls participated in speech production tasks. Results: Speakers with ataxic dysarthria produced rising lexical tones of Cantonese with with a lower mean value of fundamental frequency than healthy controls ($p < .05$). Speakers with ataxic dysarthria also made significantly more tone errors than the controls in reading and monologue ($p <.05$). Conclusions: The results revealed tone-specific speech errors in association with ataxic dysarthria. Despite of small sample size, the results supported further investigations of impact of neurodegenerative dysarthria on speech intelligbility, and communication outcome. Keywords: ataxic dysarthria, tone, Cantonese

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Ultrasound-aided versus perception-based phonetic transcription of childhood speech sound disorders

E. Sugden, J. Cleland

Although accurate transcription of speech is important, perception-based phonetic transcription can be unreliable. Adding a visual modality (ultrasound tongue images) increases the reliability of transcription of the speech of children with cleft palate but it is unknown whether ultrasound effects transcription of the speech of children with motor speech disorders (MSDs). In this study we examine whether viewing ultrasound images during transcription impacts the number and type of errors identified and the inter-rater reliability. Children with MSDs (n=35) were audio and ultrasound recorded saying 10 x /aCa/ for all places of articulation. Ultrasound-aided (UA) transcription and audio-only transcription will be performed. We predict that a similar number of errors will be identified by both transcriptions but UA will support classification of error types and increase inter-rater reliability. The results will provide evidence about the use of ultrasound in assessment for childhood MSDs.

Speech diadochokinesis in adults with traumatic brain injury: cross-sectional and longitudinal study

N. Pearl Solomon

Speech diadochokinesis (DDK) contributes to differential diagnosis of motor speech disorders (MSD). This study examined DDK productions by 295 military service members and veterans with no history of TBI or with mild (mTBI) or moderate to severe TBI (msTBI) at least 6 mo. prior to testing. Single-syllable repetition rates were slowest for the msTBI

group, but syllabic regularity did not differentiate the groups. A subgroup of 63 participants returned for a second evaluation after 0.3 to 5.3 yr. DDK results did not differ significantly over time. A supplemental speech analysis for 39 participants, including 26 with DDK performance suggestive of possible MSD, revealed probable dysarthria in 4 participants whose DDKs were notably abnormal. Overall, DDK productions are often slower than normal in adults with moderate to severe TBI 0.5-5 years after injury, and performance is stable over time. Syllabic regularity does not differ with TBI severity but may be salient in individual cases.

Spatial and temporal speech characteristics in children with apraxia of speech, phonological disorder, and typical speech
J. Vuolo

The current study investigates spatial and temporal speech features in children with childhood apraxia of speech (CAS), developmental phonological disorder (DPD), and typically developing speech (TD). We include two different speech production tasks: a relatively easy imitation task and a more challenging language retrieval task. Point measures (duration, displacement, and velocity) and spatiotemporal variability were calculated for the first syllable in two phrases. For duration, there was trend towards significance for children with CAS to produce the longest durations, $p = .08$. Numeric data showed that children with CAS produced the longest durations and DPD the shortest. For velocity, no main effect of group was observed, $p = .59$, but there was a significant group by task interaction, $p = .04$. Children with CAS produced slower velocities in retrieval compared to imitation, $p = .05$. Children with CAS use different strategies than other children to execute speech movements.

Stability of Speech Intelligibility Measures Over Repeated Sampling Times in Speakers with Acquired Apraxia of Speech
E. Vitti, J. Wambaugh

The purpose of this investigation was to measure the test-retest reliability of a word intelligibility metric in a group of 28 speakers with AOS and aphasia. The Assessment of Intelligibility of Dysarthric Speech (ASSIDS; Yorkston & Beukelman, 1981) was administered twice, with samples separated by one week. Scoring of recorded samples was completed by expert listeners using transcription and multiple choice. Percent intelligible words was remarkably similar for the group over the two sampling times for both scoring formats, with no statistically significant differences found between times. Percent intelligible words at Time 1 was very strongly, positively correlated with performance at Time 2. Transcription and multiple choice scores were strongly, positively correlated, with multiple choice scores being consistently, substantially higher. Findings suggest that speech intelligibility is sufficiently stable for AOS group treatment outcome research.

Vowel production in three connected speech tasks by individuals with Parkinson’s disease: Preliminary findings
C. Kuo, M. Barrett, Y. Kim, J. Berry

The purpose of this preliminary study is to examine potential vowel production differences associated with three connected speech tasks for individuals with PD. Four individuals with PD and two neurologically healthy individuals performed three connected speech tasks, including passage reading, picture narrative, and conversation. For each vowel token, the first and second formant (F1 and F2) trajectories for the entire vowel duration were generated, and F1 and F2 frequencies at the temporal midpoint of each vowel were obtained. Analysis to date suggests that the three methods of connected speech elicitation did not result in clear task effects. However, the productions by individuals with PD were descriptively more variable as compared to those by healthy individuals. Findings will be discussed for methodological implications in clinical practice and research and considered within the literature of connected speech research in healthy speech production and motor speech disorders.

Tracking the costs of Clear and Loud Speech: Interactions between speech motor control and concurrent visuomotor tracking
J. Whitfield, L. Sullivan, A. Fullenkamp, Z. Kriegel, S. Holdosh, A. Deemer

The purpose of this investigation was to quantify the extent to which and loud speech are affected by concurrent performance of an attention-demanding task. Speech kinematics and acoustics were collected while participants spoke using Habitual, Loud, and Clear speech styles. The styles were performed in isolation and while performing a secondary tracking task. Compared to habitual style, speaker exhibited expected increases in lip aperture range of motion and speech intensity for the Clear and Loud styles. While tracking, there was a decrease in lip aperture range of motion and

speech intensity for the habitual style. Tracking performance during Habitual speech did not differ from single-task tracking. For Loud and Clear speech, no changes in speech intensity were observed between speaking alone and speaking while tracking. A reduction in tracking performance was observed during concurrent Loud and Clear speech, compared to tracking alone.

Telediagnostic assessment of communication impairment in dysarthria: The KommPaS-tool
K. Lehner, W. Ziegler, J. Pfab

We present a new web-based, telediagnostic assessment of communication parameters for dysarthric speech (German acronym: KommPaS) that relies on naïve listeners recruited from a crowd-sourcing platform.
Four parameters were assessed for their psychometric properties, i.e., intelligibility, naturalness, perceived listening effort, and efficiency. Furthermore, the feasibility and the costs of the approach were investigated.
In the first evaluation phase, 36 non-dysarthric speakers and 36 speakers with dysarthria of varying etiologies and degrees of severity were included.
Listener agreements and distributions of test scores will be reported for each of the four parameters. ROC-analyses will be used to determine preliminary thresholds of below-normal performance. Influences of word length, frequency, familiarity, and complexity on intelligibility will be determined. A principal component analysis will be applied to determine the factor structure of the KommPaS-parameters.

The impact of clear speech on the spectral properties and intelligibility of fricatives-vowel sequences in speakers with Parkinson's Disease
V. Martel-Sauvageau

While past studies have reported effects of clear speech on vowels, diphthongs and consonants alone, few studies have investigated its effects on multi-segment sequences. The goal of the present study is to measure the impact of clear speech on the acoustical and perceptual properties of fricative-vowel sequences.
Twenty-five speakers with dysarthria as well as 25 healthy speakers were recruited. A sentence reading task containing words with the initial fricatives /s/ and /ʃ/ followed by different vowels was performed. Acoustical analyses consisted of spectral moment analysis. For the perceptual measurements, three listeners were recruited and were asked to predict the upcoming word by listening only to the isolated fricative.
Preliminary results indicate a difference between dysarthric and healthy speakers on the distinction between /s/ and / ʃ / with clear speech increasing this distinction. Regarding the perceptual effects, word prediction was higher for healthy speakers.

Orofacial and Digit Force Dynamics in Chronic MCA Ischemic Stroke
S. Barlow, J. Lee, R. Custead, J. Greenwood

Select measures of force dynamics were assessed during right and left thumb-index finger pinch, and lower lip midline compression in 7 chronic stroke survivors with single-event MCA ischemic infarcts in one hemisphere and compared to similar data collected from a cohort of 25 neurotypical male adults using a new wireless force sensor technology developed in our laboratory. In this visuomotor control task, participants produced ‘ramp-and-hold’ forces as rapidly and accurately as possible to end-point target levels at 0.25, 0.5, 1 and 2 Newtons in a randomized block design. Linear mixed modeling revealed significantly impaired force dynamics [dF/dtmax and peak force during recruitment, mean force, and criterion % hold force] in the lower lip and contralesional digits. Maximum voluntary contraction force output was also significantly diminished contralesionally compared to homonymous ipsilesional muscles, with fine force regulation radically impaired compared to neurotypical adults.

What affects communicative participation across motor speech and voice disorders?
J. Jin, C. Baylor, K. Yorkston

The purpose of this study was to explore the extent to which motor speech/voice disorder diagnosis is a significant predictor of communicative participation, and if there are common predictive variables for communicative participation across disorders. This survey methods study examined differences in Communicative Participation Item Bank (CPIB) scores across motor speech/voice disorders and variables that predicted CPIB scores across disorders. Participants

included 150 adults with dysarthria due to Parkinson's disease or stroke, or voice disorders due to spasmodic dysphonia or vocal fold immobility. Preliminary results suggest that there is a difference in self-reported communicative participation across diagnoses. While prior research has suggested that a range of variables might impact participation, this quantitative analysis suggests that only self-rated speech quality was a significant predictor of CPIB in a sample of mixed motor speech and voice disorders. Full abstract in pdf.

Orofacial and Digit Force Dynamics in Neurotypical Children
E. Hoffman, M. Hozan, J. Lee, J. Greenwood, S. Barlow

Data are limited concerning the fine force regulation in children. In the present study, 'ramp-and-hold' isometric contractions in the lower lip and thumb-index finger pinch were sampled in 29 children [age 7-12 years] using our wireless Bluetooth force sensors. Participants were instructed to contract their respective muscles as 'rapidly and accurately' to a series of end-point targets (0.25, 0.5, 1, and 2N) during visuomotor tracking. Several dependent measures were automatically extracted to characterize features of force dynamics. Linear mixed modeling showed significant main effects for age, sex, target force, and muscle group. The younger children manifest poorer end-point force accuracy and greater variability in peak force and hold-phase stability compared to older children. Males exhibited larger maximum voluntary contraction forces (MVCF) than females in both muscle groups. The digits showed a consistent advantage over the lower lip in all force measures.

The Role of Mental Simulation in Speech Motor Learning
D. Bailey, J. Whitfield, C. Dromey, M. Speights

Mental simulation is a technique that has been used in the motor learning literature, but little is known about its effects on speech motor learning. The objective of this study was to measure possible effects of mental simulation on speech motor learning in adults with typical speech. Participants in a nonword speech motor learning experiment were randomly assigned into conditions that varied in the type and amount of mental simulation, including various conditions of physical and mental practice, as well as conditions involving visual and audio models of target words. Articulator movements were measured with electromagnetic articulography, and spatiotemporal index (STI) measurements were calculated for each word for each participant. Linear mixed model analyses suggested generally lower STI measurements for participants in several of the mental simulation groups when compared to the 100% physical practice group. Further research into the role of mental simulation is warranted.

The Relationship between Production Variability and Auditory Acuity in Explicit Sensorimotor Learning for Speech
H-S. Cheng, C. Niziolek, A. Buchwald, T. McAllister

Previous studies have reported high individual variability in the amount of adaptation to implicitly-introduced perturbations of speakers' auditory feedback. Some of this variability may be attributable to differences in auditory acuity and baseline production variability. A similarly high degree of individual variability in the amount of learning was reported in a recent study where speakers were engaged in an explicit task of matching an auditory-acoustic target using a real-time visual display of formant frequencies (Klaus et al., 2019). However, neither auditory acuity nor production variability have been examined as predictors of success in explicit sensorimotor learning in speech. While analysis is underway, we predict that both acuity and variability will significantly predict learning success in this explicit sensorimotor learning task, and that production variability will be a better predictor, since it combines aspects of both auditory acuity and production stability.

Age-related changes in oromotor function and speech production
M. Eshghi, D. Salat, C. Cordella, S. Gutz, H. Ventresca, J. Green

The current study investigated the speech production of normal aging adults using speech behavioral measures and kinematic data obtained from lip, tongue, and jaw movement during speech tasks. Identifying subtle age-related speech changes may help differentiate alterations of neuromotor capacity due to normal aging processes from presymptomatic changes secondary to a nervous system disorder. The data used in this study were subsets of data collected from 67 healthy adults. Age-related changes in oromotor function were indexed using speech measures including: percent pause, pause duration, speech duration, speaking rate, spatial and time-series kinematic features of lips, and jaw during the production of /aba/, /ada/, /aga/ syllables, and sixteen kinematic features from the lip movement during the standard and

fixed-target alternating motion rate tasks. A significant effect of age and age*sex interaction were detected in speech and oromotor function using pause and kinematic measures.

Speech rate, pausing, and disfluency associated with CTE in professional fighters
A. Neel, S. Krasilshchikova, J. Richardson, R. Arenas, L. Bennett, S. Banks, C. Bernick

As a first step in describing the dysarthria associated with repeated head trauma in professional fighters, this study examined speech rate, pause characteristics, and disfluencies in passages read aloud by boxers and mixed martial artists as part of the Professional Fighters Brain Health Study (Bernick et al., 2013). Fighters displayed slow rates of speech and high frequency of pausing and disfluency suggestive of neurologic deficits. Simple acoustic measures may serve as sensitive biomarkers for neurologic impairment from repeated head trauma. Future analyses will focus on obtaining acoustic measures associated with voice quality, articulation, and prosodic aspects of speech, assessing speech differences between boxers and mixed martial artists, and determining the relationships among speech and language changes, neural damage, and exposure to head trauma in combat sports.

Effects of Task Repetition on Acoustic Measures of Speech Produced by Persons with Amyotrophic Lateral Sclerosis
K. Connaghan, S. Gutz, M. Eshghi, K. Nicholson, Y. Yunusova, JP. Onnela, J. Berry, J. Green

The widespread adoption of smartphones, coupled with technological developments, provides an unprecedented opportunity for frequent collection of speech data that can be used for progress monitoring, treatment planning, and clinical trials for individuals with neuromotor diseases, such as amyotrophic lateral sclerosis (ALS). However, it is unclear whether users learn a speech elicitation task across frequent repetitions, and if so, how this affects measures of motor speech performance. The current study was designed to compare the effects of repeating a reading passage task at different intervals on measures of speaking rate and pause in persons with ALS and healthy controls. Speaking rate and pausing variables were compared across data collection intervals of weekly, every 3-months, and every 6-months. While preliminary findings do not support a task learning effect for passage reading, possible factors influencing interpretation of the findings will be discussed.

The Relationship between Speech Characteristics and Motor Subtypes of Parkinson’s Disease
K. Brown, K. Spencer

The aim of this pilot study was to examine whether speech characteristics differ between individuals with Parkinson’s disease (PD) with tremor dominant or non-tremor dominant subtypes. There are theoretical and physiological reasons for anticipating speech differences between these subtypes, which differ in terms of motor presentation, dopaminergic responsiveness, cognitive profile, and disease progression.

Participants were grouped into non-tremor dominant (n=12) and tremor dominant (n=15) motor subtypes. Using a contextual speech sample, a between-subjects analysis of covariance was performed on five dependent variables drawn from the extant literature: fundamental frequency range, average pause duration, cepstral peak prominence, dysfluencies, and mazes.

No significant differences were found between motor subtypes. The absence of group differences will be discussed in terms of neural substrates of PD, the determination of the tremor subtype, and participant variability.

THE VARIED ROLES OF THE CAUDATE NUCLEUS IN SPONTANEOUS SPEECH
J. Sidtis, D. Sidtis

Functional brain imaging has the potential to map the neurogenic basis of speech production, but spontaneous speech is a dynamically shifting and interactive set of processes. While functional imaging has limitations with respect to characterizing this situation, investigating brain data with respect to specific characteristics of speech production may provide a perspective on the underlying neural networks. The present study examined several characteristics of spontaneous speech: the use of pause fillers, formulaic expressions, and sentence stems were measured in 60 second spontaneous monologues produced during functional brain imaging. Each speech characteristic served as a dependent variable in a multiple linear regression that used regional brain values as potential predictors. The results indicated that

the caudate nucleus played a role in the production of each characteristic, but the laterality and anatomic level of this structure varied with the speech characteristic.

The evolution of motor speech characteristics in phonetic and prosodic PPAOS
L. Bouvier

Primary progressive apraxia of speech (PPAOS) is a neurodegenerative syndrome characterised by initially isolated apraxia of speech. Clinical and neuroimaging data suggest two subtypes of PPAOS: phonetic and prosodic PPAOS. The current study aimed to track the changes in motor speech characteristics of phonetic and prosodic PPAOS from a longitudinal standpoint. Two phonetic PPAOS and two prosodic PPAOS patients underwent a comprehensive motor speech evaluation, every six months for 18 months. Thirty matched healthy controls (HC) also completed the assessment. The results of acoustic and perceptual analyses revealed a significant decrease in PPAOS performance compared to HC for almost all articulation and prosodic measures. The decline in motor speech abilities showed no clear pattern between subtypes, but no patient subtype classification changed during the study. This study brings key data for the understanding, the diagnosis and the follow-up of PPAOS.

Speech intensity response to altered intensity feedback in individuals with Parkinson's disease
A. Abeyesekera, S. Adams, A. Page, M. Jog

Hypophonia (low speech intensity) has been found to be the most common speech symptom experienced by individuals with Parkinson's disease (PD). Previous research suggests that, in individuals with PD, there may be abnormal integration of sensory information for motor production of speech intensity. In the current study, auditory feedback was systematically manipulated during sensorimotor conditions that are known to modulate speech intensity in everyday contexts. Twenty-six individuals with PD and twenty-four neurologically healthy controls were asked to complete the following tasks: converse with the experimenter, vowel prolongation, and read sentences at a comfortable loudness, while hearing their own speech intensity randomly altered. Altered intensity feedback conditions included 5, 10 and 15dB reductions and increases in the feedback intensity. Speech tasks were completed in no noise and in background noise.

Integrated head-tilt & surface electromyographic cursor control for augmentative and alternative communication
J. Vojtech, S. Hablani, G. Cler, C. Stepp

We evaluated two head control-based access methods that could be used for 2-D cursor control of an augmentative and alternative communication system: ACC/sEMG and Camera Mouse. Our ACC/sEMG system combines head acceleration and facial surface electromyography (sEMG), whereas Camera Mouse is a free-to-use computer vision-based method. Twenty-four healthy adults performed a target acquisition task using each access method across two lighting conditions and three computer configurations. Performance was assessed via target selection accuracy, movement time, and path efficiency. Results show a trade-off between speed and accuracy, as well as a dependence of Camera Mouse on environmental lighting conditions; ACC/sEMG was not significantly affected by changes in lighting or computer configuration. Future work will repeat methodology in individuals with speech and motor impairments to inform the implementation of integrated head accelerometry and sEMG cursor control for communication.

ActionSC: A new way to learn with apraxia of speech
K. Haley, K. Cunningham

Recent motor learning research indicates that autonomy-support, expectation of competence, and external attentional focus are beneficial for motivation and skill learning. We describe a treatment program designed based on these principles and demonstrate feasibility and basic therapeutic effect through a single case experimental design.The single participant was a woman with moderate AOS and nonfluent aphasia. The program was structured around a custom app installed on a tablet computer. Most practice was directed by the participant, based on options provided by the treating clinician, who served primarily as a coach. Experimental control was demonstrated, yielding a large effect size. The participant assumed an active role evaluating her own performance, administering and adjusting cues, and organizing her home practice. We conclude that an autonomy-supportive and confidence-building format for speech practice can be feasible and effective for people with AOS.

The contribution of degraded auditory feedback to speech performance in young children with cochlear implants

K. Reilly

Despite advances in cochlear implant (CI) technology children with CIs remain at-risk for speech sound disorders and reductions in intelligibility when compared chronologically and hearing age-matched peers. While there is an extensive literature documenting the range of articulatory and phonological impairments in this population, little information exists regarding the mechanisms that cause persistent reductions in intelligibility in this population. The present work evaluates putative mechanisms of speech impairment within the framework of current models of speech production that emphasize feedforward and feedback control systems for speech production. This research will relate CI-processed auditory feedback of child-specific speech to speech performance. In addition, the speech of pediatric CI users in CI-ON vs. CI-OFF conditions will be examined as a potential measure of feedforward speech development in this population.