A9

EFFECTS OF GLOBAL PROBABILITIES ON CORTICAL PROCESSING DURING AN AUDITORY SIMON TASK Carolyn Pauker[1], Edward Golob[1]; [1]Tulane University — The limits of selective attention can be probed by examining the impact of task-irrelevant information on behavior. Dual-process models propose that task-irrelevant information can impair performance by automatically activating response representations that compete with those in task-relevant controlled processing. The interplay between automatic and controlled processes is affected by global stimulus probabilities, but the neural basis has not been well characterized. Here, event-related potentials (ERPs) were recorded while subjects (n=15) listened to monaural amplitude modulated white noise. Subjects pressed a button (left/right hand) according to modulation rate (25/75 Hz) and ignored stimulus location (left/right ear). Stimulus-response locations either matched (compatible, C) or differed (incompatible, IC). The global probability of C:IC varied, with blocks of low (25%), equal (50%), or high (75%) proportions of C trials. Auditory ERPs were examined among trial types (C/IC) and global probabilities, and included early components (N100/P200) and frontal slow-waves (200-800 ms). The Simon effect (reaction time IC>C trials, $p<.001$) increased linearly with greater probability of C trials ($p<.001$), while accuracy on IC trials had corresponding decreases ($p<.001$). Across global probabilities, early slow-wave amplitudes (200-400 ms) were larger for the probable trial type ($p<.001$). Late slow-wave activity (600-800 ms) was prolonged on IC vs. C trials ($p<.05$). Global probability inversely affected slow-wave amplitude on IC trials (600-800 ms, $p<.001$), without affecting C trials or early ERP components. Early neural processing reflected trial probability, while late processing was associated with adjustments on IC trials. These findings may reflect the bias of global probability learning on dual-process interactions.

A10

PERCEPTUAL CAPTURE AND SPEEDED PROCESSING IN AUDITORY STREAMING Kevin Hill[1], Lee Miller[1]; [1]University of California, Davis — One of the brain's greatest perceptual challenges is to segregate mixtures of sounds into distinct "streams". Despite its behavioral importance, the neural mechanisms of streaming remain unclear. While interest in this field has grown, most previous neuroimaging studies could not unambiguously attribute effects to changes in perceptual state because of concomitant changes in stimulus properties, such as frequency disparity. In order to show a clear neural correlate of streaming, analysis must account for perceptual state in the absence of physical stimulus changes. Conversely, in order to interpret these prior experiments, one must account for effects due solely to the differential processing of stimulus features without a corresponding change in percept. To this end we recorded electroencephalographic (EEG) activity while subjects explicitly categorized a mixture of two tone sequences as perceptually segregated or grouped. Using a tightly controlled paradigm to measure the effects of stimulus disparity and perception independently we report two main sets of findings. First, we show that the effects of perceptual state are asymmetric between the two sequences, providing neural evidence of perceptual capture during auditory grouping. Second, we observe a faster EEG response to perceptually grouped tones relative to segregated tones, indicating facilitation of object processing within a grouped stream.

A11

TIME-FREQUENCY ANALYSIS OF NEURAL ACTIVITY DURING AUDIO-MOTOR PROCESSING AFTER TARGETED COGNITIVE TRAINING IN SCHIZOPHRENIA Ethan Brown[1], Alexander Herman[1], Anne Findlay[1], Mary Vertinski[2], Corby Dale[1,2], Sophia Vinogradov[1,2], Srikantan Nagarajan[1]; [1]University of California, San Francisco, [2]San Francisco Veterans' Affairs Medical Center — Both early auditory processing and more complex executive function are impaired in schizophrenia, though the relationship between these deficits has yet to be fully described. Targeted cognitive training (TCT) has been shown to improve these impairments according to neurocognitive metrics as well as non-specific behavioral measures, supporting a new and efficacious form of therapy for this disease. Establishing the neural activity underlying this improvement would help to confirm the efficacy of TCT, highlight the clinically relevant regions affected that contribute to cognitive deficit in schizophrenia, and illustrate the importance of these areas in normal cognitive functioning. To this end, we used magnetoencephalography (MEG) to study cortical activity during both a phoneme identification and a working memory task in 38 schizophrenic patients before and after three months of TCT or a controlled activity and in 14 healthy controls. This study is part of a randomized control trial investigating the behavioral efficacy of TCT. Time frequency analysis using a spatially adaptive filter developed in our lab provided high spatial and temporal resolution of auditory and memory-encoding processing streams. Our results indicate changes in the magnitude and spatial representation of low-frequency activity in auditory regions, representing normalization of sensory processing measures in schizophrenic patients after cognitive training. Training also affected high-gamma oscillations in frontal areas, especially inferior frontal lobe and dorsolateral prefrontal cortex, during the memory encoding tasks. These changes implicate a normalization of cortical activity in specific regions during auditory discrimination and verbal working memory, two functions impaired in schizophrenia.

A12

DIFFERENCES IN NEURAL OSCILLATORY DYNAMICS IN SCHIZOPHRENICS AND CONTROLS IN PHONEME VERBAL REPRODUCTION Alexander Herman[1], Ethan Brown[1], Anne Findlay[1], Mary Vertinsky[2], John Houde[1], Sophia Vinogradov[1,2], Srikantan Nagarajan[1]; [1]University of California, San Francisco, [2]San Francisco VA Medical Center — Speech perceptual and motor dysfunctions are well known features of schizophrenia. We aimed to elucidate how the oscillatory dynamics of the auditory-motor network differ between schizophrenic patients and healthy individuals in phoneme verbal reproduction. 14 healthy controls and 22 schizophrenic patients, matched along demographic measures, performed a phoneme repetition task, while we recorded the corresponding neural activity using magnetoencephalography. Subjects heard either two or four phoneme stimuli, waited for a visual go cue, and then repeated the phonemes. Activity filtered into canonical frequency bands was localized to each subject's structural MRI using a spatially adaptive filter implemented in our in-house open-source software package. NUTMEG. We found significant differences in the spatio-temporal dynamics of the speech motor network between patients and controls. Both theta/alpha and high gamma activity in auditory areas during the encoding phase differed between patients and controls. Patients also exhibited different high-gamma power time courses in speech auditory and motor areas during the pre-production phase. To determine the effect of phoneme cognitive load, contrasts between the four and two phoneme trials were computed for all subjects, and compared between the controls and patients. The load-effect manifested differently in patients and controls in auditory and frontal areas, across the frequency spectrum, indicating that schizophrenic patients utilize neural resources differently from healthy subjects in response to increased task difficulty. The rich spatio-temporal picture that emerges from this study may help to quantify the dysfunction in large-scale neural circuit behavior in speech perception and production in schizophrenia.

A13

EARLY AUTOMATIC DETECTION OF INTENSITY DEVIANTS REFLECTED IN THE MIDDLE-LATENCY RANGE OF THE HUMAN ELECTRICAL BRAIN RESPONSE Heike Althen[1], Sabine Grimm[1], Lavinia Slabu[1], Carles Escera[1]; [1]University of Barcelona — The violation of a regular sound pattern by irregular or novel stimuli is reflected in the mismatch negativity, a component of the human auditory evoked potential (AEP), with a latency of 100-250 ms and main sources in the auditory cortices. Evidence for auditory novelty detection however has also been reported at much shorter latencies (15 – 30 ms after stimulus onset) as revealed by single- and multiunit recordings in the auditory cortex and midbrain of animals. In this study, we aimed at finding traces of fast auditory novelty detection in the human AEP during a passive intensity oddball paradigm. An oddball condition using click stimuli (standard stimulus = 50 dB SL; deviant stimulus [14%] = 40 dB SL), a reversed oddball condition (standard stimulus = 40 dB SL; deviant stimulus [14%] = 50 dB SL) and a control condition (random presentation of 7 stimuli with different intensities ranging from 10-70 dB SL, 14 % probability each) were applied. The EEG was recorded from 7 scalp electrodes and the data was analyzed in the ranges of the auditory brainstem response, the middle-latency response, and the long-latency response. In the middle-latency range, deviants elicited a significantly more negative response than standards of the same intensity at the descending slope of the Na component (21-27 ms after stimulus onset). This outcome suggests that the human auditory novelty detection system comprises fast processes which are taking place at latencies similar to those found in single- and multiunit recordings in animals.

A14

AN OVERVIEW OF THE ROLES OF FUNCTIONAL AND ANATOMICAL STREAMS OF PROCESSING IN SPEECH PERCEPTION Sophie Scott[1], Carolyn McGettigan[1], Zarinah Agnew[1]; [1]Institute of Cognitive Neuroscience, London — The aim of this poster presentation is to examine the utility of ‘streams’ of processing in human speech perception. A decade ago, intelligible speech was demonstrated to recruit areas along the rostral ‘what’ pathway in the left temporal lobe, which has been associated with the processing of the vocalisations of conspecifics in non human primates (Scott et al, 2000). In parallel, studies indicated that auditory fields posterior and medial to primary auditory cortex were associated both with heard speech and the movement of the articulators (Wise et al, 2001; Hickok et al, 2000), and this has been termed a ‘how’ stream of processing (Scott and Johnsrude, 2003). In this poster I will review the ways that more recent studies have replicated and developed these findings, using both published and unpublished studies. For example, I will show how the anterior ‘what’ stream has been implicated in the processing of unattended speech (Scott et al, 2004, 2009), and the ‘how’ stream in speaking aloud under conditions of altered auditory feedback (Takaso, Eisner et al, 2010). I will address the kinds of hemispheric asymmetries seen in the left and right ‘what’ streams, and how auditory speech processing interacts with the wider language system (Obleser et al, 2007, Eisner et al, 2010). Finally, I will address how the ‘what’ and ‘how’ streams interact in the rehearsal of verbal information (Mcgettigan et al, in press).

A15

THE CORTICAL BASIS FOR THE DICHOTIC PITCH DEFICIT IN DEVELOPMENTAL DYSLEXIA Marita Partanen[1], Kevin Fitzpatrick[1], Dorothy Edgell[2], Bruce Bjornson[1], Deborah Giaschi[1]; [1]University of British Columbia, [2]University of Victoria — Children with developmental dyslexia have difficulty learning to read. They may also show deficits in temporal processing, which is the perception and integration of rapidly presented stimuli. Our research group has previously shown that children with dyslexia have deficits in dichotic pitch perception, which is a measure of rapid auditory temporal processing. In the current study, we examined the dichotic pitch deficit using functional MRI in children with average reading ability and children with dyslexia. We presented ascending and descending pitch sequences that were embedded in background noise, using a sparse sampling design. The task was to press a button to indicate whether the tones were ascending or descending in pitch. The conditions included low (1) and high (10) signal-to-background noise ratios (SNR), noise only, and silence. The tones in the low SNR condition can only be perceived by integrating information from both ears (dichotic), while the tones in the high SNR condition can be perceived monaurally. Results demonstrated significant activation in bilateral Heschl’s gyrus and superior temporal gyrus for low and high SNR conditions. Children with average reading ability showed activity in the right superior temporal gyrus during both the low and high SNR conditions, while children with dyslexia activated this region only during the high SNR condition. Additionally, cortical activation in the low SNR condition was correlated with reading ability. These results suggest that the cortical regions utilized for dichotic pitch perception are affected in dyslexia, and these regions may be involved in the reading process.

A16

MUSIC AND MU RHYTHMS Matt Schalles[1], Noah Bresler[1], Jaime Pineda[1]; [1]University of California, San Diego — Theories of action-observation matching systems hypothesize that hearing sounds associated with specific motor components may become associated in a Hebbian-like fashion and elicit activity in sensorimotor cortex. Activities such as playing music engage precisely coordinated muscle patterns that are tightly coupled in time to the sounds they produce, and EEG could provide the temporal specificity necessary to study these functional associations. Specifically, the mu rhythm (8-13 Hz) desynchronizes during sensorimotor activity as well as during periods of visual action observation. Hence, we predicted that audio-motor associations that rely on sequential patterns could elicit mu desynchronization despite alterations to pitch information. Over the course of 5 days subjects learned to play a simple piano melody by ear over synthesized backing instruments. After successful completion of training, subjects listened to clips from that song and two similarly constructed songs (transposed and scrambled) while their brain waves were recorded. Initial results suggest a trend towards significant differences between hearing the learned song and an unlearned song. Blind source separation analyses showed that mu and theta activity varied significantly by song in central/temporal and frontal mu clusters compared to a more occipital cluster. Significant effects of song occurred in these anterior clusters 1.5-2 seconds after the onset of the second beat of the song clip perhaps reflective of time to discriminate between songs. Finally, desynchrony in upper beta appeared while listening to the transposed version of the song, while rebound synchrony occurred across all frequency bands around the 5th second of the learned song.

A17

ACTIVATION IN MOTOR SPEECH REGIONS TRACKS WITH EXPERIMENTALLY INDUCED BIAS Jonathan Venezia[1], Kourosh Saberi[1], Gregory Hickok[1]; [1]University of California, Irvine — Recent evidence suggests that the speech motor system may play a significant role in speech perception. Repetitive transcranial magnetic stimulation (TMS) applied to a speech region of premotor cortex impaired syllable identification but not color discrimination, while TMS stimulation of motor areas for different articulators selectively facilitated identification of phonemes relying on those articulators. However, in these experiments the speech stimuli were embedded in noise and performance was not corrected for response bias. It may be that higher-level decision networks are preferentially taxed under conditions of stimulus degradation. Thus, the present functional magnetic resonance imaging experiment is designed to systematically manipulate response bias in speech perception using degraded speech input. Minimal consonant-vowel stimulus pairs were presented between volume acquisitions for same-different discrimination. Speech stimuli were embedded in Gaussian noise at the psychophysically determined threshold level. We manipulated bias by changing the ratio of same-to-different trials: 1:3, 1:2, 1:1, 2:1, 3:1. Ratios were blocked by run and subjects were cued to the upcoming ratio at the beginning of each run. We predicted that activation in speech motor regions would vary systematically with bias. Indeed, we found that the pattern of response bias – as measured using the criterion measure, “c,” from signal detection analysis – was predictive of activation patterns in left frontal brain regions typically associated with speech production. Examination of discriminability (d’) indicated that performance was constant across bias conditions. These results suggest a role for motor speech regions in decision components of speech perception under adverse listening conditions.