B98

ACETYLCHOLINE MODULATES FRONTOPARIETAL RESPONSE TO DEMANDS FOR COGNITIVE CONTROL Mary K. Askren[1], Elise Demeter[1], Mary Winters[1], Stephan Taylor[1], Martin Sarter[1], Cindy Lustig[1]; [1]University of Michigan — Cognitive neuroscience research in primates (including human neuroimaging) emphasizes the involvement of frontoparietal networks in response to demands for cognitive control. Behavioral neuroscience research with rodents indicates that increases in acetylcholine play a critical role in the brain's response to these demands. The present experiment integrates these approaches by using a task-switching procedure to vary demands for cognitive control and donepezil hydrochloride (an acetylcholinesterase inhibitor) to vary extracellular acetylcholine levels. Demand for cognitive control varied with the requirement to attend to external cues indicating the currently-relevant task rule (low: all trials used the same rule; intermediate: current trial used the same rule as the previous trial; high: current trial required switching to a new rule in response to the cue). Young adults (age 18-30, n = 20 per group) were tested at baseline and subsequently scanned 3 hours after receiving a placebo pill, 5 mg, or 10 mg donepezil. Demand-related frontoparietal activations differed most between the placebo and 5 mg conditions, suggesting a U-shaped dose-response curve. Under placebo, the largest activation increases occurred in the shift from low- to intermediate-demand, where cue-processing first became relevant. The 5 mg condition did not show significant differences between low- and intermediate-demand. Instead, activation increases were isolated to the high-demand condition. This suggests that the 5 mg group only increased engagement of frontoparietal control regions when a cue-based switch was immediately required. Moderate increases in extracellular acetylcholine may facilitate rapid shifting between internally-focused and externally-focused processing modes, allowing more selective engagement of frontoparietal networks.

B99

DISTRIBUTED PATTERNS OF ACTIVATION IN THE PREFRONTAL CORTEX REFLECT TASK-RELEVANT VISUAL DIMENSIONS OF A STIMULUS David Pagliaccio[1], Sophie Lebrecht[1], David Badre[1]; [1]Brown University — Prefrontal cortex (PFC) is thought to maintain contextual information, rules, and goals in order to guide action. However, the nature of the contextual information maintained by these various frontal regions remains an open question. In the present study, multi-voxel pattern analysis (MVPA) of fMRI data was used to index the distributed patterns of activation in PFC associated with representation of specific task-relevant dimensions of visual input and how multiple such contextual representations are maintained simultaneously. On each trial, participants were presented one of two abstract shapes appearing in one of two orientations and in one of two colors. Two of the three dimensions (color, shape, or orientation) were paired with particular manual responses based on their identity. The third dimension cued one of these two dimensions as the relevant response pairing for that trial. Thus, across all trials, one dimension was always relevant and cued which of the two other dimensions was relevant on a given trial. MVPA prediction accuracy was used to index when stimulus information along each of these three dimensions was being maintained by PFC. Initial results indicate that PFC codes for only those visual dimensions relevant to selecting a response or set of rules. By contrast, classifier success indicated that visual areas code for these same dimensions regardless of task-relevance. These results are consistent with the hypothesis that PFC flexibly maintains contextual information in working memory that is relevant to selecting a response, regardless of the specific content of that context.

B100

THE D2 AGONIST BROMOCRIPTINE MODULATES PREFRONTAL ACTIVITY ASSOCIATED WITH FLEXIBILITY IN TASK SWITCHING Christine Stelzel[1], Christian J. Fiebach[1], Roshan Cools[2], Mark D'Esposito[3]; [1]University of Heidelberg, [2]Donders Institute for Brain, Cognition and Behaviour, Nijmegen, [3]University of California, Berkeley — Recent imaging genetics studies suggest a role of the dopamine D2 receptor in the flexible adaptation of behavior in humans based on differences in fronto-striatal activity between genetic groups. However, the quasi-experimental nature of these genetic studies limits the causal interpretability of these findings. In the present study we provide converging evidence for our previous finding of an association of genetic variations in the D2 receptor gene with prefrontal activity changes in a rule-based task-switching paradigm. Using the D2 receptor agonist bromocriptine, we tested whether increased D2 receptor stimulation causes increased prefrontal task-switching-related activity as suggested by the genetic study. In two separate fMRI sessions (placebo/drug), participants performed 5 or odd/even decisions on number stimuli, depending on a task cue. Increases in switching-related reaction times under bromocriptine were accompanied by selective BOLD increases in prefrontal regions involved in task switching, i.e., the left inferior frontal junction (IFJ) region and the anterior cingulate cortex. Importantly, the greater switching-related IFJ activity under the D2 receptor agonist concurs with the finding of greater activity in this region for individuals with genetically determined high D2 receptor density. This result further supports the assumption that cognitive flexibility is related to the D2 system that exerts its effects in prefrontal regions when task sets have to be switched flexibly from trial to trial.

B101

COMPETING STRATEGIES FOR PRONOUN RESOLUTION Megan Reilly[1], Corey McMillan[1], Robin Clark[1], Murray Grossman[1]; [1]University of Pennsylvania — Individuals can use at least two decision-making strategies to resolve pronoun reference in ambiguous sentences like "The client chased the king. He laughed". A syntactic strategy relies on assigning a pronoun to the preferred subject ("client") of a sentence. A semantic strategy relies on gender information ("king" is male; "client" is gender-neutral). We hypothesize that successful resolution of pronoun reference requires, in part, the ability to choose between these strategies. bvFTD patients have mental flexibility limitations with relative sparing of language, and we predicted impaired pronoun reference resolution due to limited ability to use each strategy appropriately. 14 healthy seniors (WNL) and 9 bvFTD patients matched for age and education were presented with 40 unambiguous ("The king chased the princess. He laughed") and 40 ambiguous ("The king chased the client. He laughed") sentence pairs. We manipulated whether the correct referent was the subject or object (in unambiguous pairs) or whether the gender-biased noun (king) was the subject or object (in ambiguous pairs). Participants were instructed to identify the pronoun's referent. We evaluated mental flexibility using Oral Trails. bvFTD are less accurate for pronouns referring to the object relative to the subject [$t(8)=2.33$, $p<0.05$] in unambiguous items. In ambiguous stimuli, bvFTD select the subject noun (24% of responses) more than WNL (5% of responses) when the gender-biased noun is the object [$t(21)=2.84$, $p=0.01$]. This inappropriate use of a syntactic strategy by bvFTD correlates with Oral Trails ($r=-0.70$, $p=0.05$), which suggests that a limitation in mental flexibility may affect pronoun resolution.

B102

UNPACKING THE PROSPECTIVE CODE AVAILABLE UNDER DIFFERENTIAL OUTCOMES TRAINING Leh Woon Mok[1]; [1]National Institute of Education, Nanyang Technological University, Singapore — This study examined a form of prospection that involved minimal self-projection. The conditional discrimination choice task was used, which modeled real-life delayed choices learned and made conditionally based on the presenting discriminative/cue situation. Each correct cue-choice occurrence was followed

by an outcome stimulus. Under the "differential outcomes" (DO) training procedure, outcome stimuli were unique to each correct cue-choice occurrence ("cue-unique"). The DO procedure produces consistently more accurate and faster learning, as compared to following all correct choices with a "common outcome" (CO), or random, "non-differential outcomes" (NDO). Healthy adults performed discrimination tasks under the DO, CO and NDO procedures, and related comparison tasks, while undergoing functional magnetic resonance imaging (fMRI). Differential outcomes were sensory-perceptual events (visual vs. auditory). Sensory-specific cortices and related brain regions prospectively coded the stimulus content of the respectively expected cue-unique outcomes (Mok et al., 2009). These cue-unique outcome expectations "enriched" the prospective code available to bridge the memory delay. Previous results indicated that, facilitated by the posterior parietal cortex, this enrichment promoted an earlier transition from retrospection (of cue information) to prospection (of events expected after the delay, e.g., correct choice and/or anticipated outcome). Here, the prospective code available under DO training was further unpacked. Choice stimuli were visual objects. Conjunction analyses across tasks implicated prospective coding also for: the expected correct choice in precuneus (possibly a response intention), and visual-specific inferior, lateral and medial frontal, and lingual gyri, and cerebellum; and a general anticipatory response in anterior insula, likely for an available (sensory-perceptual) outcome goal.

B103

A COMPONENTIAL ANALYSIS OF TASK-SET SWITCHING IN PARKINSON'S DISEASE Li Jingling[1], T-H. Chang[2], C-H. Tsai[1,3,4], M-K. Lu[3,5], Y-C. Lin[3]; [1]Graduate Institute of Neural and Cognitive Sciences, China Medical University, Taichung, Taiwan, [2]China Medical University, Taichung, Taiwan, [3]Neuroscience Laboratory, China Medical University Hospital, Taichung, Taiwan, [4]Graduate Institute of Medical Science, China Medical University, Taichung, Taiwan, [5]Motor Cortex Group, Goethe-University, Frankfurt am Main, Germany — Patients with Parkinson 's disease (PD) have been reported to have problems in cognitive flexibility. In this study, we further investigated which cognitive components of this deficit in PD patients correlate with their disease and their 99mTc-TRODAT-1(dopamine transporter) SPECT image. To this aim, we included not only age-matched controls but also a young group to study the relative contributions of the disease and aging to cognitive flexibility. Twenty-two patients with PD, 28 healthy age-matched older people, and 31 healthy young controls, were recruited in this study. Three components, the mixing cost, the switching cost, and the congruency effect, were measured in a task-set switching paradigm. The participants performed two simple tasks either separately in different blocks or alternating in a mixed block. The activation of the striatum area of PD's 99mTc-TRODAT-1 SPECT image was calculated relative to the occipital lobe as an index of strength of the dopamine transporters in the striatum. PD patients performed worse in switching cost than older controls, and have larger mixing cost than young controls. Also, aging affects both the mixing cost and the congruency effect, but not the switching cost. Furthermore, the index of the 99mTc-TRODAT-1 SPECT image significantly correlated with patients' mixing cost. Our findings suggest that (1) PD patients uniquely impaired in switching mental sets from one to the other, and (2) their deficits in keeping two mental sets in mind simultaneously correlate with the loss of dopamine in striatum.

B104

PRIMING AND BACKWARD INTERFERENCE IN THE HUMAN BRAIN: STIMULUS ONSET ASYNCHRONY MANIPULATIONS REVEAL PROCESSING INTERACTIONS DURING THE STROOP AND REVERSE STROOP TASKS Lawrence Appelbaum[1], Carsten Boehler[1], Marty Woldorff[1]; [1]Duke University — Stroop interference provides a widely used and powerful marker of executive cognitive function. Moreover, the Stroop-task stimulus components can be separated in time in order to explicitly study the dynamics of information processing in the human brain. In the present work, we measured behavioral and neural markers of interference using high-density ERPs as subjects performed variants of the Stroop (color-naming) and reverse-Stroop (word-naming) tasks in which the task-irrelevant component could appear at one of five stimulus onset asynchronies (SOAs) relative to the task-relevant component: -200 or -100 ms before, simultaneously, or +100 or +200 ms after. Experimental sessions were run with both equal (50-50%) and unequal (80-20%) congruent and incongruent pairings, and with and without the inclusion of neutral distractors, to assess the relationships between task-set (color- versus word-naming), stimulus context (incongruency probability), and SOA-incongruency interactions. For all task variants, stimulus incongruency interacted with SOA producing greater conflict-related behavioral and ERP effects when the irrelevant stimulus component preceded the task-relevant target, and diminished but still significant effects when the task-irrelevant stimulus component followed. These 'priming' and 'backward interference' SOA effects both interacted with task, showing a nearly 50% reduction in behavioral and neural interference in the equal-probability reverse-Stroop task (e.g., prototypical trial-type frequency effects). Interestingly, ERP incongruency effects also produced opposite accelerating and decelerating latency patterns across SOAs for the two tasks, reflecting faster processing speeds for words than colors in these tasks. These results provide powerful examples of how cognitive task and stimulus conflict interact in the human brain.

B105

THE IMPACT OF PARKINSON'S DISEASE ON THE EFFECTS OF A MATCH BETWEEN GLOBAL AND LOCAL INCENTIVES IN RULE-BASED CATEGORY LEARNING Monica Zilioli[1], W. Todd Maddox[2], Edward Drasby[1], Shawn Ell[1]; [1]University of Maine, [2]University of Texas — Recent data suggest that performance on rule-based category learning tasks can be modulated by manipulating the extent to which global and local incentives match. The goal of the present study was to investigate if the effects of the match between global and local incentives are mediated by fronto-striatal networks by using Parkinson's disease (PD) as a model of fronto-striatal dysfunction. Global incentive was manipulated by placing participants in a promotion (sensitive to gains) or prevention (sensitive to losses) regulatory focus. The local incentive was to maximize gains by earning points on a trial-by-trial basis and was constant across conditions. Participants were trained on a rule-based task where successful performance required learning to attend to a single, relevant stimulus dimension and ignore three irrelevant stimulus dimensions. Once a learning criterion was met, the categorization rule was changed (i.e., a previously irrelevant dimensions became relevant). PD patients performed similar to healthy controls on the first rule. When the categorization rule changed, however, the performance of the two groups diverged. For healthy control participants, there was a savings when there was a match between the global and local incentives (i.e., promotion) and a cost when there was a mismatch between the global and local incentives (i.e., prevention). In contrast, for individuals with PD, there was a cost of similar magnitude for both the match and mismatch conditions. These results suggest that the fronto-striatal networks disrupted in PD mediate the effects of a match between global and local incentives in rule-based category learning.

B106

SEX DIFFERENCES UNDER DIAZEPAM IN RULE GUIDED BEHAVIOR: AN FMRI STUDY Zeidy Munoz-Torres[1], Jorge Armony[3], David Trejo-Martínez[2], Rubén Conde[2], María Corsi-Cabrera[1]; [1]Laboratory of Sleep, Faculty of Psychology, Universidad Nacional Autónoma de México, [2]Module of Neuroimage and Cognition, Hospital Ángeles del Pedregal, [3]Douglas Mental Health University Institute, McGill University — Benzodiazepines (BZD) modulate GABA-A receptor by increasing Cl- conductance across the membrane. In addition, progesterone and its metabolites have been shown to exert modulatory effects on the GABA-A receptor complex. Enhancement of inhibition with BDZ can have important effects at the cognitive level, including executive functions such as behaviour guided by complex and arbitrary rules. To investigate the neural correlates of these