

Cognitive Neuroscience

Edward E. Smith, PhD, Division Chief
Department of Psychiatry, Columbia University College of Physicians and Surgeons
New York State Psychiatric Institute
Annual Report for July 1, 2007 – June 30, 2008

Overview

Using behavioral, cognitive, physiological and neuroimaging techniques, the Division of Cognitive Neuroscience investigates brain-behavior relationships and the cognitive and neurobiological mechanisms underlying psychiatric disorders. Research involves basic and preclinical studies, development and application of laboratory-based assessment, and clinical trials. This Division was formed in recognition of the importance of applying new developments in cognitive neuroscience to the study of psychiatric disorders that entail significant cognitive dysfunctions. The Division comprises units from the prior Biopsychology Division - Psychophysiology, Temporal Cognition, Somatosensory and Pain, Clinical Chronobiology, as well as the Cognitive Electrophysiology Laboratory and the Center of Prevention & Evaluation (COPE). The Division also includes the newly crated Neuroimaging and Cognition Laboratory.

Staff

Gerard Bruder, PhD, Associate Chief

Neuroimaging and Cognition

Edward E. Smith, PhD, Director, Research Scientist VII

Psychophysiology Laboratory

Gerard Bruder, PhD, Director, Research Scientist VIII

Jürgen Kayser, PhD, Research Scientist V

Craig Tenke, PhD, Research Scientist V

Cognitive Electrophysiology Laboratory

David Friedman, PhD, Director, Research Scientist VII

Doreen Nessler, PhD, Research Scientist II

Center of Prevention & Evaluation (COPE)

Cheryl Corcoran, MD, Research Scientist VI

Timing and Cognition Laboratory

Chariklia Malapani, MD, PhD, Co-Director, Research Scientist V

Peter Balsam, PhD, Co-Director, Adjunct Professor of Medical Psychology (in Psychiatry)

Daniela Brunner, PhD, Associate Research Scientist

James Towey, PhD, Assistant Professor of Clinical Psychology
Stephen Fairhurst, M.S., Research Scientist II

Sensory and Memory

W. Crawford Clark, PhD, Director, Research Scientist VI
Mieko Hobara, M.A., Research Support Assistant III
Helena Knotkova, PhD, Research Associate

Clinical Chronobiology Program

Michael Terman, PhD, Director, Research Scientist VI
Jiuan Su Terman, PhD, Senior Research Worker

Current Research

Neuroimaging and Cognition Laboratory: Dr. Edward E. Smith and his colleagues in the Neuroimaging and Cognition Laboratory use cognitive paradigms and neuroimaging techniques to study cognitive and affective deficits in various psychiatric disorders, including schizophrenia, depression, and anxiety disorders (particularly OCD and PTSD). The major imaging method is functional Magnetic Resonance Imaging (fMRI); the major topic areas are working memory, cognitive control, and stress.

One working memory (WM) project is concerned with determining why the well-known Schizophrenic deficit in WM is sometimes associated with reduced neural activity in the dorsolateral prefrontal cortex, and sometimes with increased neural activity in this area. In addition, the Division are currently collaborating with Drs. Anissa Abi-Dargham and Joy Hirsch (PICS) on studies relating altered neural activation in schizophrenia to alterations in cortical dopamine levels. In another WM project, investigators are using both fMRI and electrophysiological measures to determine why patients with schizophrenia are so vulnerable to interference in memory. This work is being done in conjunction with Drs. Gerald Bruder and Jürgen Kayser. And another WM project is concerned with the detrimental effects of stress on WM, as mediated by cortisol increases, particularly in patients with PTSD. This work is being done in collaboration with three members of the Psychiatry Department of the University of Michigan (Drs. Abelson, Liberzon, and Taylor).

A different kind of project concerns deficits in cognitive control (e.g., selective attention, inhibition) in schizophrenia. Here the Division's researchers are using fMRI studies to uncover different kinds of inhibitory mechanisms, and to show that patients with schizophrenia are differentially impaired on the different mechanisms (indeed, they appear to be intact on some inhibitory mechanisms). This work is being done in conjunction with Dr. Chara Malapani, and the group has already begun to extend it to studies with OCD patients. We note that deficits in cognitive control and deficits in WM are perhaps the two most common cognitive deficits in schizophrenia, and a better understanding of them could lead to substantial improvements in the quality of life of these patients.

Psychophysiology Laboratory: The Psychophysiology Laboratory uses quantitative EEG, brain event-related potentials (ERPs), and behavioral measures to study cognitive and neurophysiologic function in schizophrenia, depressive disorders, and healthy adults. Drs. Bruder, Tenke and Kayser, in collaboration with the Depression Evaluation Service (DES), received an NIMH grant to continue their studies of right-left brain asymmetry and cognitive function in depressive disorders. Most recently, they replicated prior findings suggesting the potential of EEG measures of alpha power and asymmetry as predictors of therapeutic response to an SSRI antidepressant and found that these EEG predictors are reliable and stable following treatment. In their current study, resting EEG, auditory ERPs, and behavioral measures are being obtained before treatment, after one week of treatment with an SSRI antidepressant, an NDRI antidepressant, or both antidepressants, and again after 8-12 weeks of treatment. As part of Dr. Myrna Weissman's longitudinal, high risk study of depression, grandchildren having both a depressed parent and grandparent showed the same pattern of EEG alpha asymmetry seen in adolescents and adults having a depressive disorder and in offspring of parents concordant for major depression. This supports the hypothesis that the EEG alpha asymmetry represents an endophenotypic marker of vulnerability for a familial form of depression. Dr. Kayser also received an NIMH grant to begin studies of olfaction and emotional function in depressed patients. The measurement of behavioral and neurophysiologic responses to pleasant and unpleasant odors should provide a new window for studying abnormalities of emotional reactivity in depression.

Along with members of the Lieber Center, they also continued their NIMH-funded studies of brain event-related potentials (ERPs) and cognitive function in schizophrenia. In their current study, brain ERPs of schizophrenic patients and healthy controls are being recorded during both working memory and continuous recognition memory tests with word and face stimuli. The aim is to study the neurophysiology of memory deficits in schizophrenia and to examine whether these deficits are specific to verbal or nonverbal information processing or represent more general deficits in cognitive function. Drs. Kayser and Tenke also continued their work developing advanced techniques for processing electrophysiologic data, which are being applied in the above studies of schizophrenia and depression.

Cognitive Electrophysiology Laboratory: Dr. David Friedman and his colleagues in the Cognitive Electrophysiology Laboratory are involved in a series of interlocking investigations concerned with cognitive event-related brain potentials (ERPs) recorded from the scalp. Projects include memory, attention and executive function in normal development and aging. A recent addition has been functional magnetic resonance imaging to investigate the brain regions recruited in the variety of cognitive processes under study. The cognitive aging project is directed at understanding basic executive and memory processes and how they change, in relationship to brain activity, with normal aging. Findings from this NIA-funded project are consistent with deficiencies in executive processing underlying the well-documented age-related deficit in episodic memory. In the NICHD-funded project on cognitive development, studies of executive processes and recognition memory implicate immature frontal lobe function as a factor in the lower episodic memory performance of children compared to young adults.

Center of Prevention & Evaluation (COPE): Dr. Corcoran and her colleagues in the Center of Prevention and Evaluation evaluate clinical risk for psychosis in adolescents and young adults, a risk state that is characterized by subtle cognitive effects, affective symptoms, sub-threshold positive symptoms, and decrements in social and academic function. COPE has been supported by awards from private (NARSAD (seven), Irving (three), Pissetsky (four), Kempf (one), Janssen (one), Sackler (two)), federal (NIMH) and state funding; and has enrolled fifty subjects thus far. The research goal is to integrate the tools of neuroscience (imaging, genetics, and animal models) with clinical research strategies to study evolving symptoms in psychotic disorders. Specific aims of this clinical research program are to 1) characterize this high risk state; 2) identify risk and protective factors; 3) follow markers of evolving illness or symptom resolution; and 4) ultimately, to develop safe and effective services and interventions to prevent the onset of psychosis and improve current function.

There are several collaborations with other investigators, both within and outside of the Cognitive Neuroscience Division, to address the specific aims of identifying phenomenology and biomarkers in this prodromal or high-risk period:

- Proximal exposures, such as drug use and stress, and temporal associations with symptoms and function.
 - Cannabis: Dr. Corcoran has shown that cannabis use is temporally associated with severity of anxiety, perceptual disturbances, and functional impairment. Dr. Nehal Vadhan (of Substance Abuse) has a NARSAD Young Investigator Award (2008) to evaluate effects on working memory in high risk patients of cannabis smoking in the laboratory.
 - Stress: Dr. Thompson, a NARSAD Young Investigator, has funding to evaluate clinical, endocrine, and autonomic responses to a laboratory stressor in clinical high risk patients. She has a manuscript in press describing the prevalence of early trauma exposure in a clinical high risk cohort and its associations with positive symptoms.
- Cognitive Neuroscience:
 - Event-Related potentials: In collaboration with Drs. Bruder, Kayser and Tenke, auditory and olfactory ERPs will be evaluated as potential biomarkers of risk for schizophrenia which may be related also to concurrent social dysfunction.
 - Neuropsychology: High-risk patients have a full neuropsychological battery, overseen by John Keilp (Molecular Imaging and Neuropathology).
 - Translational studies: Drs. Holly Moore and Victoria Cressman probe the social dysfunction in high-risk adolescents to determine if it is related to social anxiety, social anhedonia, or lack of social skills. This will inform their studies of neurocircuitry in their MAM rodent model of schizophrenia.
- Neuroimaging:
 - Multimodal imaging: In collaboration with Dr. Bradley Peterson, clinical high risk patients have longitudinal multimodal imaging to identify markers of illness risk and progression. Modes include structural and functional imaging, spectroscopy, and diffusion tensor. Dr. Tiziano Colibazzi has received a NARSAD Young Investigator Award, Sackler Award and CTSA Irving Award for this work.

- High-resolution functional imaging: Mentored by Dr. Scott Small, Dr. Scott Schobel has a Janssen, NARSAD and CTSA Irving Award to evaluate high-resolution functional imaging in high risk patients, in schizophrenia patients, and in animal models of schizophrenia. Dr. Schobel has a manuscript in review demonstrating a positive predictive value of 80% for psychosis associated with baseline hippocampal CA1 hyperactivity.
- Phenomenology: Dr. Michael Birnbaum is undertaking qualitative research with both high-risk patients and family members to understand the evolution of symptoms, and its relation to help-seeking strategies and stigma.
- Services and treatment: As a Beck Scholar, Dr. David Kimhy (of Services) evaluates metacognition and oversees the use of cognitive behavioural therapy and experience sampling in high-risk patients. Dr. Susan Essock (Director of Services) has consulted on program development at COPE and its effort to meet the NYS OMH mission of illness prevention.

Timing and Cognition Laboratory: The Timing and Cognition laboratory is a merge of the "Temporal Cognition Laboratory" (from the prior Division of Biopsychology) and the "Adaptive Behavioral Laboratory" (Barnard College). The laboratory studies how a time organizes cognition and behavior. The first goal is to create a phenotypic characterization of temporally distorted aspects of learning and behavior that characterize several major neurological and mental disorders i.e. depression, drug-abuse, schizophrenia, as well as, Parkinson's disease and other movement disorders. The second goal is to identify the neural circuitry underlying specific patterns of timing errors associated with distinct behavioral phenotypes and/or diseased entities. The work is an interplay between basic and clinical research and draws on behavioral and cognitive neuroscience, computer modeling, and neuropsychological and psychiatric patient profiling.

Dr. Peter Balsam is supervising the animal research in the lab, which is currently focused on understanding how time is learned and used to guide behavior. The lab is studying the mechanisms of adaptive behavior and how they might be altered in animal models of psychiatric disorders. In an NIMH funded project the lab studies how animals learn about time and use it to guide behavior. Additionally, this project examines how temporal information processing is changed by alterations in dopaminergic function. One project along these lines being done in collaboration with the labs of Drs. Eric Kandel and Christoph Kellendonk (Columbia University) is analyzing and seeking to remediate the timing and motivational deficits found in a transgenic mouse line that like schizophrenic patients, exhibits an increased level of dopamine D2 receptor activity in the striatum. In a related NIDA funded project researchers are studying how dopaminergic function changes over the course of learning in collaboration with Dr. Jon Horvitz (City College) and Dr. Mark West (Rutgers University). We are also examining the brain circuits involved in temporal information processing in studies that employ transcranial magnetic stimulation to alter cortical function. These latter studies are funded by DARPA and done in collaboration with Dr. Holly Lisanby (Division of Brain Stimulation).

Dr. Malapani continues her studies of functional and neural mechanisms of time perception and temporal memory in humans as well as animals. The human research focuses upon abnormalities of the time sense in patients with degenerative diseases, especially of the basal ganglia, e.g., Parkinson's disease (PD) and Huntington's disease (HD). This research seeks to both understand the basic neural mechanisms of timing and to use cognitive processing as a means of early detection and diagnosis. In collaboration with Dr. John Rinzel (New York University) and Eric Brown (University of Washington) Dr. Malapani continues her work in modeling the separable encoding and retrieval distortions in PD based on the lab's research on temporal psychophysics. In collaboration with Daniela Brunner (VP at PsychoGenics) and Dr. Trevor Penney (University of Hong Kong), Dr Malapani pursued translational research that uses similar tasks in patients with HD and in an animal model of HD (a review paper is currently under preparation).

Dr. Malapani followed up her prior work with Deep Brain Stimulation in collaboration with the movement disorders clinic at the Neurological Institute studying PD patients with subthalamic DBS. Computational modeling of the DBS data has been also pursued in collaboration with Drs. Rinzel and Brown. This study extends prior work, which showed partial recovery of timing deficits with subthalamic stimulation, by controlling for placebo (sham-DBS) effects and combined effects of DBS and dopaminergic medications. Therefore, timing results may suggest localization, and can be correlated with other measures of behavior. The preliminary results of the project are promising and should make great advances in understanding the relationship between impulsivity and timing mechanisms. A NINDS RO1 grant that focuses on "modeling DBS and L-Dopa effects of parkinsonian timing" is currently pending.

Dr. Malapani continued new research direction that was initiated two years ago in collaboration with Drs. Gerard Bruder and James Towey, studying deficits in temporal cognition among psychiatric patients diagnosed with schizophrenia (SZ). Dr. Malapani presented the findings of the first completed study of the project at the Lieber Center. The results show that compared to normal controls time estimates by schizophrenic patients when reproducing three target durations were, on average, equivalent in terms of time reproduction accuracy, but the patients were significantly more variable than the controls. The effects were larger in unmedicated patients and correlation analyses suggest that the deficit results from distortions in temporal (working) memory, while perceptual discrimination or attentional performance does not predict the timing distortions in schizophrenia. A paper on the findings is currently under preparation. The timing tasks that were used in this study were developed in Dr Malapani's lab in collaboration with Dr. Claudette Fortin (University of Quebec) and Dr. Warren Meck (Duke University). The validation of this task in young college students is reported in a paper that is currently in press at the Journal of Learning & Motivation (Fortin et al, 2008). A developmental study across the life span that studies children, young adults and aged subjects with the same task has also been completed and a paper is currently in preparation.

A collaborative study with Dr. Peter Balsam, Dr. Janet Metcalfe (Hillside Hospital) and Dr. Malapani asks whether timing deficits seen in one of Dr. Balsam's study generalize across production and perception timing tasks and across different time ranges in schizophrenics. It also asks whether deficits of agency are independent of timing distortions using meta-cognition tasks.

In collaboration with Dr. Peter Balsam, Dr Malapani pursues animal studies, which are focused on understanding how time is learned and used to guide behavior and search to clarify the role of dopaminergic systems in timing behavior. In this NIMH and NIDA supported work the roles of dopamine in the learning and retrieval of temporal information are being explored. In collaboration with the laboratories of Dr. Claudia Schmauss and Dr. Marcelo Rubenstein (University of Buenos Aires) various strains of mice with altered dopaminergic function are being studied in this project. Dr. Malapani presented data from D2, D3 and D4 KO mice at the Society of Neuroscience meeting last year. The paper reporting these findings is currently under preparation.

In recent years, the members of the Timing and Cognition Lab have added new areas of human research aimed in part at translating the basic science into practical application. For example, Dr. Malapani's work on the retrieval distortion associated with PD led to a new line of experiments exploring the role of distinct kinds of feedback in correcting those deficits. This work was published earlier this year (Rakitin and Malapani, 2008). This research is a follow up of previous studies that looked at the effects of dopaminergic drugs on timing distortions seen with aging, which is being conducted in collaboration with Drs. Yaakov Stern and Brian Rakitin (Sergievsky Center, Department of Neurology and Cognitive Neuroscience). Additionally, Drs. Malapani and Balsam are collaborating with Drs. Carl Hart and Sandra Comer (Columbia University) on how drugs abuse and anticipation of these drugs affects temporal information processing. Finally, Dr. Malapani in collaboration with Drs. Ed Smith and Gerard Bruder are looking into defining deficits of cognitive control in schizophrenics at different levels of cognitive processing using a battery of cognitive tasks and fMRI. The project is underway and this year Drs. Smith and Malapani collected preliminary data with a working memory task ("ignore-suppress") in schizophrenic patients and young control subjects. The findings are promising and are currently being used as preliminary data for a NIMH grant submission early next year.

Sensory and Memory Unit: A final report was submitted to NIH on the research supported by a five year grant titled: Gender Differences in Pain Sensation and Pain Report, from the National Institute of Craniofacial and Dental Research.

The NICDR study employed both the statistical decision-making model and the multidimensional individual differences scaling (INDSCAL) model to the assessment of gender differences in responses to calibrated noxious and non-noxious stimuli. The statistical decision-making model yielded a number of findings that are contrary to reports in the literature that used the traditional method of serial exploration (or "limits") to determine threshold. This is because the threshold measure fails to distinguish between neurosensory sensitivity and report bias (e.g., degree of stoicism). The findings based on statistical decision-making theory demonstrated that the threshold measure is more influenced by response bias, B, (a measure of the subject's attitude) than, as is mistakenly thought, a measure of neurosensory function, P(A). These findings show, contrary to threshold studies, that fast-rising and slow-rising noxious stimuli do not differentially stimulate the two neurosensory systems (C- and A-delta fibers) that mediate pain.

In a study with Dr. Dorm and colleagues University of North Carolina, Chapel Hill), using the statistical decision theory model, found that patients suffering irritable bowel disease reported more pain to calibrated rectal pressure stimuli than did healthy controls, and that this difference was caused by their less stoical attitude (B), not, as is commonly thought by injury to their gut, P(A).

The most important finding was that the stimulus coordinates of the single dimension obtained by Multidimensional Individual Difference Scaling of a combined set of verbal descriptors and calibrated physical stimuli could be plotted against a physical scale (in this case 0-250 milliwatts) to construct patient rating scales at the interval, rather than ordinal, level of measurement precision. This now makes it possible to apply more precise parametric, rather than non-parametric statistical tests to differences between: patient groups, diagnostic tests and evaluation of various treatment strategies. Another study demonstrated that this approach is far superior to the commonly used Stevens' Magnitude Estimation Procedure for sensory scaling. Papers based on these studies are under editorial review.

In a study with Dr. Chokhavatia and others at Mount Sinai Medical Center it was found that the medical staff failed to collect adequate data from patients concerning the emotional aspects of their illness. And in another study it demonstrated that patients with irritable bowel syndrome manage to cope fairly well with their disease even though many are often suffering from pain.

Other studies were conducted with associates in Japan and China; researchers demonstrated widespread cultural and gender differences in the public expression of pain. Americans, as well as women of all nationalities, are more willing to exhibit pain behavior. These differences are important to recognize when treating patients more stoical from other national or cultural groups.

Clinical Chronobiology Program: The rapidly expanding clinical domain of light therapy to nonseasonal depressions – including treatment-resistant depression first investigated in NYSPI inpatients – was laid out by Dr. Michael Terman in Sleep Medicine Reviews, and has become one of the top downloaded papers in the journal's history. With colleagues Drs. Anna Wirz-Justice (Basel) and Francesco Benedetti (Milan), he is preparing the first treatment manual for psychiatric chronotherapeutics (combining light, wake and sleep phase advance therapies). With Dr. Thomas M. White (NYS Office of Mental Health), Dr. Terman showed that in a sample of over 5000 web respondents the incidence of winter depression rises linearly with latitude across the lower half the U.S., but then levels off. Above 38° north, depression rises toward the west of each time zone, which they attribute to later sunrise. The Termans completed an FDA Phase I trial of a new low-dose (0.2 mg) formulation of controlled-release melatonin, designed to facilitate phase-advance shifts of the internal circadian pacemaker system without causing a direct soporific effect. The results demonstrated equivalent timing of washout for both the drug and endogenous pineal melatonin (Columbia patent pending).

Education and Training

COPE has provided research and clinical training to a number of medical students, psychiatry residents, psychology interns and externs, volunteers and social work students. Visiting fellows have returned to Israel, Singapore and Spain to set up similar early identification clinical research programs.

Dr. James Towe continues to direct a unique training program for minority undergraduate students. Most are pre-baccalaureate NRSA fellows who received support from NIMH's Career Opportunities in Research (COR) Training Program. The main objective is to increase the diversity of doctoral-level researchers in mental health fields. Mentors for research training at Psychiatric Institute include Drs. Peter Balsam, Hector Bird, Adam Bisaga, Gerard Bruder, Madelyn Gould, Christina Hoven, Sarah Lisanby, Bruce Luber, Chara Malapani, John Martin, Michael Myers, Harry Shair and Rikki Waterhouse. Last year, NIMH granted a highly competitive renewal for this training grant, COR Training of Mercy Scholars at Psychiatric Institute.

Dr. Clark is a Mentor to Dr. N. Sonty in the Department of Anesthesiology. Together they are working on a grant application to NIH on improving the treatment of back-pain patients. He is assisting Dr. J. Brown, (Child Advocacy Group, Department of Pediatrics) to develop a questionnaire to aid health givers to distinguish injuries caused by child abuse from those due to accidents. He is also mentoring a graduate student from the Department of Psychology at Columbia University who plans to use statistical decision-making theory to study the responses of schizophrenic patients to noxious cold stimuli at NYSPI.

Clinical Services

The Clinical Chronobiology Program at Columbia University Medical Center, directed by Dr. Michael Terman, serves a broad national and international patient base with supervision of light treatment both as monotherapy and in conjunction with melatonin or antidepressant medication "treatment as usual." The Psychophysiology Laboratory records clinical EEGs for inpatient and outpatient services at Psychiatric Institute.

Grant Awards

NIH RO1 grant, Behavioral, ERP, and EEG Asymmetry in Affective Disorders, G. Bruder, PI.

NIH R21 grant, Olfaction and Emotion in Depression: Behavioral, Electrodermal and ERP Measures, J. Kayser, PI.

Dr. Clark received a continuing grant from the Nathaniel Wharton Fund for Research and Education in Brain, Body and Behavior.

Awards and Honors

Dr. Cheryl Corcoran received the Florence T. Irving Award. Four NARSAD Young Investigator Awards were funded in 2008 for prodromal research (Thompson, Schobel, Colibazzi, Vadhan), two CTSA Irving Awards (Schobel, Colibazzi), 1 Sackler Award (Colibazzi), one Janssen Award (Schobel with Corcoran as clinical mentor; Small as basic science mentor).

Highlights

Drs. Bruder and Tenke, in collaboration with Drs. Stewart and McGrath, are finding that EEG measures are of potential value for predicting whether a depressed patient will benefit from treatment with an SSRI antidepressant.

Publications

Bodkin, LL, Singh, A & Corcoran, C: Cannabis as a risk factor for psychosis in vulnerable teens: Implications for treatment. *Primary Psychiatry*, 2008; 15:51-57.

Bruder, GE, Sedoruk, JP, Stewart, JW, McGrath, PJ, Quitkin, FM & Tenke, CE: Electroencephalographic alpha measures predict therapeutic response to a selective serotonin reuptake inhibitor antidepressant: Pre- and post-treatment findings. *Biol Psychiatry*, 2008; 63:1171-1177.

Bruder, GE, Stewart, JW, Schaller, JD & McGrath, PJ: Predicting therapeutic response to secondary treatment with bupropion: Dichotic listening tests of functional brain asymmetry. *Psychiatry Res*, 2007; 153:137-143.

Bruder, GE, Tenke, CE, Warner, V & Weissman, MM: Grandchildren at high and low risk for depression differ in EEG measures of regional brain asymmetry. *Biol Psychiatry*, 2007; 62:1317-1323.

Bruder-Costello, B, Warner, V, Talati, A, Nomura, Y, Bruder, G & Weissman, M: Temperament among offspring at high and low risk for depression. *Psychiatry Res*, 2007; 153:145-151.

Corcoran, C, Gerson, R, Sills-Shahar, R, Nickou, C, Mcglashan, T, Malaspina, D & Davidson, L: Trajectory to a first episode of psychosis: A qualitative research study with families. *Early Intervention in Psychiatry*, 2007; 1:308-315.

Czernochowski, D, Fabiani, M & Friedman, D: Use it or lose it? SES mitigates age-related decline in a recency/recognition task. *Neurobiology of Aging*, 2008; 29:945-958.

Dorn, SD, Palsson, OS, Thiwan, SI, Kanazawa, M, Clark, WC, Van Tilburg, MA, Drossman, DA, Scarlett, Y, Levy, RL, Ringel, Y, Crowell, MD, Olden, KW & Whitehead, WE: Increased

colonic pain sensitivity in irritable bowel syndrome is the result of an increased tendency to report pain rather than increased neurosensory sensitivity. *Gut*, 2007; 56:1202-1209.

Drew, MR, Simpson, EH, Kellendonk, C, Herzberg, WG, Lipatova, O, Fairhurst, S, Kandel, ER, Malapani, C & Balsam, PD: Transient overexpression of striatal d2 receptors impairs operant motivation and interval timing. *J Neurosci*, 2007; 27:7731-7739.

Friedman, D, Nessler, D & Johnson, R, Jr: Memory encoding and retrieval in the aging brain. *Clin EEG Neurosci*, 2007; 38:2-7 Jan.

Friedman, D, Nessler, D, Johnson, R, Jr, Ritter, W & Bersick, M: Age-related changes in executive function: An event-related potential (ERP) investigation of task-switching. *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn*, 2008; 15:95-128.

Goetz, RR, Corcoran, C, Yale, S, Stanford, AD, Kimhy, D, Amador, X & Malaspina, D: Validity of a 'proxy' for the deficit syndrome derived from the positive and negative syndrome scale (PANSS). *Schizophr Res*, 2007; 93:169-177.

Kayser, J, Tenke, CE, Gates, NA & Bruder, GE: Reference-independent ERP old/new effects of auditory and visual word recognition memory: Joint extraction of stimulus- and response-locked neuronal generator patterns. *Psychophysiology*, 2007; 44:949-967.

Kimhy, D, Corcoran, C, Harkavy-Friedman, JM, Ritzler, B, Javitt, DC & Malaspina, D: Visual form perception: A comparison of individuals at high risk for psychosis, recent onset schizophrenia and chronic schizophrenia. *Schizophr Res*, 2007; 97:25-34.

Lieberman, J & Corcoran, C: The impossible dream: Can psychiatry prevent psychosis? *Early Intervention in Psychiatry*, 2007; 1:219-221

Luber, B, Balsam, P, Nguyen, T, Gross, M & Lisanby, SH: Classical conditioned learning using transcranial magnetic stimulation. *Exp Brain Res*, 2007; 183:361-369.

Nessler, D, Friedman, D, Johnson, R, Jr & Bersick, M: Does repetition engender the same retrieval processes in young and older adults? *Neuroreport*, 2007; 18:1837-1840.

Nessler, D, Friedman, D, Johnson, R, Jr & Bersick, M: ERPs suggest that age affects cognitive control but not response conflict detection. *Neurobiol Aging*, 2007; 28:1769-1782.

Nessler, D, Johnson, R, Jr., Bersick, M & Friedman, D: Age-related ERP differences at retrieval persist despite age-invariant performance and left-frontal negativity during encoding. *Neurosci Lett*, 2008; 432:151-156.

Rakitin, BC & Malapani, C: Effects of feedback on time production errors in aging participants. *Brain Res Bull*, 2008; 75:23-33.

Sit, D, Wisner, KL, Hanusa, BH, Stull, S & Terman, M: Light therapy for bipolar disorder: A case series in women. *Bipolar Disord*, 2007; 9:918-927.

Smith, EE: The case for implicit category learning. *Cogn Affect Behav Neurosci*, 2008; 8:3-16.

Smith, EE & Grossman, M: Multiple systems of category learning. *Neurosci Biobehav Rev*, 2008; 32:249-264.

Pfirman, S, Balsam, P, Bell, RE, Laird, JD, Culligan, P: Maximizing Productivity and Recognition, Part 1: Publication, Citation, and Impact.
http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2007_11_02/caredit.a0700155.

Pfirman, S, Balsam, P, Bell, RE, Culligan, P, Laird, JD: Maximizing Productivity and Recognition, Part 2: Collaboration and Networking.
http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2008_02_01/caredit.a0800016.

Stanford, AD, Sharif, Z, Corcoran, C, Urban, N, Malaspina, D & Lisanby, SH: RTMs strategies for the study and treatment of schizophrenia: A review. *Int J Neuropsychopharmacol*, 2008; 11:563-576.

Taylor, KM, Joseph, VT, Balsam, PD & Bitterman, ME: Target-absent controls in blocking experiments with rats. *Learn Behav*, 2008; 36:145-148.

Tenke, CE, Kayser, J, Shankman, SA, Griggs, CB, Leite, P, Stewart, JW & Bruder, GE: Hemispatial PCA dissociates temporal from parietal ERP generator patterns: CSD components in healthy adults and depressed patients during a dichotic oddball task. *Int J Psychophysiol*, 2008; 67:1-16.

Terman, M: Evolving applications of light therapy. *Sleep Med Rev*, 2007; 11:497-507.

Terman M: Addressing seasonal affective disorder. *Journal of Employee Assistance*, 2007; 37; 10-11.

Terman M: Sleep. In: *Approach to the Psychiatric Patient: Case-Based Essays*, Barnhill JW, Ed. American Psychiatric Press, 2008.