

**Annual Report of the Sackler Institute/Weill Medical College of Cornell University
July 2003-July 2004**

Under the continued direction of Dr. B.J. Casey, the Institute's international reputation in research and training in the field of human brain development is at an all-time high, with over 100 publications this year and an increasing number of international faculty and fellows spending sabbaticals, internships, and summers at the Institute (see Education, Training and Outreach). The Institute's network has broadened this past year with collaborations now formally established with Boston College, Brown University and NYU in addition to existing ones at Cornell-Ithaca, Princeton, Yale, Columbia, Duke, UC-Berkeley, Stanford, Brookhaven, Mt. Sinai, U. Penn, UC-Irvine, University of Pittsburgh, NIMH, Rockefeller and Oregon and with research fellows from U-Penn, UCLA, Minnesota, Greece, the Netherlands, Germany, Spain, Nottingham, Switzerland, and the University College London.

Academic Faculty and Staff for 2003-2004

Faculty:

Michael Posner, Ph.D., Director Emeritus
B.J. Casey, Ph.D., Director and Sackler Professor
James Swanson, Ph.D., Professor (Affiliation at Sackler and UC-Irvine)
Bruce D. McCandliss, Ph.D., Assistant Professor of Psychology
John Fossella, Ph.D., Assistant Professor of Molecular Biology
Michael Worden, Ph.D., Assistant Research Professor
Matthew Davidson, Ph.D., Instructor

Staff:

Clayton Eccard, Administrator
Elizabeth Dibble, Research Assistant
Lisa Ochs, Research Assistant
Julie Spicer, Research Assistant
Michael Wolmetz, Research Assistant
Robert Colvin, Research Assistant

Sackler Fellows for 2003-2004

Postdoctoral Fellows:

Inge-Marie Eigsti, PhD, Joint Columbia and Cornell Sackler Fellow (Casey)
Barbara Ganzel, PhD, Ithaca Fellow (Casey)
Eleni Kotsoni, PhD, Sackler Fellow (Casey)
Urs Maurer, PhD, Sackler Fellow (McCandliss)
Jason Zevin, PhD, Sackler Fellow (McCandliss)

Predocctoral Fellows:

Vera Blau, PhD student, University of Maastricht, the Netherlands (McCandliss)
Adriana Galvin, PhD student, Neuroscience (Casey)
Todd Hare, PhD student, Neuroscience (Casey)
Conor Liston, MD PhD student, Tri-Institutional Program (Casey)
Kim Noble, MD, PhD student, University of Pennsylvania (McCandliss)
Maria Ruz, PhD student Spain, Fulbright Scholar (McCandliss)
Nim Tottenham, PhD student, University of Minnesota (Casey)

Program of Research

A significant number of empirical studies have been completed and published using brain imaging, genetics, high density EEG, and behavioral methods, to study populations from childhood to adulthood (see Publications). Below, are highlights from research studies in six different areas: perception, attention, learning, affect and cognitive control, genomics and clinical populations. A significant objective of the Sackler Institute is in education, training and outreach. Efforts in this area are highlighted followed by a list of grants, awards and publications including 5 books and edited volumes.

1) Studies of Perception

Ongoing Projects:

Dr. Bruce McCandliss and Fulbright Scholar, Maria Ruz from Spain, continue to investigate the extent to which word reading is automatic. Their electrophysiological results suggest that word processing, is an automatized process that takes place even when attention is engaged in a simultaneous demanding task (Ruz et al., submitted).

Dr. BJ Casey and PhD candidate, Nim Tottenham, have developed behavioral assays for measuring subconscious perceptual processing of faces and objects in children. Given the vast experience with faces, the finding that children process faces faster than other objects (houses) suggests that extensive experience with one class of objects can affect the speed of processing of these objects over others and explain developmental differences consistently found in the literature on face processing. Parallel imaging studies show that activity of the fusiform face area can be modulated by attention to or away from a face stimulus. This groundbreaking developmental research is important for understanding developmental disorders that appear to process faces differently (e.g. autism).

New Projects:

Drs. Bruce McCandliss and Jason Zevin are examining the development of speech perception in American and Japanese native speakers. Specifically they are examining cognitive and neural basis for learning distinct sounds early in life depending on the degree of experience with these sounds. This work is funded by a NRSA postdoctoral fellowship to Dr. Zevin.

Drs. Casey and Worden are collaborating with Dr. Scott Johnson of NYU on ERP studies of visual perception in infants as they view occluded objects. These studies will constrain current developmental theory on how infants learn to recognize violations in expectations about objects that are occluded.

2) Studies of Attention

On-going Projects:

Drs. McCandliss, Posner and Fan continue their work related to the NSF funded project on “Attention and the learning of literacy and numeracy”. This ongoing project examines techniques for measuring brain mechanisms of attention in adults and children, and explores methods of enhancing attention abilities in children. During this last year the majority of activity on this project focused on investigations of the conflict network in adults, examining the role of linguistic and non-linguistic information as sources of conflict. Results, recently published in NeuroImage (Fan et al., 2003) demonstrate that both linguistic and nonlinguistic forms of conflict activate similar regions of the anterior cingulate cortex, which might be linked most closely to conflict monitoring, yet activates

distinct inferior frontal regions. In addition, they have begun screening first grade children from New York City public elementary schools. Children demonstrating deficits in executive function will be invited to participate in fMRI scans of activity related to attention.

Drs. Casey and Matthew Davidson, as part of a Conte Center on Attentional Conflict and Control, are examining attention switching in children and adults using both behavioral and imaging measures. An important component of attention is the ability to switch attention between competing inputs. This year the Institute published findings showing early development of attention switching when the switch occurred without conscious awareness (Casey et al. 2004, *Developmental Science*), but a lag in children's ability to switch attention when consciously cued to do so (Davidson et al., 2004 *J. Cog Neuro* abstract). The results suggest an important role of the caudate nucleus in simple task switching across development with increasing recruitment of cortical regions with maturity.

New Projects:

Drs. BJ Casey and Michael Worden together with Dr. Gaia Scerif, of Nottingham, have been examining mechanisms underlying focusing of attention using a spot light analogy and a combination of high density ERP and fMRI methods (Worden et al., 2004 *J. Cog Neuro* abstract). The preliminary results suggest a very early posterior system plays a role in directing attention instead of a hypothesized later prefrontal system.

3) Studies of Cognitive and Affective Control

On-going Projects:

The Sackler Institute has been working on a number of cognitive control tasks that would allow us to understand the development of control systems from childhood to adulthood and atypical development of this system in children with developmental disorders. Two theoretical papers that integrate much of this work will be published this year (see Casey, in press; Casey, Amso & Davidson, submitted).

Work funded by a NIDA R21 grant to Dr. Casey examines the development of prediction and reward related circuitry implicated in substance abuse (Davidson et al., submitted; Casey et al., submitted). Dr. Davidson, a postdoctoral fellow with Dr. Casey has taken the lead on these studies in collaboration with Dr. Jon Hortvitz of Boston College and Dr. John Fossella of the Institute. Preliminary findings suggest that adolescents have exaggerated responses in dopamine rich frontostriatal regions that may explain the greater risk of substance abuse during this period. This task is currently being exported to Brookhaven and Brown University in the context of substance abuse related research and built the foundation for a currently pending NIDA R01 grant application submitted by Dr. Casey.

Drs. Jin Fan, Mike Posner, Mike Worden and John Fossella have been using a combination of high-density EEG and fMRI to explore the interaction that occurs between different prefrontal, frontal-midline and other brain areas associated with subjects monitoring their own behavior and mistakes. Such work may prove significant when investigating disorders such as ADHD and conduct disorder. This work was recently presented as part of an invited symposium at the Cognitive Neuroscience Society meeting.

New Projects:

Last year the Institute began relating new imaging techniques to behavioral and existing imaging methods. One such method is that of diffusion tensor imaging- a relatively new technique to assess

directionality and myelination of axonal tracts in vivo in the developing human brain. Conor Liston, a tri-institutional MD, PhD student and Sumit Niogi, a Physiology PhD student together with Dr. Casey and Dr. Richard Watts, a physicist in New Zealand, have begun to examine connectivity of frontostriatal pathways implicated in cognitive control (Watt et al. 2003; Liston et al. submitted). They have shown that average diffusion in frontostriatal white matter decreases with age and that decreased diffusion perpendicular to a tract, which should be maximally sensitive to changes in myelination, correlates with efficiency in performing a cognitive control task (Go/NoGo test). Average diffusion in occipital lobe white matter also decreases with age, but is not significantly correlated with behavior in the Go/NoGo paradigm showing specificity of the association between performance and frontostriatal connectivity.

Drs. Casey and Fossella are working with Drs. Walter Mischel and Inge-Marie Eigsti of Columbia University to relate the ability of preschoolers to delay gratification with measures of cognitive control now that they are adolescents. Preliminary results suggest those individuals most able to delay or wait for a reward, as a toddler, are better able to resolve conflict on cognitive control tasks as adolescents. We are currently genotyping these subjects to examine genes that may explain the observed individual differences in this ability.

Dr. Casey together with Todd Hare, a Neuroscience PhD student and Nim Tottenham, a Minnesota PhD student are examining the interdependence of frontostriatal and frontoamygdala circuitry in affect regulation. They are using emotional facial expressions in a go-nogo together with fMRI. Whereas increases in striatal activity were shown when subjects inhibited a response to a positive expression, increases in amygdala activity were shown when subjects detected (approached) a negative expression. This emotional go-nogo paradigm should prove useful in further specifying the biological substrates of clinical populations with affect dysregulation as in anxiety disorders and major depression. Todd Hare has submitted a NRSA to support his work in this area.

4) Studies of Learning

On-going Projects

Michael Worden has been investigating the neural processes underlying perceptual learning in the visual system (see Worden et al., in press). His data support the hypothesis that extensive practice induces changes in processing in low-level visual brain areas and are mediated by feedback connections rather than by modifications of intrinsic circuitry in those low-level areas. Ongoing work in this area is attempting to further characterize the changes that occur in the visual system as a result of practice and to understand how these changes relate to visual attention, brain plasticity and reading.

Dr. McCandliss together with collaborators at University of Pittsburgh have continued to work on a project entitled “Enhancing Literacy through Tutors and Computers” This project involves the creation and initial testing of a user friendly computer program designed to guide a minimally trained tutor and a child with reading disability through 20 sessions of intervention. During this final year of the project, extensive work was completed for final debugging, the creation of extensive training materials, and initial efficacy testing of the computerized tutorial methods. An efficacy test was conducted by a group of 15 minimally trained tutors working with children in realistic school settings for 20 sessions. Improvements in reading and decoding scores were equivalent to the gains in standardized scores produced by the laboratory study upon which the intervention was based (McCandliss et al, 2002), providing an initial demonstration of efficacy which awaits validation in an active intervention control study currently underway.

Dr. McCandliss has been funded by the McDonnell Foundation to explore novel learning paradigms that

engage adults in learning a new alphabetic writing system, and novel fMRI activation tasks to measure the impact of learning. This work formed the basis for a new grant from the NSF described below.

New Projects.

Dr. McCandliss has received NSF funding to examine the biological bases of alphanumeric learning interventions. This study, in collaboration with Stanford, uses learning-based changes in fMRI responses in children to contrast different computer-based intervention programs designed for basic reading and numerical skills. A central theoretical focus involves comparisons of the neural impact of interventions that target a specific cognitive operation (i.e. parsing phonemes or comparing magnitudes) vs. interventions that attempt to integrate two sets of codes (i.e. grapheme-phoneme correspondences, number symbol-magnitude correspondences).

Dr. Casey and Neuroscience PhD student, Adriana Galvan, have been examining the impact of reward in learning. They have developed behavioral paradigms for the scanner environment that parametrically manipulate reward magnitude and frequency. This assay allows us to examine how differences in reward magnitude influence behavioral responses (accuracy and reaction time) and neural activity in dopamine-rich regions (e.g. striatum). Preliminary results suggest that reward magnitude and frequency influences behavioral performance such that subjects have the fastest reaction time to the large reward and the slowest to the small reward. This behavioral pattern parallels neural activity in the dopamine rich region of the striatum.

Dr. Casey and NYU PhD Psychology student, Dima Amso, are examining implicit learning from complex structure in the environment. They developed a paradigm that simultaneously manipulates learning based on the frequency of a event and learning based on the frequency of associations between events. This work is important in the context of habituation and novelty preference studies in infants. Little is known about the underlying neural mechanisms involved in this form of simplistic learning. Their preliminary analyses suggest that the caudate nucleus appears to be involved in learning related to frequency of a stimulus while the hippocampus appears to contribute to learning by representing new associations between events. These data suggest that different structures may underlie the organization of learning across development.

5) Genomic Investigations

Ongoing Projects:

Drs. Fan, Posner and Fossella have continued their genetic and imaging work on attentional control. Brain imaging data has repeatedly shown that the anterior cingulate gyrus (ACC) is an important node in the brain network mediating conflict. They have previously reported that polymorphisms in a dopamine receptor (DRD4) and in monoamine oxidase A (MAOA) genes showed significant associations with efficiency of handling conflict as measured by reaction time (RT) differences in the Attention Network Test (ANT). To examine whether this genetic variation might contribute to differences in brain activation, they genotyped 16 subjects for the DRD4 and MAOA genes who had been scanned during the ANT. In each of the two genes previously associated with more efficient handling of conflict in RT experiments, they found a polymorphism in which persons with the allele with better behavioral performance showed significantly more activation in the anterior cingulate while performing the ANT than those with the allele associated with worse performance. The results demonstrate how genetic differences among individuals can be linked to individual differences in neuromodulators and in the efficiency of the operation of an appropriate attentional network.

Dr. Jim Swanson has continued molecular genetic investigations of ADHD using laboratory tests to measure quantitative traits for use in candidate gene studies of the dopamine 4 receptor (DRD4) and dopamine transporter genes with colleagues at UC-Irvine. He has developed a collaboration with the National Human Genome Research Institute (NHGRI) to perform a genome scan of ADHD children and controls and has received a NIH R01 to investigate genetics of ADHD. His work has shown that genetic forms of ADHD related to the DRD4 gene show a behavioral, but not a cognitive profile.

Drs. Fossella and Casey together with Dr. Sonia Bishop of Cambridge have shown that the magnitude of the dorsolateral prefrontal cortical response evoked by emotional distractors differs between individuals with the 3- versus 4- repeat copy allele of the MAOA-LPR polymorphism. The MAOA gene plays a role in catalyzing the degradation of catecholamines. The 3 and 4- repeat copy MAOA-LPR alleles are most common, with the 4-repeat allele having 5- fold higher levels of expression and hence being associated with reduced catecholamine levels. Individuals with the 'low expression/high dopamine' 3-repeat allele showed reduced DLPFC activation when performing a matching task in the presence of emotional (versus neutral) distractors relative to individuals with the 4-repeat allele. This result is consistent with the suggestion that heightened catecholamine levels mediate a reduction in PFC activity in the presence of emotional stimuli (Fossella, Bishop & Casey, 2004).

New Projects:

Drs. Fossella, Casey, and Dr. Sarah Durston of University Medical Center Utrecht have begun to link genotype to brain morphometry in ADHD. Some of the most consistently implicated genes in ADHD have been those involved in dopaminergic neurotransmission. They are initially focusing on these genes, and looking at the gene coding for the dopamine-4 receptor (DRD4), the dopamine transporter (DAT). The DRD4 receptor is preferentially expressed in prefrontal cortex, whereas the dopamine transporter is preferentially expressed in the striatum. Therefore they hypothesized that these regions would be affected preferentially. They found a dissociation between the effects of DAT genotype and DRD4 genotype, with those heterozygous for the DAT polymorphism having smaller caudate volumes, but not smaller prefrontal gray matter volumes and those with the DRD4 variant genotype impacting prefrontal gray matter volume, but not caudate volume.

6) Clinical Studies

The Institute continues work to translate its methods for use with clinical populations. Currently our experimental assays for analyzing attentional deficits are in use by a wide range of researchers working in diverse areas such as schizophrenia, depression, anxiety, substance abuse, ADHD, OCD, autism, abuse and genetic deletion syndromes. We have continued to work with the residents in Psychiatry in joint clinical reading and research projects. In addition recent experimental results of particular relevance to clinical issues are briefly discussed below.

On-going Projects:

Dr. Casey is examining the effects of prior institutionalization on the structural and functional development of the amygdala and hippocampus using magnetic resonance imaging (MRI). She and Nim Tottenham, a PhD candidate of the U. Minnesota have examined the association of hippocampal and amygdala volume with length of institutionalization, age of institutionalization, and length of time with an adopted family, controlling for overall cerebral volume and age. The preliminary findings are provocative, suggesting an inverse relation between volumetric measures of the amygdala and hippocampus for institutionalized children but not typically developing children. These findings are

consistent with the animal and human imaging work on chronic stress leading to structural and functional changes in the hippocampus and amygdala that are inversely related. This preliminary data has resulted in a R01 submission by Dr. Casey with consultation with Dr. Bruce McEwen of The Rockefeller University.

Dr. Swanson has made progress in diagnosis, and pharmacological treatment of ADHD. His work in this area focuses on understanding the mechanisms of action of stimulant medications. The studies include: a comparative study of different preparations of methylphenidate that have been recently approved by the FDA for once-a-day administration to ADHD children; a continuation of the MTA study of the long-term effects of pharmacological and psychosocial interventions; and a continuation of the Preschool ADHD Treatment Study (PATs) that involves pre-treatment with behavioral interventions followed by treatment with methylphenidate (Swanson et al 2002)

In a related study, Dr. Casey in collaboration with Duke, Columbia, Stanford and UC Berkeley, is examining the imaging profiles of children and their parents with ADHD on behavioral assays she has developed at the Institute. Preliminary findings on this clinical population are published in *Biological Psychiatry* (see Durston et al 2003) and show abnormal patterns of brain activity in the caudate nucleus rather prefrontal regions.

Dr. Casey together with Dr. Ted Shapiro and Dr. Inge-Marie Eigsti, a joint Columbia/Cornell Sackler fellow, are examining cognitive and neural correlates of orienting in autistic patients using fMRI and a spatial cueing paradigm. Attention is directed either with arrows or face profiles to direct attention. The autistic patients appear to use the face cues differently from the typically developing comparison group. Preliminary results from this work and related studies have been published (Eigsti & Shapiro, 2003; Eigsti & Casey, in press). This work was supported by a NARSAD grant to Dr. Eigsti.

Dr. McCandliss continues his behavioral and fMRI investigations of reading skills. During this latest period he has launched initial data collection efforts involving first grade children with a test battery approved by the New York City Board of Education. He and his staff are currently collecting behavioral reading data from 150 first grade children whose parents have opted into the study following recruitment in 18 New York City public elementary schools. During the summer a subset of these children that show deficits in reading skills will be invited to participate in fMRI scans of activity related to reading.

Dr. McCandliss received a subcontract from the Brain Trauma Foundation as part of a 3 year multimillion dollar grant from the J. S. McDonnell Foundation on "Cognitive and Neurobiological Research Consortium in Traumatic Brain Injury." This project will work on identifying three separate brain networks associated with sub-components of attention (Fan, McCandliss, Somer, Raz, and Posner, 2002) to understand deficits in mild traumatic brain injury. The central hypothesis is that deficits in mild TBI can be systematically linked to specific patterns of diffuse white matter tract damage, as measured by Diffusion Tensor Imaging based fiber tract tracings.

New Projects:

Dr. McCandliss and Kim Noble, a U Penn MD, PhD student are examining neuropsychological constructs related to socioeconomic status. They have found a specific association between low SES and language skills. Preliminary findings have been published (see Noble et al., 2004; Noble et al., in press).

In collaboration with Dr. Sue Swedo of NIMH, Dr. Casey will be imaging children with chronic and episodic OCD relative to normal controls on a task that requires the subject to shift out of a behavioral set in favor of a new one (Casey et al 2002). This two-year NIH intramural contract uses a task that taps frontostriatal and frontohippocampal circuitry implicated in OCD developed by Dr. Casey.

In collaboration with colleagues at Brown University, Dr. Casey has exported cognitive control tasks that tap frontostriatal circuitry for use with prenatally exposed children to cocaine. The team is submitting a NIDA program project together.

Grants and Collaborations

Dr. Bruce McCandliss has received funding from the National Science Foundation to examine the biological bases of alphanumeric learning interventions. This study, in collaboration with Stanford, uses learning-based changes in fMRI responses in children to contrast different computer-based intervention programs designed for basic reading and numerical skills.

Dr. Barbara Ganzel has received a NIMH NRSA postdoctoral fellowship to examine anxiety related behavior in children who were near or far from the terrorist attacks on 9/11. This work is a collaboration between Cornell-Ithaca and Cornell Medical.

Dr. Casey has received funding from the John Merck Fund to continue directing a summer institute on the Biology of Developmental Disabilities. The institute trains psychologists and neurobiologists in methods used in developmental science (imaging, genetics, behavior) in the context of central themes of behavioral and brain development.

Dr. Casey has two NIH R01 grants pending: one submitted in response to NIDA-RFA on adolescent substance abuse and a second dually assigned to NICHD and NIMH on brain development following institutionalization. The later has received a score in the 18.6 percentile.

Dr. Casey will be a Co-PI on a NIDA grant submitted from Brown University on cognitive and neural correlates of prenatal exposure to cocaine.

Dr. Casey has 2 training grants that are pending on which she is Co-PI: one in the area of clinical and pediatric imaging led by Dr. Silbersweig and the other in psychology in the area of life span depression led by Dr. Susan Evans.

Todd Hare has a NIMH NRSA predoctoral grant application sponsored by Dr. Casey that is pending, on the development and neurobiology of affective regulation using fMRI.

Dana Byrd has a NIMH NRSA postdoctoral grant application sponsored by Dr. Casey that is pending, to use fMRI and high density ERP to examine development of cognitive control and conflict.

The Institute directly and in collaboration with others, has grants and awards from NSF, NIMH, NIDA, the McDonnell Foundation, the John Merck Fund, Swiss Foundation and McNeil Health Care Co. This funding supplements the generous gift by the Mortimer Sackler family.

Education, Training and Outreach

As part of the research network mission of the Institute, funded collaborations have been established with Brown, Boston College, NYU, Princeton, Yale, Columbia, Duke, UC-Berkeley, Stanford, Brookhaven, Mt. Sinai, U. Penn, UC-Irvine, University of Pittsburgh, NIMH, and Oregon. Our current pre- and postdoctoral fellows are from Spain, Norway, U-Penn, Minnesota, the Netherlands, Switzerland, Nottingham, Greece and the University College London. Locally, we have formed research collaborations with faculty at the sister Sackler Institute of Columbia and with faculty in the Lasdon Laboratories at Weill Medical College on infant and animal models of brain and behavioral development that complement the Weill Cornell Sackler Institute program of research on human brain development. Finally, last year marked the first Ithaca/Sackler predoctoral summer fellowships in biomedical research to form more collaborative ties with students and faculty at the Ithaca campus of Cornell.

The Institute has several training initiatives in addition to the Sackler/Ithaca fellowships for research opportunities for pre and postdoctoral fellows. These include a fourth annual summer institute that Dr. Casey has directed with financial support from The John Merck Fund on the Biology of Developmental Disabilities for pre and postdoctoral fellows.

The Institute actively participates in summer workshops with the Functional Neuroimaging Laboratory directed by Drs. David Silbersweig and Emily Stern as part of a Training Grant. In addition, Dr. Casey has become an active member of the Neuroscience program at Weill Medical College and is both teaching and sponsoring student rotations and PhD candidates from that program and from the Tri-institutional MD PhD program.

Dr. Casey has three publishing efforts in addition to her peer-reviewed and invited papers. She edited and published a book entitled *Developmental Psychobiology*, edited a special issue on developmental psychobiology in the journal of *Mental Retardation and Developmental Disabilities Research Reviews*. Finally, she continues to co-write her textbook on *Cognitive Developmental Neuroscience*.

Dr Posner has three current publishing efforts in the area of attention and brain development. First, he has a project with APA books to edit a series of books on *Human Brain Development*. Second, he has a project with Guilford Press to edit a book on *Attention*. Finally, together with Dante Cichetti he is co-editing a special issue of *Development and Psychopathology* on human brain development from a cognitive neuroscience perspective.

Dr. Worden has been working on software tools that serve two important functions. The first allows training of children and adults to be still in the scanning environment by use of feedback from the video display to aid suppression of movements. The second involves tools for visualization of EEG and fMRI data that can be made available to researchers through our website. In addition, he has helped make behavioral assays by institute affiliated faculty available through our website.

Dr. McCandliss continues to direct one of three networks supported by the Paris based Organization for Economic Cooperation and Development (Center for Research in Education Innovation). The networks will work to develop international cooperation on the collection, organization and dissemination of material on brain mechanisms related to education.

Dr. Casey has organized a Sackler sponsored symposium at APA on *Developmental Psychobiology* that highlights her book on this topic and highlights work at both the Columbia and Cornell Sackler Institutes.

Published papers and In Press Papers July 2002-03

Arnold, LE, Chuang S, Davies M, Abikoff HB, Conners CK, Elliott GR, Greenhill LL, Hechtman L, Hinshaw SP, Hoza B, Jensen PS, Kraemer HC, Langworthy-Lam KS, March JS, Newcorn JH, Pelham WE, Severe JB, Swanson JM, Vitiello B, Wells KC, Wigal T. (2004). Nine months of multicomponent behavioral treatment for ADHD and effectiveness of MTA fading procedures. *J Abnorm Child Psychol*, 32: 39-51.

Arnold LE, Elliott M, Sachs L, Kraemer HC, Abikoff HB, Conners CK, Greenhill LL, Hinshaw SP, Jensen PS, Newcorn JH, Severe JB, Vitiello B, Bird H, Wells KC, Comarda A, Elliott GR, Hechtman L, Hoza B, March JS, Pelham WE, Swanson JM, Wigal T. (2003). Effects of ethnicity on treatment attendance, stimulant response/dose, and 14-month outcome in ADHD. *J Consult Clin Psychol*, 71: 713-727.

Casey, BJ, Davidson, MC, Hara, Y, Thomas, KM, Martinez, A, Galvan, A, Halperin, JA, Rodríguez-Aranda, CE & Tottenham, N (in press) Early development of subcortical regions involved in noncued attention switching. *Developmental Science*.

Durston, S., Davidson, M.C., Thomas, K.M., Worden, M.S., Tottenham, N., Martinez, A., Watts, R., Ulug A.M. & Casey, B.J. (in press). Parametric Manipulation of Conflict and Response Competition using rapid mixed-trial event-related fMRI. *Neuroimage*.

Durston, S., Tottenham, N. Thomas, K.M., Davidson, M.C., Eigsti, I-M, Yang, Y., Ulug, A.M. & Casey, BJ (2003). Differential patterns of striatal activation in young children with and without ADHD. *Biological Psychiatry*

Durston S: A Review of the Biological Bases of ADHD: What have we learned from imaging studies? (2003) *Ment Retard Dev Disabil Res Rev*,

Eigsti, IM & Cicchetti, D (2004). The impact of child maltreatment on expressive syntax at 60 months. *Developmental Science*, 7, 88-102.

Eigsti, IM & Casey, BJ (in press). Functional imaging of autism spectrum disorders. *Pediatric Rehabilitation*.

Eigsti, IM & Shapiro, T (2003). A systems neuroscience approach to autism: Biological, cognitive and clinical perspectives. *Mental Retardation and Developmental Disabilities Review*, 9, 205-215.

Fan, J., Fossella, J.A., Sommer, T., Wu, Y., & Posner M.I. (2003). Mapping the genetic variation of executive attention onto brain activity. *Proceedings of the National Academy of Sciences USA*, 100(12), 7406-7411

Fan, J., Flombaum, J. I., McCandliss, B.D., Thomas, K.M., & Posner, M.I. (2003). Cognitive and brain consequences of conflict. *NeuroImage*, 18(1), 42-57

Fan, J., McCandliss, B.D., Fossella, J., Flombaum, J.I., & Posner, M.I. (in press) The activation of attentional networks J. Cog Neuro

Fan, J., Snodgrass, J. G., & Bilder, R. M. (2003). Functional magnetic resonance imaging of source versus item memory. NeuroReport, 14(17), 2275-2281

Flowers, D.L., Jones, K., Noble, K.G., VanMeter, J. Zeffiro, T.A., Wood, F.b., Eden, G.F. (2004) Attention to single letters activates left extrastriate cortex. NeuroImage 21 (3) 829-839.

Fossella, JA, Bishop, S & Casey, BJ (2003) Exploring Genetic Influences on Cognition: Emerging Strategies for Target Validation and Treatment Optimization Current Drug Targets - CNS & Neurological Disorders, 2:357-362.

Fossella, J., Sommer, T., Fan, J., Pfaff, D., Posner, M.I. (2003). Synaptogenesis and heritable aspects of executive attention. Mental Retardation and Developmental Disabilities Research Review, 9 (3), 178-183

Fossella J and Posner M. (2003) Genes and the development of neural networks underlying cognitive processes. The Cognitive Neurosciences (MIT Press)

Forman, SD, Dougherty, GG, Casey, BJ, Siegle, GJ, Braver, T, Barch, DM, Stenger, VA, Wick-Hull, C, Pisarov, LA, Lorensen, E (in press). Opiate Addicts Lack Error-Dependent Activation of Rostral Anterior Cingulate. Biological Psychiatry.

Galanter CA, Carlson GA, Jensen PS, Greenhill LL, Davies M, Li W, Chuang SZ, Elliott GR, Arnold LE, March JS, Hechtman L, Pelham WE, Swanson JM. (2003). Response to methylphenidate in children with attention deficit hyperactivity disorder and manic symptoms in the multimodal treatment study of children with attention deficit hyperactivity disorder titration trial. J Child Adolesc Psychopharmacol, 13: 123-136.

Grady DL, Chi HC, Ding YC, Smith M, Wang E, Schuck S, Flodman P, Spence MA, Swanson JM, Moyzis RK. (2003). High prevalence of rare dopamine receptor D4 alleles in children diagnosed with attention-deficit hyperactivity disorder. Mol Psychiatry, 8: 536-545.

Greenhill LL, Swanson JM, Steinhoff K, Fried J, Posner K, Lerner M, Wigal S, Clausen SB, Zhang Y, Tulloch S. (2003) A pharmacokinetic/pharmacodynamic study comparing a single morning dose of adderall to twice-daily dosing in children with ADHD. J Am Acad Child Adolesc Psychiatry, 42: 1234-1241.

Harm, W.M., McCandliss, B. D., & Seidenberg, M. S., (2003). Modeling the success and failures of interventions for disabled readers. Scientific Studies of Reading, 7, 155-182.

Jones, L., Rothbart, M.K. & Posner, M.I. (2003) Development of Inhibitory Control in Preschool Children Developmental Science 6, 498-504

Kurt P. Schulz, Jin Fan, Cheuk Y. Tang, Jeffrey H. Newcorn, Angeles M. Cheung, Monte S. Buchsbaum, Jeffrey M. Halperin (in press). Response inhibition in adolescents diagnosed with Attention-Deficit/Hyperactivity Disorder during childhood: An event-related fMRI study. American Journal of Psychiatry

Leung PWL, Lee CC, Hung SF, Ho TP, Tang CP, Kwong SL, Leung SY, Yuen ST, Leih-Mak L, Oosterlaan J, Grady D, Harxhi A, Ding HC, Chi HC, Flodman P, Schuck S, Spence MA, Moyzis RK, and Swanson JM. (2004). The dopamine receptor D4 (DRD4) gene in Han Chinese children with attentiondeficit/hyperactivity disorder (ADHD): Increased prevalence of the 2-repeat allele. American J Medical Genetics (Neuropsychiatric Genetics),

Luu, P & Posner, M.I. (2003) Editorial: Anterior cingulated regulation of sympathetic activity Brain 126, 2119-20 K

McCandliss, B. D., Cohen, L., & Dehaene, S. (2003). The Visual Word Form Area: Expertise for reading in the fusiform gyrus. Trends in Cognitive Sciences. 7 (7):293-299

McCandliss, B. D., Colvin, R. F. and Zevin, J. D. (submitted) Attentional modulation of orthographic processing in a rhyme-judgment task.

McCandliss, B.M. & Posner, M.I. (2003) Fostering literacy through understanding brain mechanisms. Education Canada 43, 4-7

McCandliss, B.D., Sandak, R., Beck, I., & Perfetti, C., (2003). Focusing attention on decoding for children with poor reading skills: Design and preliminary tests of the Word Building intervention. Scientific Studies of Reading. 7(1),75-105.

McCandliss, B. D., Kalchman, M., & Bryant, P. (2003) Design Experiment and Laboratory Approaches to Learning: Steps Toward Collaborative Exchange. Educational Researcher, 32 (1): 14-16

McCandliss, B. D., Fiez, J. A., Protopapas, A., Conway, M., & McClelland, J. L. (in press). Success and failure in teaching the [r]-[l] contrast to Japanese adults: tests of a Hebbian model of plasticity and stabilization in spoken language perception. Cognitive, Affective, and Behavioral Neuroscience.

McCandliss, B. D., Noble, K. (in press-2003) The Development of Reading Impairment : a Cognitive Neuroscience Model. Mental Retardation and Developmental Disabilities Research Reviews.

McCracken JT, Biederman J, Greenhill LL, Swanson JM, McGough JJ, Spencer TJ, Posner K, Wigal S, Pataki C, Zhang Y, Tulloch S. (2003). Analog classroom assessment of a once-daily mixed amphetamine formulation, SLI38 (Adderall XR), in children with ADHD. J Am Acad Child Adolesc Psychiatry, 42: 673-683.

McGough JJ, Biederman J, Greenhill LL, McCracken JT, Spencer TJ, Posner K, Wigal S, Gornbein J, Tulloch S, Swanson JM. (2003). Pharmacokinetics of SLI381 (ADDERALL XR), an extended-release formulation of Adderall. . J Am Acad Child Adolesc Psychiatry, 42: 684-691.

McClelland, J. L., Fiez, J. A., & McCandliss, B. D., (2003). Teaching the Non-Native [r]-[l] Speech contrast to Japanese adults: training methods, outcomes, and neural basis. Physiology and Behavior.

Noble, K.G., Norman, M.F., Farah, M.J. (under review) The neurocognitive correlates of socioeconomic status in children.

Noble, K.G., Tottenham, N., Casey, B.J. (in press) Neuroscience perspectives on disparities in school readiness. Future of Children. Special issue - The ethnic and racial test score gap: School readiness and the first five years of life.

Owens EB, Hinshaw SP, Kraemer HC, Arnold LE, Abikoff HB, Cantwell DP, Conners CK, Elliott G, Greenhill LL, Hechtman L, Hoza B, Jensen PS, March JS, Newcorn JH, Pelham WE, Severe JB, Swanson JM, Vitiello B, Wells KC, Wigal T. (2003). Which treatment for whom for ADHD? Moderators of treatment response in the MTA. J Consult Clin Psychol, 71: 540-552.

Posner, M.I. (in press) The Achievements of Brain Imaging: Past and Present to appear in N. Kanwisher & J. Duncan (eds) Attention and Performance XX. Oxford University Press

Posner, M.I. (in press) Higher Perception an overview (Oct) To appear in J. Pomerantz editor Neurobiology of Perception and Communication: From Synapse to Society the IVth De Lange Conference. Cambridge UK:Cambridge University Press

Posner, M.I. & Fan, J. (in press). Attention as an organ system. In Roland Baddeley, Peter Hancock, and Peter Foldiak (Ed.), Information Theory and the Brain. Cambridge University Press.

Posner, MI, Rothbart, MK, Vizueta, N., Thomas, K.M., Levy, K., Fossella, J., Silbersweig, DA, Stern, E., Clarkin, J., & Kernberg, O. (in press) An approach to the psychobiology of personality disorders. Development and Psychopathology

Posner, M.I. (2003) Imaging a science of mind. Trends in Cognitive Sciences, 7:10:450-453

Posner, M.I. (2004) Neural Systems and Individual Differences. Teachers College Record 106, 24-30

Posner, M.I. & Fan, J. (2004). Attention as an organ system. Topics in Integrative Neuroscience: From Cells to Cognition. James R. Pomerantz and Michael C. Crair, Eds. Cambridge University Pr

Posner, MI, Rothbart, MK, Vizueta, N., Thomas, K.M., Levy, K., Fossella, J., Silbersweig, DA, Stern, E., Clarkin, J., & Kernberg, O. (2003) An approach to the psychobiology of personality disorders. Development and Psychopathology 15, 1093-1106

Raz, A., Landzberg, K.S., Schweizer, H.R., Zephrani, Z., Shapiro, T., & Posner, M.I. (2003) Posthypnotic Suggestion and the Modulation of Stroop Interference under Cycloplegia Cognition and Consciousness 12, 332-346

Raz, A., Landzberg, K.S., Schweizer, H.R., Zephrani, Z., Shapiro, T., & Posner, M.I. (in press) Posthypnotic Suggestion and the Modulation of Stroop Interference under Cycloplegia Cognition and Consciousness

Raz A, Fossella J, Fan J, Sommer T, McGuinness P, Zephrani Z, Posner M. (2003) Correlates and Exploratory Genetic Associations of Attentional and Hypnotic Phenomena. Hypnose und Kognition (in press).

- Rothbart, M.K., Ellis, L.K., Rueda, M.R. & Posner, M.I. (2003) Developing mechanisms of effortful control. Journal of Personality, 71 1113-1143,
- Rueda, M.R., Fan, J., McCandliss, B.D., Halparin, J.D., Gruber, D.B., Lercari, L.P., Posner, M.I. (in press). Development of attentional networks in childhood. Neuropsychologia.
- Rueda, M.R., Fan, J., Halparin, J., Gruber, D., Lercari, L.P., McCandliss B.D. & Posner, M.I. (in press) Development of attention during childhood. Neuropsychologia
- Rueda, M. R., Fan, J. & Posner, M.I. (2003) Measuring attention in neuropsychological diagnosis and rehabilitation. 2nd Int'l Congress of Neuropsychology in the Internet to be published in Revista de Neurologia
- Ruz, M., Worden, M. S., Tudela, P., & McCandliss, B. D. (submitted) Automatic neural responses to familiar stimuli persist under high perceptual load distractor tasks. Journal of Cognitive Neuroscience
- Scheres A, Oosterlaan J, Swanson J, Morein-Zamir S, Meiran N, Schut H, Vlasveld L, Sergeant JA (2003). The effect of methylphenidate on three forms of response inhibition in boys with AD/HD. J Abnorm Child Psychol, 31: 105-120.
- Sommer, T., Fossella, J., Fan, J., Posner, M.I. (in press). Inhibitory control: cognitive subfunctions, individual differences and variation in dopaminergic genes. Proceedings of the Hanse Institute
- Sonuga-Barke EJS, Daley D, Thompson M, Swanson J. (2003) Preschool ADHD: exploring uncertainties in diagnostic validity and utility, and treatment efficacy and safety. Expert Rev Neurotherapeutics, 3: 465-476.
- Stahl SM, Alexopoulos GS, Doghramji K, Fava M, Swanson JM, Lieberman JA. (2003). Optimizing wakefulness in patients with fatigue and executive dysfunction [audiotape]. The Journal of Clinical Psychiatry, 6(4).
- Swanson J, Gupta S, Lam A, Shoulson I, Lerner M, Modi N, Lindemulder E, Wigal S. (2003). Development of a New Once-A-Day Formulation of Methylphenidate for the Treatment of ADHD: Proof-of-Concept and Proof-of-Product Studies. Arch Gen Psychiatry, 60: 204-211.
- Swanson J, Lerner M. (2003). Onset of action of MPH formulations. ADHD Insights, #2.
- Swanson J, Moyzis R, Fossella J, Fan J, and Posner M. (2003) Adaptationism and molecular biology: An example based on ADHD. Behavioral and Brain Sciences (in press).
- Swanson JM, Volkow ND. (2003) Serum and brain concentrations of methylphenidate: implications for use and abuse. Neurosci Biobehav Rev, 27: 615-621.
- Swanson JM, Wigal SB, et al. (2004). Comparison of once-daily extended-release methylphenidate formulations in children with ADHD in the laboratory school, Pediatrics, 113: 206-216.
- Temple, E. & Posner, M.I. (1998). Brain mechanisms of quantity are similar in 5-year-olds and adults.

Proceedings of the National Academy of Sciences of the U.S.A., 95: 7836-7841.

The MTA Cooperative Group. (2004). The NIMH MTA follow-up: 24 month outcomes of treatment strategies for ADHD. Pediatrics, 113: 754-761.

The MTA Cooperative Group. (2004). The NIMH MTA follow-up: changes in effectiveness and growth after the end of treatment. Pediatrics, 113: 762-769.

Volkow ND, Swanson JM. (2003) Variables that affect the clinical use and abuse of methylphenidate in the treatment of ADHD. Am J Psychiatry, 160: 1909-1918.

Volkow ND, Wang GJ, Fowler JS, Molina PE, Logan J, Gatley SJ, Gifford A, Ding YS, Wong C, Pappas NR, Zhu W, Swanson JM. (2003). Cardiovascular effects of methylphenidate in humans are associated with increases of dopamine in brain and of epinephrine in plasma. Psychopharmacol, 166: 264-270.

Volkow ND, Wang GJ, Ma Y, Fowler JS, Zhu W, Maynard L, Telang F, Vaska P, Ding YS, Wong C, Swanson JM. (2003) Expectation enhances the regional brain metabolic and the reinforcing effects of stimulants in cocaine abusers. J Neurosci, 23: 11461-11468.

Wang, H., Fan, J., Johnson, T.R. (in press). A symbolic model of human attentional networks. Cognitive Systems Research.

Wang E, Ding Y-C, Flodman P, Kidd KK, Grady DL, Ryder OA, Spence MA, Swanson JM, and Moyzis RK. (2004). The Genetic Architecture of Selection at the Human Dopamine Receptor D4 (DRD4) Gene Locus. American J Human Genetics, 74: 1-14.

Wigal SB, Sanchez DY, DeCory HH, D'Imperio JM, Swanson JM. (2003) Selection of the Optimal Dose Ratio for a Controlled-Delivery Formulation of Methylphenidate. The Journal of Applied Research, 3: 46-63.

Wigal SB, Nemet D, Swanson JM, Regino R, Trampush J, Ziegler MG, Cooper DM. (2003). Catecholamine response to exercise in children with attention deficit hyperactivity disorder. Pediatr Res, 53: 756-761.

Wilens T, Pelham W, Stein M, Conners CK, Abikoff H, Atkins M, August G, Greenhill L, McBurnett K, Palumbo D, Swanson J, Wolraich M. (2003). ADHD treatment with once-daily OROS methylphenidate: interim 12-month results from a long-term open-label study. J Am Acad Child Adolesc Psychiatry, 42: 424-433.

Volkow ND, Swanson JM. (2003) Variables that affect the clinical use and abuse of methylphenidate in the treatment of ADHD. Am J Psychiatry, 160: 1909-1918.

Volkow ND, Wang GJ, Fowler JS, Molina PE, Logan J, Gatley SJ, Gifford A, Ding YS, Wong C, Pappas NR, Zhu W, Swanson JM. (2003). Cardiovascular effects of methylphenidate in humans are associated with increases of dopamine in brain and of epinephrine in plasma. Psychopharmacol, 166: 264-270.

Volkow ND, Wang GJ, Ma Y, Fowler JS, Zhu W, Maynard L, Telang F, Vaska P, Ding YS, Wong C, Swanson JM. (2003) Expectation enhances the regional brain metabolic and the reinforcing effects of stimulants in cocaine abusers. J Neurosci, 23: 11461-11468.

Wang, H., Fan, J., Johnson, T.R. (in press). A symbolic model of human attentional networks. Cognitive Systems Research.

Wang E, Ding Y-C, Flodman P, Kidd KK, Grady DL, Ryder OA, Spence MA, Swanson JM, and Moyzis RK. (2004). The Genetic Architecture of Selection at the Human Dopamine Receptor D4 (DRD4) Gene Locus. American J Human Genetics, 74: 1-14.

Wigal SB, Sanchez DY, DeCory HH, D'Imperio JM, Swanson JM. (2003) Selection of the Optimal Dose Ratio for a Controlled-Delivery Formulation of Methylphenidate. The Journal of Applied Research, 3: 46-63.

Wigal SB, Nemet D, Swanson JM, Regino R, Trampush J, Ziegler MG, Cooper DM. (2003). Catecholamine response to exercise in children with attention deficit hyperactivity disorder. Pediatr Res, 53: 756-761.

Wilens T, Pelham W, Stein M, Conners CK, Abikoff H, Atkins M, August G, Greenhill L, McBurnett K, Palumbo D, Swanson J, Wolraich M. (2003). ADHD treatment with once-daily OROS methylphenidate: interim 12-month results from a long-term open-label study. J Am Acad Child Adolesc Psychiatry, 42: 424-433.

Worden, M, Noll, D and Schneider, W. (in press) Relation Between Stimulus Features And The Expression Of Spatial Attention In Human Areas V1 And V2. NeuroImage

Zevin, J. D. & Seidenberg, M. S. (2004) Age of acquisition effects in reading aloud: Tests of cumulative frequency and frequency trajectory Memory & Cognition, 32, 31-38.

Books and Edited Volumes

Casey, B.J (2003) Special I issue “Brain Plasticity, Development and Learning” Invited Editor Mental Retardation and Developmental Disabilities Research Reviews. Wiley

Casey, BJ (2004). Developmental Psychobiology, Review of Psychiatry Series, Volume 23 Editor, American Psychiatric Publishing.

Diamond, A., Munakata. Y. & Casey, BJ (under contract) Cognitive Developmental Neuroscience: A Textbook. Oxford Press.

Posner M.I. & Rothbart, M.K. (submitted) Educating the Human Brain. APA Books

Posner, M.I. (ed.) Cognitive Neuroscience of Attention. New York:Guilford Press

Chapters and Letters

Casey, B.J (2003) Special Issue “Brain Plasticity, Development and Learning” Invited Editor Mental Retardation and Developmental Disabilities Research Reviews. Wiley.

Casey, B.J. (in press). Frontostriatal and Frontocerebellar Circuitry underlying Cognitive Control in Developing individuality in the Human Brain. American Psychiatric Association: Washington, DC

Davis, E., Parker, S., Tottenham, N., & Gunnar, M. (2003). “Neuroendocrinology: Emotion and Cognition.” Chapter to M. DeHaan & M.H. Johnson (Eds.), The Cognitive Neuroscience of Development. Sussex, England: Psychology Press, Ltd.

Casey, B.J (2003) Special issue “Brain Plasticity, Development and Learning” Invited Editor Mental Retardation and Developmental Disabilities Research Reviews.

Casey, B.J., Durston, S., Tottenham, N., Eigsti, I.-M., Galvan, A., Davidson, M.C. & Fossella, J. (in press). Disruption of Frontostriatal Circuitry, Dopamine and Cognitive Control in ADHD. To appear in D. Barch (Ed.) Cognitive and Affective Neuroscience of Psychopathology Oxford Press.

Fan, J., Raz, A., & Posner, M.I. (2003). Attentional Mechanisms. In Michael J. Aminoff & Robert B. Daroff (Ed.) Encyclopedia of Neurological Sciences. Academic Press, San Diego, Vol. 1, pp. 292-299

Fossella, J & Posner, M.I. Genes and the development of neural networks underlying cognitive processes To appear in M.S. Gazzaniga ed The Cognitive Neurosciences 3rd edition Cambridge: MIT Press

McCandliss, B.D. (2003). Will advances in psychological and neurobiological understanding of learning disabilities lead to some form of cure? In A. Fine and R. Kotkin (Eds.) Therapist’s Guide to Learning and Attention Disorders, (pp. 468-473), New York: Academic Press.

Manos MJ, McGough J, Rosen DJ, Sallee FR, Swanson JM, Wilens TE. (2003). The Pediatric ADHD Puzzle. Clinical criteria for diagnosis & management. Medical Crossfire. 4(4):Special Edition.

McCandliss, B. D. (in press). Brain based education. In J. Guthrie (Ed.) 2003 Encyclopedia of Education, Second Edition, New York: Macmillan Reference.

Myachykov, A. & Posner M.I. (in press) Attention in Language to appear in L. Itti, G. Rees, & J. Tsotsos (eds) Neurobiology of Attention

Munakata, Y., Casey, B. J., & Diamond, A. (2003) Developmental cognitive neuroscience: Progress and potential. Trends in Cognitive Sciences.

Noble, K, Tottenham, N & Casey, BJ (in press) Neuroscience Perspectives on Disparities in School Readiness and Cognitive Achievement. Future of Children Princeton/Brookings

Posner, M.I. (in press). How I Got Here. in U. Mayr, S.W. Keele & E. Awh eds Developing individuality in the human brain Washington DC APA Books.

Posner, M.I. (in press) The Achievements of Brain Imaging: Past and Present to appear in N. Kanwisher & J. Duncan (eds) Attention and Performance XX. Oxford Univ Press

Rueda, M.R., Posner, M.I. & Rothbart, M.K. (in press) Attentional control and self regulation. To appear in R.F. Baumeister & K.D. Vohs (Eds). Handbook of Self Regulation New York: Guilford Press

Schiff, N.D. & Posner, M.I. Mechanisms of consciousness Encyclopedia of Life Sciences

Scerif, G., Kotsoni, E., & Casey, B.J. (in press). The functional neuroimaging of development. To appear in R. Cabeza and A. Kingstone (Eds.), Functional Neuroimaging of Cognition. Cambridge: MIT Press.

Thomas, K. M. & Casey, B. J., (2003). Methods in Developmental Cognitive Neuroscience: MRI, fMRI and ERP. In M. de Haan & MH Johnson (Eds.) The Cognitive Neuroscience of Development pp. 19-41. East Sussex, UK: Psychology Press.

Worden, M. S., Martinez, A. and Posner, M. I. (2002) Spatial Attention, Neural Basis of. In Nadel, L. (Ed.) Encyclopedia of Cognitive Science. Vol. 4, pp. 108 - 111. London: Nature Publishing Group.

Awards and Honors 2002-2003

BJ Casey	The John Merck Fund Grant: to direct <i>Fourth Annual Summer Institute</i>
Bruce McCandliss	NSF Grant: <i>Biological bases of alphanumeric learning interventions</i>
Jason Zevin	National Institutes of Health/NIDCD NRSA Post Doctoral Award (McCandliss).
Barbara Ganzel	National Institutes of Health/NIDCD NRSA Post Doctoral Award (Casey).
Mike Posner	Presidential Symposium Am. Psychological Assoc. 2003 Fysson International Prize 2003 (Nature and function of consciousness) George A. Miller Award and Lecture Cog Neuroscience Society 2003