

The Sackler Institute for Developmental Psychobiology
Weill Cornell Medical College
Annual Report for June 2006-May 2007

The Institute's reputation in neurodevelopmental research remains high, as evidenced by the appointment of the Director, Dr. Casey to co-chair the National Institutes of Health (NIH) Blue Print initiative meeting on neurodevelopment that involves 15 NIH institutes. The Institute is establishing a high profile in genomic and translational research too. Select studies are highlighted in this report (see *Program of Research and Publications*). The faculty and fellows have received a number of awards this year (See *Grants and Awards*) and training remains a priority with the continuation of the annual Summer Institute on the *Biology of Developmental Disabilities*, increased involvement in medical and graduate student training, and organization of local and national symposia by the faculty (see *Education, Training and Outreach*).

Academic Faculty and Staff

Sackler Faculty

Dima Amso, Ph.D. Assistant Professor of Psychology in Psychiatry

B.J. Casey, Ph.D., Director and Sackler Professor of Developmental Psychobiology

Bruce D. McCandliss, Ph.D., Associate Professor of Psychology in Psychiatry

Michael Posner, Ph.D., Professor of Psychology in Psychiatry, Emeritus

James Swanson, Ph.D., Part-time Professor of Psychology in Psychiatry

Nim Tottenham, Ph.D., Assistant Professor of Psychology in Psychiatry

Jason Zevin, Ph.D., Assistant Professor of Psychology in Psychiatry

Sackler Staff

Gina Sophia Pierre, Institute Administrator

Emmanuel Stein, IT Manager

Sackler Research Assistants

Alpana Choudhury, Research Assistant

Juliet Davidow, Research Assistant

Jamie Ferri, Research Assistant

Sarah Getz, Research Assistant

Tara Gilhooly, Research Assistant

Rebecca Gottlieb, Research Assistant

Eva Hulse, Research Assistant

Alexander Millner, Research Assistant

Cathy Yun, Research Assistant

National and International Fellows

Sackler Predoctoral Fellows

Todd Hare, Neuroscience Ph.D. student

Rebecca Jones, Neuroscience Ph.D. student

Conor Liston, Tri-Institutional M.D., Ph.D. student

Sumit Niogi, Physiology Ph.D. student

Fatima Soliman, Tri-Institutional M.D., Ph.D. student

Yuliya Yoncheva, Neuroscience Ph.D. student

Sackler Postdoctoral Fellows

Kevin Bath, Ph.D., Lasdon-Sackler Fellow

Minna Hannula, Ph.D., Sackler Fellow

Liat Levita, Ph.D., Sackler Fellow

Mark Dubin, M.D., Psychiatry PGY III

International Sackler Scholars

Oana Benga, Babes-Bolyai University, Romania

Sarah Durston, University of Utrecht, The Netherlands

Annette Karmiloff-Smith, University College London, United Kingdom

Urs Maurer, Swiss National Science Foundation, Switzerland

Gaia Scerif, University of Oxford, United Kingdom

Program of Research

This year, several empirical studies have been completed and published using the techniques of brain imaging, human genetics, electrophysiology, and behavioral methods, to study typical and atypical populations from childhood to adulthood (see Publications). Below, are highlights from a few of these studies representing three general domains of study: 1) studies of learning and development, 2) genomic investigations; and 3) clinical investigations.

Studies of Learning and Development

Behavioral and imaging studies of learning and development form the very foundation of the Institute's research program, laying the critical groundwork for genetic and clinical studies. The primary areas of research in this area encompass perceptual learning and development and motivational-based learning and development.

Object Learning in Infancy: Infants as young as 4 months fail to show surprise when occluded moving objects fail to emerge from behind a static object, indicating that they do not form a visual memory of the object and its trajectory while it was occluded. By 6 months, infants indicate understanding of this continuity and can use this information to guide crawling and reaching. When infants are exposed to the relevant information about an object's trajectory they can perform this task at an earlier age. Dr. Dima Amso is using electrophysiological measures to constrain current developmental theory on how infants can use repetition to learn to organize their environment. Ultimately these measures may serve as early predictors for learning disabilities. Preliminary findings are published in the *Proceedings of the National Academy of Sciences*.

Object Learning in Children: Faces are a special class of objects as humans have vast experiences with them over the life span. Dr. Nim Tottenham has found that children process faces faster than inanimate objects therefore suggesting that extensive exposure with one class of objects can affect the speed of processing and explain developmental differences consistently found in the literature on face processing. Parallel imaging studies show that brain activity in the fusiform face area is enhanced in response to faces over other objects and increases with age. Developmental disorders such as autism, in which faces appear to be processed differently, may be better understood using information gained from this study. Preliminary findings from this work are published in *Developmental Science*.

Oculomotor Development, Selection, & Learning in Infancy. Saccades early in infancy are largely reflexive, with voluntary attention-directed eye movements emerging at approximately three to four months of age. In a series of studies, Dr. Dima Amso is investigating the mechanisms of the development of visual selection and how they play a role in efficient attenuation of distractor

information during learning. Her work suggests that where infants look determines what they perceive and is dependent on their ability to control their eye movements. Preliminary results are published in *Developmental Psychology* and *The Journal of Adaptive Behavior*.

Neural Basis of Statistical Learning: Dr. Dima Amso is examining the neural basis of statistical learning. This work is influential in the area of habituation and novelty preference studies in infants. The results show that the caudate nucleus appears to be involved in simple frequency-based learning (habituation) while the hippocampus appears to contribute to learning of associations between stimuli (novelty preferences). Dr. Amso is currently examining these abilities in infants and children using electrophysiological and magnetic resonance imaging methods. This work lays the groundwork for identification of learning disabilities early in life and forms the basis for a recent NIMH K01 submission.

Development of Speech Perception in Children and Adults: Drs. Bruce McCandliss and Jason Zevin are examining the neural basis of language development, with a specific focus on the development of speech perception in American and Japanese native speakers. They are using functional neuroimaging to examine the neural basis for the finding that learning distinct sounds early in life depends on the degree of experience with these sounds. This work investigates the neural basis for the well-known changes in language learning that occur from childhood to adulthood, and seeks to develop broader neural theories for failures to learn language. This work is funded by an NIH R01 award to Drs. McCandliss (PI) and Zevin. Yuliya Yoncheva, a Neuroscience PhD student who is working on this project and related ones, is showing distinct regions for listening to words relative to non-linguistic information (tones).

Rapid Visual Word Perception in Adults and Children: Dr. McCandliss and Dr. Urs Maurer, an International Sackler Fellow from Switzerland, are actively pursuing the neural basis for specialization in recognizing visual words that support reading ability, through a series of electrophysiological studies contrasting responses to familiar words with other visual stimuli. Brain responses, as early as 200 milliseconds, show specialized responses over visual perception regions. They are now examining the development of this ability children with typical and atypical reading ability.

What Changes with Learning and Development: Dr. Casey, Conor Liston, a tri-institutional M.D., Ph.D. student, and Dr. Sarah Durston of the University of Utrecht are collaborating on cross-sectional and longitudinal brain imaging studies of cognitive control. Findings suggest that cortical function becomes fine-tuned with development. Brain regions associated with more basic functions such as sensory and motor processes mature first, followed by association areas involved in top-down control of behavior. This work is funded by an NIMH R01 to Dr. Casey and preliminary findings are published in *Developmental Science* and *Cerebral Cortex*.

Reinforcement Learning and Risky Decisions in Adolescents. Dr. Casey together with Julie Spicer, now a Ph.D. candidate at Columbia University, and Adriana Galvan, now a postdoctoral fellow at UCLA have been studying the neural basis for the effects of different reward schedules and amounts on behavior that are relevant for understanding extinction of appetitive behaviors (e.g., addiction). This work is supported by grants from the National Institute of Drug Addiction (NIDA). Findings are published in the *Journal of Neuroscience*, *Neuroimage*, and *Developmental Science* and have been highlighted in *Nature* and by NIDA this year.

Individual and Developmental Differences in the Delay of Gratification: Dr. Casey has been working with Dr. Walter Mischel of Columbia University to relate preschoolers' ability to delay gratification with their cognitive control abilities in adolescence. Preliminary results suggest those individuals most able to wait for a reward, as a toddler, were better able to resolve conflict on cognitive control tasks as adolescents. A collaborative National Science Foundation grant involving Columbia University, University of Washington and University of Michigan has been awarded to support this program of research. Preliminary findings are published in *Psychological Science*.

Development of Emotion Regulation: Dr. Casey and Todd Hare, a Neuroscience PhD student who is defending his dissertation this year, are examining the interaction of limbic and prefrontal circuitry in regulation of emotions in children. Hare was awarded an NIH predoctoral fellowship to support this work in addition to a NIDA R01 to Casey. He has found that adolescents show an initial response to emotional information in the amygdala that is exaggerated relative to children and adults. This project forms the foundation for parallel studies of children with problems in emotional and behavioral regulation (e.g., PTSD, anxiety, depression and, previously institutionalized). This work will be highlighted by PBS in a special documentary on adolescent depression.

Genomic Investigations

The Sackler Institute is rapidly establishing a high profile in genomic research that represents an elegant mapping of human and animal projects that examine gene-environment interactions in developing humans and transgenic mouse models.

Joint US Sackler Institutes Genomic Initiatives. The Sackler Institutes of Weill Cornell and Columbia have built interdisciplinary groups of expertise and developed mouse models that are crucial for understanding the brain mechanisms underlying psychopathology. At Weill Cornell, Dr. Francis Lee has developed a transgenic mouse model of the human Val66 Met variant in the gene for the growth factor, BDNF, which has been implicated in schizophrenia and affective disorders. Both institutes will be focusing their research on understanding how pharmacological and environmental influences interact with the expression of genetic potential for these two mental disorders. In the populations being studied at each institute, we will be including analyses for both BDNF and serotonin gene variants, thus greatly increasing our sample size, and enabling us to look for novel interactions between the two gene families as well as with environmental factors.

Biological Differences Underlying Sensitive Periods in Language Learning. This new McDonnell grant (PI:Maurer) subcontract to McCandliss will parallel an ongoing NIH-R01 (PI: McCandliss) investigation of the sensitive period effects in speech perception. This work provides a collaborative effort of 6 labs around the world looking at different aspects of critical period effects from different perspectives. The Sackler Institute will contribute a unique set of studies examining how learning language changes from age 6 to 18, and link these changes to genetic measures of BDNF polymorphisms, white matter tract measures of developmental changes in myelination, and Tanner stages of pubertal development.

Gene-Environment Interactions across Development: In a unique marshaling of the talents of a distinguished group of scientists with expertise in pediatric imaging, molecular biology, mouse models, and neurotrophins, Dr. Casey (PI) in collaboration with Drs. Francis Lee and Charles Glatt of Psychiatry, Dr. Barbara Hempstead of the Department of Medicine, Bruce McEwen of The Rockefeller University and Dr. Megan Gunnar of the University of Minnesota, have submitted an NIMH P50 Interdisciplinary Developmental Research Center application to examine the impact of brain-derived neurotrophic factor (BDNF) and experiential events (e.g., stress, trauma, enrichment) on learning and development, and on vulnerability and resistance to psychopathology. The Center proposal is comprised of 3 highly interdependent projects using both human imaging and transgenic mouse models to track the developmental trajectory of brain systems involved in associative and cued learning as a function of the BDNF genotype; to characterize the impact of early adversity (stress) on these brain systems during development as a function of BDNF genotype; and to test the extent to which the BDNF phenotype can be rescued genetically and environmentally. This proposal builds on pilot data supported by the generous gift of the Mortimer D. Sackler family and based on collaborations among faculty and fellows of Lasdon Laboratories and the Sackler Institute within the Department of Psychiatry.

Genes, Brain, and Behavior: Drs. Casey and Fossella have co-edited a special issue of the journal *Cognitive, Affective, and Behavioral Neuroscience* that includes studies of cognitive genetics,

imaging genetics and transgenic mouse models of variability in human behavior. This special issue outlines the current state of the field and provides future directions for the field.

Clinical Investigations

The overarching mission of the Sackler Institute is to delineate the biological mechanisms underlying developmental disabilities to direct treatments and interventions and hopefully ameliorate these disorders in the future. The majority of studies currently underway focus on treatments and interventions for the disorders of dyslexia, ADHD and autism. Other areas of research in this area include examination of the long-term effects of physiological (e.g., brain trauma) and psychological stressors (e.g., institutionalization). These latter studies are moving the field toward individualized treatment and intervention approaches to stress related diseases, based on identified genetic and environmental risk factors discussed in editorials and reviews in the *American Journal of Psychiatry* and *Current Opinions in Neurology*.

Role of the thalamic magno- and parvo-cellular organization in dyslexia. This new NIH R01 (PI: Kasner) subcontract to McCandliss uses high resolution fMRI scanning to isolate functional activity in magno- versus parvo-cellular pathways in the thalamus of typically reading and dyslexic adults. This study provides the most direct test to date of the 'magno-cellular deficit' hypothesis as a critical neurobiological cause of dyslexia.

Enhancing Literacy through Tutors and Computers: Dr. McCandliss, together with collaborators at the University of Pittsburgh, continues to provide empirical support for a child-friendly computer program designed to guide a minimally trained tutor and a child with a reading disability through 20 sessions of intervention. Results from this computer-based tutorial program show improvements in reading, and decoding scores are equivalent to the gains in standardized scores produced by the laboratory study upon which the intervention was based. In a remarkable development, an active intervention control study is currently underway in the New York Public Schools.

Learning-based changes in academic skills in children: Dr. McCandliss has been funded by the McDonnell Foundation to explore novel learning paradigms that engage adults in learning a new alphabetic writing system with novel fMRI activation tasks to measure the impact of learning. A follow-up National Science Foundation funded project, in collaboration with Stanford, uses learning-based changes in fMRI responses by children to contrast different computer-based intervention programs designed for basic reading and numerical skills. This work is leading to a set of novel educational interventions for number processing skills now being carried out in schools in California for assessment of potential positive impact on mathematics skills. Cathy Yun, a grad student from Columbia Teacher's College, is carrying out a related project with McCandliss on children's enumeration of dots, and their ability to take advantage of sets to speed enumeration, that she'll be presenting at APS.

Double Blind Cross-Over Placebo-Ritalin Challenge: In an NIMH collaboration with Duke, Columbia, Stanford and University of California at Berkeley, Dr. Casey is examining the imaging profiles of children with ADHD and their parents. Behavioral assays she has developed at the Institute are studied to assess for changes with medication. Preliminary findings have been published in *Biological Psychiatry*, *Journal of Child Psychology and Psychiatry* and the *American Journal of Psychiatry* by Dr. Casey and colleagues.

Studies of Autism: A number of recent studies of autism have suggested a deficit in eye gaze that may underlie problems in joint attention in this disorder. Autistic patients appear to attend more to the mouth than the eyes when perceiving faces, unlike typically developing children. Dr. Nim Tottenham, in collaboration with Margaret Hertzog of the Department of Psychiatry, is examining this ability in individuals with autism. Dr. Tottenham has developed a paradigm that cues patients to attend to the eyes of face stimuli and is examining changes in orientation and

neural systems with extended training on this paradigm. This work has served as the basis for a recent grant application to National Alliance for Autism Research.

Traumatic Brain Injury and Predictors of Outcome: Dr. McCandliss, as co-Principal Investigator, has joined forces with Dr. Ghjar, President of the Brain Trauma Foundation, on a 3-year multimillion dollar grant from the J. S. McDonnell Foundation entitled "Cognitive and Neurobiological Research Consortium in Traumatic Brain Injury." The central hypothesis of this project is that deficits in mild Traumatic Brain Injury (TBI) in both adults and children can be systematically linked to specific patterns of diffuse white matter tract damage, as measured by Diffusion Tensor Imaging based fiber tract tracings. Sumit Niogi, a Physiology PhD student, has been instrumental in developing methods for this project that have recently been published in *Neuropsychologia*. New findings show a double dissociation between white matter tracts related to long term memory versus conflict in normals and TBI patients

Brain Development following Institutionalization: The long-term outcomes of children reared in orphanages abroad has become a primary health concern given the rising number of adoptions of these children to the United States. The effects of prior institutionalization on the structural and functional development of limbic circuitry using magnetic resonance imaging (MRI), are being explored by Drs. Casey and Tottenham. They are examining the association of hippocampal and amygdala volume with length of institutionalization, age at institutionalization, and length of time with an adopted family. The preliminary 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 and somewhat transient. These preliminary data have resulted in a NIMH funded R01 grant to Dr. Casey and served, in part, as preliminary data for a NIMH Center grant application. Preliminary data have recently been presented at a symposium on international adoption at the Society for Research on Child Development in Boston by Dr. Tottenham and accepted for publication (see Tottenham et al., in press) .

Long-term Effects of Psychological Stress: Dr. Casey and Conor Liston, a tri-institutional M.D., Ph.D. student and recipient of the Soros and Perry Awards last year, are examining in humans and animals the impact of moderate stress in collaboration with Dr. Bruce McEwen of The Rockefeller University. Both populations show changes in attention shifts, but not behavioral set shifting, following stress that normalizes once the stressor is removed. Human imaging and animal histological studies show changes in prefrontal cortical regions that support attention shifting. Preliminary imaging data from this study have recently been published in *Neuron* and formed the basis for a DOD grant submission by Dr. Mary Charlson, Chief of General Internal Medicine, to elucidate the biological and neural mechanisms through which meditation acts to ameliorate the psychological and functional consequences of stress and radiation among patients with radiation-treated cancer.

Education, Training and Outreach

A significant objective of the Institute is in training, education and outreach. The Institute's network has international collaborations established with Romania, Oxford, London, Switzerland and The Netherlands in addition national ones with Berkeley, Brookhaven Laboratories, Brown University, Cornell-Ithaca, Columbia, Duke, Mt. Sinai, NIMH, NYU, University of Oregon, Pennsylvania, Princeton, Rockefeller, Stanford, UC-Irvine, University of Pittsburgh and Yale and with research fellows from Finland, Switzerland, and The Netherlands. Highlights of the Institute's training and outreach program are provided below.

Summer Institute on the Biology of Developmental Disabilities. Casey has received funding for a seventh year to direct a week-long course on the *Biology of Developmental Disabilities* from the John Merck Fund. This year's course is co-directed by Drs. Dima Amso and BJ Casey of the Sackler Institute and Barbara Finlay of Cornell University and will focus on training psychologists and neurobiologists in methods used in developmental neuroscience (imaging, genetics, and

behavior) in the context of the central themes of learning and development (see: <http://www.sacklerinstitute.org/cornell/summerinstitute/>).

International Conference on Development and Learning. Dr. Amso was part of an invited Symposium: "Toward a Constructivist Account of Perceptual Completion". The goal of the conference is to present state-of-the-art research on autonomous development in humans, animals and robots, and to continue to identify new interdisciplinary research directions for the field.

Winter Conference on Current Issues in Developmental Psychobiology. Drs. Amso, Bath, and Casey of the Sackler Institute and Dr. Francis Lee of the Department of Psychiatry presented an invited symposium on "BDNF, Learning and Development". The meeting was co-organized by Dr. William Fifer of the Sackler Institute at Columbia University.

Developing Researchers in Neuropsychiatric Imaging. The Institute actively participates in summer workshops with the Functional Neuroimaging Laboratory directed by Drs. David Silbersweig (PI) and Emily Stern as part of a NIMH R25 Grant to train researchers in neuropsychiatric imaging.

Weill Graduate School of Medical Science. Dr. Casey has rotated from Director of the Neuroscience Program at Weill Graduate School of Medical Science to the executive committee that advises the program. The program includes over 60 faculty and graduate students. The Institute has taken a significant role in both teaching and sponsoring student rotations and PhD candidates from the graduate program and from the Tri-institutional MD PhD program with two PhD students defending their dissertations this spring (Todd Hare: mentor- Casey and Sumit Niogi: mentor- McCandliss).

Brain to Mind. Drs. Amso, Casey, McCandliss, Tottenham and Zevin all played significant roles this year in teaching medical students at Weill Cornell and Weill Quatar about developmental systems neuroscience. Each faculty member provided lectures and labs for the students that were received as evidenced by the request of greater involvement in teaching next year.

Neuron to Brain. Drs. Amso, Casey, McCandliss, Tottenham and Zevin all played significant roles this year in teaching Weill Biomedical Graduate Program in Neuroscience related courses that link brain and behavior across learning. Some of the best teaching evaluations were given to this group, with highest praise to Dr. Amso, for her lectures in particular.

Ithaca-Weill Joint Graduate Program in Development and Learning. Dr. Casey in collaboration with Dr. Barbara Finlay of Cornell University-Ithaca have hosted joint campus meetings of psychology and neuroscience faculty for the past two years and have submitted a NIH T32 joint institutional interdisciplinary training grant submission for predoctoral fellows in development and learning (see <http://neuroscience.cornell.edu/imagine.html>).

American Psychological Society Symposium. Dr. McCandliss has organized a symposium on *Developmental Changes in Number Skills Reflect the Emergence of Children's Ability to Focus Attention on Different Aspects of Number* that highlights his team's research in this area at the Sackler Institute (see http://www.psychologicalscience.org/convention/program_2007).

NYAS Imaging Discussion Group. Dr. Casey continues to serve on the steering committee of the Imaging Discussion Group that is organized through the New York Academy of Sciences. This group facilitates interactions and collaborations among neuroimagers in the New York Metropolitan area, especially among predoctoral and postdoctoral fellows, as part of their training initiative (see <http://www.nyas.org/channels/about.asp?channelID=51>).

NYAS Symposium. Infants have a remarkable ability to learn language, but how they do so is not well understood. In the fall, the Imaging Discussion Group of the New York Academy of Sciences sponsored a special symposium entitled *From Birdsong to Baby Talk: Studies of Language Development* that explored brain processes that may underlie early learning with animal, computational, and neuroimaging studies. The event was organized by BJ Casey of the

Sackler Institute. The speakers included Jason Zevin of the Sackler Institute and many more (see <http://www.nyas.org/ebrief/miniEB.asp?ebriefID=615>)

NYAS Symposium. It is no longer sufficient to consider genetics or environment alone when explaining human behavior. Gene-environment interactions are essential in understanding variation in behavior. In the summer of 2006, the Imaging Discussion Group of the New York Academy of Sciences sponsored a special symposium on *Genes, Brain and Behavior on Stress* organized by BJ Casey that showcased faculty and fellows affiliated with the Sackler Institute. The speakers included Drs. Nim Tottenham, Barbara Ganzel and Conor Liston of the Sackler Institute and Drs. Francis Lee and Kevin Bath of Lasdon Laboratories in the Department of Psychiatry (see <http://www.nyas.org/ebriefreps/main.asp?intSubsectionID=4498>).

Grants and Awards

2006-2007 Grants and Award

Dr. Casey together with Dr. Walter Mischel of Columbia University, Dr. Yuichi Shoda (PI) of the University of Washington and Dr. John Jonides of the University of Michigan received a collaborative NSF grant application that uses imaging, genetics and behavioral methodologies to explain individual differences in self regulation across development.

Dr. Casey received a grant from the John Merck Fund to support the 7th annual Summer Institute on the Biology of Developmental Disabilities that she has been directing for seven years.

Dr. Casey was awarded the Most Significant Contribution to the Field of Psychology by the University of South Carolina where she completed her doctoral work.

Dr. Casey was appointed to the Advisory Board of NARSAD, to the NIMH Board of Scientific Counselors by NIMH and elected as a Fellow of the NYAS.

Dr. Marc Dubin, a PGYIII working with Dr. McCandliss has received the American Psychiatric Institute for Research and Education Janssen Resident Psychiatric Research Scholars Award. This award will be recognized at this year's American Psychiatric Association meeting May 19-24, and he'll get a small monetary prize next year. This work focuses on how cognitive deficits related to dyslexia are linked to white matter tract differences in the left hemisphere.

Dr. Dubin also won first prize at the APA ceremony for the paper he submitted with Dr. McCandliss on this work. Dubin received the Perry Award from the Department of Psychiatry for this work last year as well.

Dr. McCandliss has received a subcontract from a McDonnell grant (PI Daphne Maurer, McMaster University) to investigate sensitive period effects in speech perception. This provides a collaborative effort of 6 labs around the world looking at different aspects of critical period effects from different perspectives. The Sackler Institute will contribute a unique set of studies examining how learning language changes from age 6 to 18, and link these changes to genetic measures of BDNF polymorphisms, white matter tract measures of developmental changes in myelination, and Tanner stages of pubertal development.

Dr. McCandliss will be receiving a subcontract from a NIMH R01 (PI Sabine Kasner, Princeton University). This work uses high resolution fMRI scanning to isolate functional activity in magno-versus parvo-cellular pathways in the the thalamus of typically reading and dyslexic adults. This study provides the most direct test to date of the 'magno-cellular deficit' hypothesis as a critical neurobiological cause of dyslexia.

Sumit Niogi, a PhD, MD candidate working with Dr. McCandliss, has been awarded the 2007 Service Excellence Award in recognition of his outstanding contributions to the Graduate School. He will be receiving the award at Convocation on May 29, 2007.

Dr. Nim Tottenham, in collaboration with Dr. Margaret Hertzog of the Department of Psychiatry, received an award from the National Alliance for Autism Research-Autism Speaks

foundation to examine the neural bases of face processing in individuals with autism from childhood through adulthood. Dr. Tottenham has developed a paradigm that cues patients to the eyes of face stimuli and she will be examining changes in perceptual and neural systems with extended training on this paradigm that has direct implications for treatment and intervention.

Dr. Zevin received a Dewitt Wallace/Reader's Digest seed grant from the Department of Psychiatry to support preliminary data collection for resubmission of a R21 application to study phonetic representation in temporal cortex using novel applications of multivariate analysis techniques.

Pending Grants and Awards

Dr. Amso (PI) has a pending NIMH K01 award application that received a 168 priority score, to examine statistical learning in infants and children using electrophysiological and magnetic resonance imaging methods under the mentorship of Dr. Casey. This work will form the basis for later studies on identification of learning disabilities early in life.

Dr. Amso (PI) has a pending application to the John Merck Fund for a Faculty Scholarship to examine how disruption of brain systems associated with premature birth can give rise to various developmental and learning deficits that, when in place early postnatally, can alter the general course of development.

Drs. Casey (Center PI), Dima Amso, Kevin Bath and Nim Tottenham of the Sackler Institute together with Drs. Francis Lee and Charles Glatt of the Department of Psychiatry, Barbara Hempstead of the Department of Medicine and Megan Gunnar of the University of Minnesota have submitted a NIMH P50 Center for Interdisciplinary Developmental Research grant to examine the interaction of genes and environment across development. The application focuses on the impact of stress and polymorphisms in the brain derived neurotrophin factor (BDNF) gene on learning and development.

Dr. Casey and Conor Liston, in collaboration with Dr. Mary Charlson (PI), Chief of General Internal Medicine, submitted a DOD grant to elucidate the biological and neural mechanisms through which meditation acts to ameliorate the psychological and functional consequences of radiation treatment and stress and improve quality of life among cancer patients.

Dr. Casey has a pending competitive NIMH RO1 renewal to investigate what changes with learning and development. The proposed program of research examines the effects of a controlled amount of training on cognitive control tasks at different ages to determine windows of development that may be more sensitive to future interventions to help regulate behavior.

Dr. Casey in collaboration with Elke Weber (PI) and Bernd Figner of Columbia University and Mauricio Delgado submitted a collaborative NSF grant to examine the development of risky decisions during adolescence using fMRI.

Dr. Casey in collaboration with Dr. Barbara Finlay of Cornell University-Ithaca have submitted an NIH T32 cross campus interdisciplinary training grant for predoctoral fellows in development and learning. This application bridges imaging, genetic and clinical approaches from the Medical College together with computational, behavioral and theoretical approaches from the Ithaca campus in psychology and neuroscience.

Dr. Zevin submitted an R21 application that scored 195 on the first round to study phonetic representation in temporal cortex using novel applications of multivariate analysis techniques. He will use machine learning models to identify patterns of brain activity that correspond to particular speech sound categories. The proposed combination of data collection and analysis techniques has great potential for use in basic, translational and clinical research on the development and plasticity of speech perception as well as communication disorders including dyslexia and language impairment related to deficits in speech sound categorization.

The Institute directly, and in collaboration with others, has grants and awards from NSF, NIMH, NIDA, NICHD, the Dewitt Wallace Readers Digest, the McDonnell Foundation, and the John Merck Fund. This funding supplements the generous gifts by the Mortimer D. Sackler family.

Publications

- Amso, D., & Casey, B. J. (in press). The development of cognitive control. *The New Encyclopedia of Neuroscience*. Larry Squire (Ed.). Elsevier.
- Amso, D., & Casey, B.J. (2006). Beyond what develops when: Neuroimaging may inform how cognition changes with development. *Current Directions in Psychological Science*, 15(1), 24-29.
- Amso, D., & Johnson, S. P. (2006). Learning by selection: Visual search and object perception in young infants. *Developmental Psychology*, 42(6), 1236-1245.
- Bath KG, Johnston RE. (2007) Dominant-subordinate relationships in hamster: Sex differences in reactions to familiar opponents. *Hormones & Behavior* 51(2): 258-64.
- Berger, A., Tzur, G. & Posner, M.I. (2006) Infant babies detect arithmetic error. *Proceeding of the National Academy of Science USA* 103, 12649-12553
- Bishop, SJ, Cohen, JD, Fossella, JA, Casey, B.J. & Farah, M.J. (2006) COMT genotype influences prefrontal response to emotional distraction. *Cognitive, Affective and Behavioral Neurosciences*. 6(1): 62-70.
- Blau, V.C., Maurer, U., Tottenham, N., & McCandliss, B. D. (2007). The face-specific N170 component is modulated by emotional facial expression. *Behavioral and Brain Functions*, 3:7.
- Casey, B.J., Amso, D & Davidson, MC (2006). Learning about learning and development with neuroimaging. In M. Johnsons & Y. Munakata (Eds). *Attention and Performance XXI: Processes of Change in Brain and Cognitive Development*. pp. 513–533. Cambridge, MA: MIT
- Casey, B.J., Durston, S., Tottenham, N., Spicer, J, Eigsti, I.-M., Galvan, A., et al. Disruption of Frontostriatal Circuitry, Dopamine and Cognitive Control in ADHD. In D. Barch (Ed.) *Cognitive and Affective Neuroscience of Psychopathology* Oxford Press (in press).
- Casey, BJ & Durston, S Cognitive neuroscience approaches to normal and abnormal development. In D. Charney & E. Nestler's *The Neurobiology of Mental Illness: 3rd edition* (in press)
- Casey, BJ, Getz. S. & Galvan, A. Adolescent Brain Development. *Reviews in the Neurosc* (in press)
- Casey, BJ, et al (in press) Adolescent Brain Development and Suboptimal Decision Making. *Developmental Review*.
- Casey, BJ & Durston, S (2006) From Behavior to Cognition to the Brain and Back: What Have We Learned From Functional Imaging Studies of ADHD. *Amer. Journal of Psychiatry* 163:957–960
- Casey, BJ, Nigg, J & Durston, S New potential leads in the biology and treatment of ADHD. *Current Opinions in Neurology*. 20:119–124 (2006)
- Chen ZY, Jing D, Bath KG, Ieraci A, Khan T, Siao CJ, Herrera DG, Toth M, Yang C, McEwen BS, Hempstead BL, Lee FS. (2006) Genetic variant BDNF (Val66Met) polymorphism alters anxiety-related behavior. *Science* 314(5769):140-143.
- Davidson, M., Amso, D., Cruess, L., & Diamond, A. (2006). Development of cognitive control and executive functions from 4-13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, 44(11), 2037-2078.
- Dennis, T., Chen, C.C., & McCandliss, B.D. (in press). Threat-related attentional biases: an analysis of three attention systems. *Anxiety and Depression*.
- Diamond, A., Munakata. Y. & Casey, BJ (under contract) *Cognitive Developmental Neuroscience:*

- A Textbook. Oxford Press.
- Durstun, S & Casey, B.J. Imaging Studies of ADHD. In (Ed.) Progress in Attention-Deficit/Hyperactivity Disorder Research (2006).
- Durstun, S & Casey, B.J. What have we learned about cognitive development from neuroimaging? *Neuropsychologia* (2006)
- Durstun, S, & Casey, B.J. A Shift from Diffuse to Focal Cortical Activity with Development: the authors' reply. *Developmental Science* 2006; 9:1, 18-20.
- Durstun, S., Davidson, M. C., Tottenham, N., Galvan, A., Spicer, J., Fossella, J. A., et al. (2006). A shift from diffuse to focal cortical activity with development. *Dev Sci*, 9(1), 1-8.
- Durstun, S, Mulder, M, Casey, BJ, Ziermans, T & van Engeland, H. Activation in ventral prefrontal cortex is sensitive to genetic vulnerability for ADHD. *Biological Psychiatry* 2006
- Eigsti, I-M, Zaya, V, Mischel, W, Shoda, Y, Ayduk, O, Dadlani, MB, Davidson, MC, Aber, JL & Casey, B.J. (2006) Attentional Control in preschool predicts cognitive control at age eighteen. *Psychological Science* 17: 478-484.
- Epstein, J. N., Casey, B. J., Tonev, S. T., Davidson, M., Reiss, A., Garrett, A., Hinshaw, S.P., Greenhill, L.L., Glover, G., Vitolo, A., Kotler, L.A., Jarrett, M.A., Spicer, J. ADHD- and medication-related brain activation effects in concordantly affected parent-child dyads with ADHD. *Journal of Child Psychology and Psychiatry* (in press).
- Epstein, J. N., Casey, B. J., Tonev, S. T., Davidson, M., Reiss, A., Garrett, A., Hinshaw, S.P., Greenhill, L.L., Glover, G., Vitolo, A., Kotler, L.A., Jarrett, M.A., Spicer, J. Assessment and prevention of head motion during imaging of patients with Attention Deficit Hyperactivity Disorder. *Psychiatry Research: Neuroimaging* (in press).
- Fan, J., Kolster, R., Ghajar, J., Suh, M., Knight R.T., Sarkar, R., & McCandliss, B. D. (2007). Response anticipation and response conflict: an event related potential and functional magnetic resonance Imaging study. *Journal of Neuroscience*, 27(9): 2272-2282.
- Fossella, JA & Casey, B.J. (2006) Genes, Brain and Behavior: Bridging Disciplines. *Cognitive, Affective and Behavioral Neuroscience*, 6(1):1-8.
- Galvan, A, Hare, T, Parra, CE, Penn, J, Voss, H, Glover, G & Casey, B.J. Earlier development of the accumbens relative to orbitofrontal cortex may underlie risk taking in adolescence. (2006). *Journal of Neuroscience* 26(25):6885-6892.
- Galvan, A., Hare, T.A. Voss, H., Glover, G. & Casey, B.J, Risk Taking and the Adolescent Brain: Who is at Risk? *Developmental Science* 10: 8-14 (2007).
- Ganzel, B., Casey, B.J., Voss, H.U., Glover, G., & Temple, E. The aftermath of 9/11: Effect of intensity and recency of trauma on outcome. *Emotion*. (in press).
- Hannula, M. M., & Lepola, J. (2006). Huomio lasten taitoihin ennen kouluikää. [Focus on children's skills before schoolage.] In J. Lepola & M. M. Hannula (toim.) Kohti koulua. Kielellisten, matemaattisten ja motivationaalisten valmiuksien kehitys [On the Way to School. The Development of Linguistic, Mathematical and Motivational Skills.] (pp. 9-21). Kasvatustieteiden tiedekunnan julkaisusarja A:205. Turku: Painosalama.
- Hannula, M. M., & Lepola, J. (2006). Matemaattisten taitojen kehittyminen esi- ja alkuopetuksen aikana: Mitkä tekijät ennakoivat aritmeettisten taitojen kehitystä? In J. Lepola & M. M. Hannula (toim.) Kohti koulua. Kielellisten, matemaattisten ja motivationaalisten valmiuksien kehitys [On the Way to School. The Development of Linguistic, Mathematical and Motivational Skills.] (s. 129-149). Kasvatustieteiden tiedekunnan julkaisusarja A:205. Turku: Painosalama.

- Hannula, M. M., Räsänen, P. & Lehtinen E. (2007). Development of Counting Skills: Role of Spontaneous Focusing on Numerosity and Subitizing-based Enumeration. *Mathematical Thinking and Learning*, 9 (1), 51-57.
- Joanisse, M.F., Zevin, J.D., & McCandliss, B. D. (2006). Brain mechanisms implicated in the preattentive categorization of speech sounds revealed using fMRI and short-interval habituation trial paradigm. *Cerebral Cortex*, doi: 10.1093/cercor/bhl124.
- Johnson, S. P., Amso, D., Frank, M. C., & Shuwairi, S. M. (in press). Perceptual development in infancy as the foundation of event perception. To appear in T. F. Shipley & J. Zacks (Eds.), *Understanding events: How humans see, represent, and act on events*. New York: Oxford University Press.
- Kotsoni, E, Byrd, D & Casey, B.J. Special Considerations for fMRI of Pediatric Populations. *Journal of Magnetic Resonance Imaging* (2006).
- Lehtinen, E., & Hannula, M. M. (2006). Attentional Processes, Abstraction, and Transfer in Early Mathematical Development. In L. Verschaffel, F. Dochy, M. Boekaerts, and S. Vosniadou (eds.) *Instructional Psychology. Past, Present and Future trends*. (pp. 39-55). Amsterdam: Elsevier.
- Lepola, J. & Hannula, M. M. (Eds.) (2006). Kohti koulua. Kielellisten, matemaattisten ja motivaationaalisten valmiuksien kehitys [On the Way to School. The Development of Linguistic, Mathematical and Motivational Skills.] *Kasvatustieteiden tiedekunnan julkaisusarja A:205*. Turku: Painosalama.
- Liston, C, Miller, MM Goldwater, DS Radley, JJ Rocher, AB Hof, PR Morrison, JH and McEwen, BS (2006). Stress-Induced Alterations in Prefrontal Cortical Dendritic Morphology Predict Selective Impairments in Perceptual Attentional Set-Shifting. *Journal of Neuroscience*, 26(30):7870-787
- Liston C, Matalon S, Hare TA, Davidson MC, Casey BJ (2006). Anterior cingulate and posterior parietal cortices are sensitive to dissociable forms of conflict in a task-switching paradigm. *Neuron*. 18;50(4):643-53.
- Liston, C., Watts, R., Tottenham, N., Davidson, M. C., Niogi, S., Ulug, A. M., et al. (2006). Frontostriatal microstructure modulates efficient recruitment of cognitive control. *Cereb Cortex*, 16(4), 553-560.
- Mattinen, A., Hannula, M. M., & Lehtinen, E. (2006). Katsotaanpas kuinka monta jalkaa tallä toukalla on! Lapsen ohjaaminen lukumaarien havaitsemiseen ja kasittelemiseen. [Let's see how many legs this caterpillar has! Guiding children's focus on numbers.] In J. Lepola & M. M. Hannula (toim.) *Kohti koulua. Kielellisten, matemaattisten ja motivaationaalisten valmiuksien kehitys* [On the way to school. The development of linguistic, mathematical and motivational skills.] (s. 155-181). *Kasvatustieteiden tiedekunnan julkaisusarja A:205*. Turku: Painosalama.
- Maurer U., & McCandliss, B. D. (in press). The development of visual expertise for words: the contribution of electrophysiology In E. L. Grigorenko & A. Naples (Eds.). *Single-Word Reading: Cognitive, behavioral and biological perspectives*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Niogi SN, Mukherjee P, McCandliss BD. Diffusion Tensor Imaging Segmentation of White Matter Structures Using a Reproducible Objective Quantification Scheme (ROQS). *Neuroimage*. 2007 Mar;35(1):166-74. Epub 2007 Jan 4.
- Niogi, S.N., & McCandliss, B. D. (2006). Left lateralized white matter microstructure accounts for individual differences in reading ability and disability. *Neuropsychologia*, 44(11): 2178-2188.
- Noble, K. G., Farah, M. & McCandliss, B. D. (2006). Socioeconomic background modulates cognition-achievement relationships in reading. *Cognitive Development*, 21, 349-368. Noble, K. G., Wolmetz, M.E., Ochs,

- Noble, K. G., McCandliss, B. D., & Farah, M. (in press). Socioeconomic gradients predict individual differences in neurocognitive abilities. *Developmental Science*.
- Noble, K.G., Farah, M. & McCandliss, B. D. (2006). Brain-behavior relationships in reading acquisition are modulated by socioeconomic status factors. *Developmental Science*, 9:6(2006), 642-654.
- Pardo, J.V., Pardo, P.J., Humes, S.W. & Posner, M.I. (2006) Neurocognitive dysfunction in antidepressant free non-elderly patients with unipolar depression: Alerting and covert orienting of visuospatial attention. *J. of Affective Disorders* 92, 71-78
- Posner, M.I. & Rothbart, M.K. (2007) Research on attention networks as a model for the integration of psychological science *Ann Rev of Psychology* 58, 1-23.
- Posner, M.I. & Rothbart, M.K.(2007) *Educating the human brain*. Washington DC:APA Books
- Posner, M.I. (2006) Neuropsychology of human attention networks. *Revista de Neuropsychologia* 1, 19-24.
- Posner, M.I., Rothbart, M.K. & Sheese, B.E. (2007) Attention Genes *Developmental Science* 10, 24-29
- Posner, M.I., Rueda, M.R. & Kanske, P. (2007) Probing the mechanisms of attention. In J.T. Cacioppo, J.G. Tassinari & G.G. Berntson (eds) *Handbook of psychophysiology* 3rd Ed. Cambridge U.K.: Cambridge University Press 410-32
- Posner, M.I., Sheese, B, Odludas, Y., Tang, Y. (2006) Analyzing and shaping neural networks of attention. *Neural Networks*19, 1422-1429
- Radley, JJ Rocher, AB Miller, MM Liston, C, Janssen, WGM, Hof, PR McEwen, BS and Morrison, JH (2006). Repeated Stress Induces Dendritic Spine Loss in the Rat Medial Prefrontal Cortex. *Cerebral Cortex*16(3):313-320
- Raz, A., Fan, J., Posner, M.I. (2006) Neuroimaging and genetic association of attentional and hypnotic processes. *Journal of Physiology-Paris* 99, 483-491
- Rothbart, M.K. & Posner, M.I. (2006). Temperament, attention, and developmental psychopathology. in D. Cicchetti & D. J. Cohen (eds.), *Handbook of Developmental Psychopathology* Vol. 2 Revised. New York:Wiley Press. 465-501
- Rothbart, M.K., Posner, M.I. & Kieras, J. (2006) Temperament attention and self regulation. In K. McCartney & D. Phillips (eds.) *Handbook of early childhood development*. Ch. 17 pp. 338-357
- Rueda, M.R., Rothbart, M.K. Saccomanno, L., & Posner, M.I. (2007) Modifying brain networks underlying self regulation in D. Romer & E.F. Walker (eds) *Adolescent Psychopathology and the Developing Brain*. New York:Oxford Ch. 18 p. 401-419.
- Scerif, G, Kotsoni, E & Casey, BJ Functional neuroimaging of development. To appear in Roberto Cabeza and Alan Kingstone, (Eds.) *Handbook on Functional Neuroimaging of Cognition: Second Edition*, MIT Press. (2006).
- Scerif, G, Worden, MI, Yu, J, Casey, B.J. Context modulates early stimulus-processing when resolving stimulus-response conflict. *J of Cognitive Neuroscience*. (2006). 18:5 78-792.
- Schlaggar, B.L. & McCandliss, B. D. (in press). Development of Neural Systems for Reading. *Annual Review Neuroscience*.
- Schlesinger, M., Amso, D., & Johnson, S. P. (in press). The neural basis for visual selective attention in young infants: A computational account. *Adaptive Behavior*, Special Issue.
- Seidenberg, M. S., & Zevin, J. D. (2006). Connectionist models in developmental cognitive neuroscience: Critical periods and the paradox of success. In Y. Munakata., & M. Johnson. (Eds.), *Processes of Change in Brain and Cognitive Development*. Attention and Performance XXI. Oxford, UK: Oxford University Press.

- Spicer, J., Galvan, A., Hare, T.A. Voss, H., Glover, G. & Casey, B.J, Sensitivity of the Nucleus Accumbens to Violations in Expectation of Reward. *Neuroimage* 2006 34, 455-9.
- Suh M., Basu S., Kolster R., Sarkar R., McCandliss, B. D., & Ghajar, J. (in press). Increased oculomotor deficits during target blanking as an indicator of mild traumatic brain injury. *Neuroscience Letters*.
- Suh M., Kolster R., Sarkar R., McCandliss, B. D., J. Ghajar, & CNRC TBI (2006). Deficits in predictive smooth pursuit after mild traumatic brain injury. *Neuroscience Letters*, 401(1-2): 108-113.
- Swanson, JM, Kinsbourne, M Nigg, J Lanphear, B, · Stefanatos, G · Volkow, N · Taylor, E · Casey, BJ Castellanos, FX · Wadhwa, PD · Etiologic Subtypes of Attention-Deficit/Hyperactivity Disorder: Brain Imaging, Molecular Genetic and Environmental Factors and the Dopamine Hypothesis *Neuropsychology Review* (in press).
- Tamm, L., McCandliss, B. D., Liang, B. A., Wigal, T. L., Posner, M. I., & Swanson, J. M. (in press). Can attention itself be trained? Attention training for children at-risk for ADHD. In K. McBurnett (Ed.), *Attention Deficit/Hyperactivity Disorder: A 21st Century Perspective*. New York: Marcel Dekker.
- Tottenham, N., Hare, T.A., Casey, B.J. (in press). "A Developmental Perspective on Human Amygdala Function". Chapter in *The Human Amygdala*; Eds.: Phelps, E. & Whalen, P.
- Tottenham, N., Leon, A. C., & Casey, B. J. (2006). The face behind the mask: a developmental study. *Dev Sci*, 9(3), 288-294.
- Treiman, R., Kessler, B., Zevin, J. D., Bick, S. & Davis, M. (2006) Influence of consonantal context on the reading of vowels: Evidence from children. *Journal of Experimental Child Psychology*, 93, 1-24.
- Tricomi, E., Delgado, M. R., McCandliss, B. D., McClelland, J. L., & Fiez, J. A. (2006). Performance feedback drives caudate activation in a perceptual learning task. *Journal of Cognitive Neuroscience*, 18(6): 1029-1043.
- Voss, H. U., McCandliss, B. D., Ghajar, J., Suh, M. (in press). A quantitative synchronization model for smooth pursuit target tracking. *Biological Cybernetics*.
- Voss, H. U., Zevin, J. D., & McCandliss, B. D. (2006). Functional MRI at 1.5 and 3 Tesla: a comparison. *Neuroimaging Clinics of North America*, 16, 285-297.
- Voss, H.U., Ulug, A.M., Dyke, J.P., Watts, R., Kobylarz, E.J., McCandliss, B., Heier, L.A., Beattie, B.J., Hamacher, K.A., Vallabhajosula, S., Goldsmith, S., Ballon, D., Giacino, J.T., Schiff, N.D. (2006). Possible axonal regrowth in late recovery from the minimally conscious state. *Journal of Clinical Investigation*, 116(7): 2005-11.
- Zevin, J. D. & Seidenberg, M. S. (2006) Simulating consistency effects and individual differences in nonword naming. *Journal of Memory and Language*, 54, 145-160.
- Zevin, J. D. (in press) Word recognition. In L. Squire (ed.), *New Encyclopedia of Neuroscience*, Oxford, UK: Elsevier Ltd.