

**Annual Report of the Sackler Institute for Developmental Psychobiology  
Weill Medical College of Cornell University  
July 2004-July 2005**

Under the continued direction of Dr. B.J. Casey, the Institute's international reputation and productivity in research and training on typical and atypical brain development remains extremely high. The Institute's program of research and training emphasize genetic, brain and behavioral influences on cognitive and emotional development. Select studies are highlighted in this report (see *Program of Research and Publications*). The faculty and fellows have received a number of grants and awards and the Institute continues to be home for several international and national faculty and fellows (See *Grants and Awards*). The Institute's network has broadened this past year with new international collaborations now established in Romania, London, Cambridge and Glasgow and with research fellows from Greece, Italy, The Netherlands, and Switzerland and a recently formed exchange program between the Sackler Institute and Birbeck College in London (see *Education, Training and Outreach*).

**Academic Faculty and Staff**

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., Associate Professor of Psychology in Psychiatry  
John Fossella, Ph.D., Assistant Professor of Molecular Biology in Psychiatry  
Michael Worden, Ph.D., Assistant Research Professor in Psychiatry  
Matthew Davidson, Ph.D., Instructor

Staff:

Alpana Choudhry, Research Assistant  
Elizabeth Dibble, Research Assistant  
Clayton Eccard, Institute Administrator  
Eva Hulse, Research Assistant  
Marcella Nurse, Research Assistant  
Lisa Ochs, Research Assistant  
Julie Spicer, Research Assistant  
Michael Wolmetz, Research Assistant

**Sackler National and International Fellows**

Predoctoral Fellows:

Adriana Galvin, Ph.D. student, Neuroscience (Casey)  
Todd Hare, Ph.D. student, Neuroscience (Casey)  
Conor Liston, M.D. Ph.D. student, Tri-Institutional Program (Casey)  
Sumit Niogi, Ph.D. student, Physiology (McCandliss)  
Kim Noble, M.D., Ph.D. student, University of Pennsylvania (McCandliss)  
Nim Tottenham, Ph.D. student, University of Minnesota (Casey)

Postdoctoral Fellows:

Dana Byrd, PhD, Columbia-Cornell Sackler Fellow (Casey and Fifer)  
Barbara Ganzel, PhD, Cornell-Ithaca Fellow (Casey)

Eleni Kotsoni, PhD, Sackler Fellow (Casey)  
Urs Maurer, PhD, Sackler Fellow (McCandliss)  
Jason Zevin, PhD, Sackler Fellow (McCandliss)

International Sackler Scholars:

Oana Benga, Babes-Bolyai University, Romania  
Sarah Durston, University of Utrecht, The Netherlands  
Annette Karmiloff-Smith, University College London, United Kingdom  
Gaia Scerif, University of Nottingham, 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 five different domains: perception, learning, motivation and affect, genomics and developmental disabilities.

1) Studies of Perception

*Object Perception in Infancy.* Drs. Casey and Worden continue their collaborations with Dr. Scott Johnson and Dima Amso of NYU on electrophysiological studies of visual perception in infants as they view occluded objects. Infants as young as 4 months show surprise when occluded moving objects fail to emerge from behind a static object. The electrophysiological component of this study will constrain current developmental theory on how infants learn to recognize violations in expectations about objects that are occluded.

*Perceptual Processing of Faces in Children.* Dr. BJ Casey and PhD candidate, Nim Tottenham, have developed behavioral assays for measuring how quickly children can process faces and objects. Given our vast experience with faces, the finding that children process faces faster than other objects such as houses suggests that extensive experience 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 to faces over other objects with age. This groundbreaking developmental research is important for understanding developmental disorders such as autism for which faces appear to be processed differently.

*Emotional Perception and Brain Responses to Faces.* Dr. Bruce McCandliss, PhD candidate Nim Tottenham, and visiting fellow Vera Blau (University of Maastricht) have used electrophysiology measures of early neural responses to faces to examine how emotional expressions are perceived. They have demonstrated responsiveness to facial affect in typical adults within 200 milliseconds of perception, suggesting that emotions are assessed during the initial perception of faces. This finding and paradigm may eventually serve as a developmental assay for emotional responsiveness in typical and atypically developing children.

*Rapid Visual Word Perception in Adults and Children.* Drs. McCandliss and Maurer, International Sackler Fellow from Switzerland, are actively pursuing the neural basis for specialization for 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. We are now examining the

development of this ability in typical and atypically developing children, which will inform research on reading development and dyslexia.

*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 fMRI (See Zevin & McCandliss, in press) to examine the neural basis for learning distinct sounds early in life depending 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 learning language. This work is funded by an NRSA postdoctoral fellowship to Dr. Zevin.

## 2) Studies of Motivation and Affect

*Delay in Gratification.* Drs. Casey and Fossella are working with Dr. Walter Mischel of Columbia University to relate the ability of preschoolers in a delay gratification task with measures of cognitive control in adolescents. Preliminary results suggest those individuals most able to wait for a reward, as a toddler, are better able to resolve conflict on cognitive control tasks as adolescents. We are currently imaging and genotyping these subjects to explain the biological basis for the observed individual differences in this ability. A collaborative NSF grant among Columbia University, University of Washington and Cornell has been submitted to support this program of research.

*Development of Reward Systems.* Work funded by a NIDA R21 and R01 grant to Dr. Casey examines the development of reward related circuitry implicated in addiction (Davidson et al., 2004). Preliminary findings suggest that adolescents have exaggerated responses in dopamine rich frontostriatal regions (nucleus accumbens) that may explain the greater risk of substance abuse during this period (Galvan et al, under review). This task is currently being used by collaborators at Brookhaven Laboratories and Brown University with patient populations and formed the basis of a NIDA P20 submission by Casey, Dr. Barry Kosofsky (PI) of the Department of Pediatrics, and Drs. Stewart Anderson and Francis Lee of Lasdon Laboratories in the Department of Psychiatry.

*Approach- and Avoidance-related Behavior.* Dr. Casey together with Todd Hare, a Neuroscience PhD student and Nim Tottenham, a Minnesota PhD student are examining the interaction of frontostriatal and frontoamygdala circuitry in affect regulation in children and adults. They are using facial expressions in a go/nogo task together with fMRI. Their results show an inverse association between brain systems involved in avoiding happy expressions and those involved in approaching negative expressions (Hare et al 2004, in press). Hare has a pending NRSA to support this work (score 141, 3<sup>rd</sup> percentile).

## 3) Studies of Learning

*Attention and the learning of literacy and numeracy.* Drs. McCandliss and Posner are exploring methods of enhancing attention abilities in children. They have shown together with Dr. Jin Fan of Mt Sinai 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. This work is funded in part by the National Science Foundation and is now being carried out in the New York City public elementary schools.

*Enhancing Literacy through Tutors and Computers* Dr. McCandliss together with collaborators at University of Pittsburgh have continued to provide empirical support for a child-friendly computer program designed to guide a minimally trained tutor and a child with 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. 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, and novel fMRI activation tasks to measure the impact of learning. A follow-up NSF funded project, 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).

*Intermittent versus Continuous Reward Schedules.* Dr. Casey and Julie Spicer, a recently admitted Ph.D. candidate to Columbia University, have examined the neural basis of learning from intermittent and continuous reward schedules. They have shown that the nucleus accumbens, a reward related brain structure, shows enhanced activity for intermittent reward relative to continuous reward. These findings provide a neural basis for the effects of different reward schedules on behavior and are relevant to understanding motivational-based disorders and interventions.

*Neural Basis of Statistical Learning.* Dr. Casey and Dima Amso, a Ph.D. candidate at NYU, are examining the neural basis of statistical learning. They developed a paradigm that simultaneously manipulates the statistical frequency of a stimulus and the frequency of associations between stimuli. 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. The results show that the caudate nucleus appears to be involved in simple frequency based learning while the hippocampus appears to contribute to learning of associations between stimuli (Amso et al 2005).

*What Changes with Learning and Development.* Dr. Casey, Conor Liston, a tri-institutional M.D., Ph.D. student and Dr. Sarah Durston at the University of Utrecht have collaborative studies that examine cross sectional and longitudinal data from brain imaging studies on cognitive control. The 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.

#### 4) Genomic Investigations

*Imaging Genetics of ADHD.* Drs. Fossella and Casey in collaboration with Dr. 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 including 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. They showed a dissociation between the effects of DAT genotype and DRD4 genotype, with those heterozygous for the DAT polymorphism impacting caudate volumes, but not prefrontal gray matter volumes and those with the DRD4 variant genotype impacting prefrontal gray matter volume, but not caudate volume. These results are published in *Molecular Psychiatry* (see Durston et al., 2005).

*Genetics and Treatment of ADHD.* Dr. Fossella is a collaborator on an NIMH funded study of the genetics of ADHD, under the direction of Professor Jeff Halperin, Queens College, CUNY. This project will link genetic variation in several serotonergic genes with measures of response to serotonergic medications. This project is presently in the early stages and has not yielded any publications. However, a collaboration on the role of the DRD4 gene in ADHD between Dr. Fossella and Professor Stephanie Hammarman, Rutgers University Medical School, was completed and published in the *Journal of Child & Adolescent Psychopharmacology*. This study found a significant association between DRD4 genotype and response to methylphenidate.

*Genetics of Normal Attentional Development (Alerting, Orienting and Executive Attention).* Dr. Fossella has continued his studies on genetic influences on attention that were initiated in 2000 under the direction of Dr. Posner. These studies are aimed at exploring how various neurotransmitter genes influence the specific processes of alerting and executive attention. Dr. Fossella's latest study concerns the role of noradrenaline on alerting in normal adult subject. Studies in non-human primates and humans show that pharmacologic modulation of noradrenaline levels by the alpha-2 adrenergic agonists clonidine and guanfacine lessen the alerting effect. In order to explore the molecular basis of this finding in more detail, Dr. Fossella has undertaken human genetic studies concerning the adrenergic-2A receptor gene (ADRA2A). A pilot study of 80 human subjects suggested an association between ADAR2A and alerting ( $p < 0.05$ ). These studies and other past work conducted by Drs. Fossella, Fan and Posner were presented at the first *Annual Imaging Genetics Meeting*, held at the University of California Irvine in January of 2005.

*Cholinergic Genes and Orienting of Attention.* A collaboration between Dr. Fossella and Professor Raja Parasuraman of George Mason University was completed and published this year. This study focused on the role of cholinergic genes and their role in the orienting of attention. Gene association studies of a T-to-C polymorphism in CHRNA4, a nicotinic receptor subunit gene and this aspect of attention were published in *Psychological Science* in March of this year.

*Genomics Initiative in Psychiatry.* Dr. Fossella has begun to explore how genetic technology will be applied in the clinical setting. In two articles, "Aligning the stakeholders" published in *Pharmacogenomics* and "On the valuation of genetic tests" published in *Personalized Medicine*, Dr. Fossella has examined progress in the field of genomic medicine and discussed the role of population genetic structure in the development of new genetically optimized therapies.

*Genes, Brain, and Behavior.* Drs. Casey and Fossella are co-editing a special issue of the journal *Cognitive, Affective, and Behavioral Neuroscience* that will include studies of behavioral genetics, imaging genetics and animal models of genes implicated in human behavior.

##### 5) Developmental Disabilities

*Brain Development following Institutionalization.* 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 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. These preliminary data have resulted in a NIMH funded R01 by Dr. Casey with consultation with Dr. Bruce McEwen of The Rockefeller University.

*Double Blind Cross-Over Placebo-Ritalin Challenge.* In a NIMH collaboration with Duke, Columbia, Stanford and UC Berkeley, Dr. Casey is examining the imaging profiles of children and their parents with ADHD on behavioral assays she has developed at the Institute and how these change with medication. Preliminary findings on this clinical population were published in *Biological Psychiatry* (see Durston et al 2003) and the most recent findings show normalization of behavior and prefrontal and subcortical activity with medication.

*Effects of Prenatal Exposure to Cocaine on Brain Development.* Dr. Casey together with Dr. Barry Kosofsky (PI) of the Department of Pediatrics, Drs. Lee and Anderson of the Department of Psychiatry and Dr. Barry Lester of Brown University have submitted a NIDA P20 grant to examine brain development in mice and humans exposed to cocaine prenatally. This project illustrates a vertically integrated program of research across animal models thru complex human imaging and clinical diagnostics. Preliminary imaging data have been submitted for publication.

*Traumatic Brain Injury and Predictors of Outcome.* Dr. McCandliss (co-PI) has joined forces with Dr. Ghjar (PI), President of 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." The central hypothesis of this project is that deficits in mild TBI including 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.

*Impact of Poverty on Brain and Behavior.* Dr. McCandliss and Kim Noble, a University of Pennsylvania M.D., Ph.D. student are examining neuropsychological constructs related to socioeconomic status in children. They have found a specific association between low SES and language skills that may be remedied with extensive exposure to print and reading interventions. Preliminary findings have been published (see Noble et al., 2004; Noble et al., in press).

## **Education, Training and Outreach**

A significant objective of the Institute is in training, education and outreach. The Institute's network has broadened this past year with new international collaborations now established in Romania, London, Cambridge and Glasgow, in addition to existing national ones at Berkeley, Boston College, 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 University of Pennsylvania, UCLA, Minnesota, Greece, Italy and Switzerland. Highlights of the Institute's training and outreach program are provided below.

*NYLon(don) Student/Faculty Exchange Program.* A Student/Faculty exchange program between the Sackler Institute in NY and the Centre for Brain and Cognitive Development at Birbeck College in London has been established. This initiative is referred to as the NYLon(don) Exchange and will consist of mini sabbaticals for students and faculty at each institution. The Sackler Institute specializes in functional magnetic resonance imaging and genetics in human development, while the Centre for Brain and Cognitive Development specializes in infant electrophysiological imaging and computational models of typical and atypical early development. This exchange program will strengthen the program of research at both institutions.

*Summer Institute on the Biology of Developmental Disabilities.* Casey has received funding for a fifth year to direct a week-long course on the biology of developmental disabilities from the John Merck Fund. The course trains psychologists and neurobiologists in methods used in developmental science (imaging, genetics, and behavior) in the context of central themes of behavioral and brain development ( see: <http://www.sacklerinstitute.org/cornell/summerinstitute/> ).

*Developing Researchers in Neuropsychiatric Imaging.* The Institute actively participates in summer workshops with the Functional Neuroimaging Laboratory directed by Drs. David Silbersweig 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 become the Director of the Neuroscience Program at Weill Graduate School of Medical Science that includes over 50 faculty and nearly 60 graduate students. The Institute has taken a significant role in both teaching and sponsoring student rotations and PhD candidates from that program and from the Tri-institutional MD PhD program.

*Organization for Economic Cooperation and Development(OECD Symposium).* Dr. McCandliss organized a three-day international symposium in El Escorial, Spain, on the brain bases of literacy, as part of his continued scientific advisor role to the Literacy Network 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.

*NYAS Imaging Discussion Group.* Dr. Casey, together with Drs. Truman Browne of Columbia University and Joe Helpert of NYU, have formed an 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.

*NYAS Symposium.* Dr. Casey organized a symposium at the New York Academy of Sciences entitled “Emotions: The Good, The Bad and Learned” that showcased the work of the Sackler Institute and others. The speakers included Nim Tottenham of the Sackler Institute, Rene Hen and Kevin Ochsner of Columbia University, and Joe LeDoux of NYU.

*Romania and US Collaboration.* Dr. Casey is editing a book with Dr. Oana Benga of Babes-Bolyai University in Romania on developmental cognitive neuroscience that will be published by Lawrence Erlbaum. This edited volume will expose Romanian scientists to work being done in the US and vice versa.

*Society for Research in Child Development (SRCD) Invited Symposium.* Dr. McCandliss organized an invited international symposium entitled “Cognitive and Brain Mechanisms of Reading Development and Disability: An International Perspective”, which brought together a diverse international panel including researchers from the Yale dyslexia project (Shawwitz), Beijing, China, (Shu Hua), and Jyväskylä, Finland (Lyytinen).

*Meeting of the UK and US Sackler Institutes.* Dr. Casey is organizing a two-day meeting of the UK and US Sackler Institutes at the New York Academy of Medicine this June. This meeting is funded by a generous gift from the Sackler family and will foster collaborative research across the four sites. In preparation for this meeting, Dr. Casey invited Drs. Jonathan Cavanaugh and David Wyper of Glasgow, following several informal exchanges, to meet with faculty from both Sackler Institutes in the US. This

visit formed the basis for a number of potential collaborative projects, especially in the domain of psychiatric genetics that will be fully developed during the June meeting.

## **Grants and Awards**

Dr. Casey has received a NIMH R01 grant entitled *Brain Development following Institutionalization*. This program of research will examine the effects of institutionalization and subsequent adoption on the development of amygdala and hippocampal structure and function using the animal and human literature on glucocorticoids and stress to constrain predictions and interpretations.

Dr. Casey has a received a NIDA R01 entitled *Development of Basic Component of Decision Making* that examines the development of cognitive and neural processes underlying decision-making that may place adolescents at greater risk for substance abuse. This program of research involves formal models of reinforcement learning and principles of decision-making together with functional neuroimaging.

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.

Drs. Casey and Fossella , together with Dr. Walter Mischel of Columbia University and Dr. Yuichi Shoda (PI) of the University of Washington have submitted a collaborative NSF grant application to test hypothesized links between cognitive neuroscience measures of basic cognitive-control mechanisms, developed at the Institute, and distinctive life trajectories of self-control in delay of gratification developed by Dr. Mischel. The proposed program of research will use imaging, genetics and behavioral methodologies to explain individual differences in self regulation.

Dr. Casey together with Barry Kosofsky (PI) of the Department of Pediatrics, Drs. Lee and Anderson of the Department of Psychiatry and Barry Lester of Brown University have submitted a NIDA P20 grant to examine brain development in mice and humans exposed to cocaine prenatally.

Todd Hare has a NIMH NRSA predoctoral grant application sponsored by Dr. Casey that is pending (score 141, percentile 3.4), on the development and neurobiology of affective regulation using fMRI.

Conor Liston, a Tri-Institutional M.D., Ph.D. candidate won the Paul and Daisy Soros Fellowship Award this year . This prestigious award will support his program of research on the effects of stress on the brain in rats in humans under the co-direction of Drs. Casey and Dr. Bruce McEwen of the Rockefeller University.

Drs. McCandliss and Zevin have a pending NIMH R01 to examine the development of speech perception and the neural basis of the critical period effect in language learning.

Dr. McCandliss, Dr. Zevin and Bruno Tagliaferri have a pending NIH-STTR grant to help develop and distribute software that addresses the particular challenges faced by cognitive neuroscience research laboratories that attempt to combine eye-tracking, electrophysiology, and fMRI data collection techniques, thereby furthering the Sackler Institute's role as both a site of innovation and a source of useful techniques for the rest of the field.



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.

## **Publications**

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- Casey, B.J. (2004). *Developmental Psychobiology*, Review of Psychiatry Series, Volume 23 Editor, American Psychiatric Publishing.
- Casey, B.J., Amso, D. & Davidson, M.C (in press). 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*. Cambridge, MA: MIT.
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- Diamond, A., Munakata. Y. & Casey, BJ (under contract) *Cognitive Developmental Neuroscience: A Textbook*. Oxford Press.
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- Durston, S., Davidson, M.C., Tottenham, N., Galvan, A., Spicer, J., Fossella, J.A. & Casey, B.J. (under review). A Shift from Diffuse to Focal Cortical Activity with Development.
- Durston S., Fossella J., Casey B.J., Hulshoff H., Galvan A., Schnack H., Steenhuis M., Minderaa, R., Buitelaar, J., Kahn, R., van Engeland, H. (2005). Differential effects of DRD4 and DAT1 genotype on fronto-striatal gray matter volumes in a sample of subjects with attention deficit hyperactivity disorder, their unaffected siblings, and controls. *Mol Psychiatry* (epub at present).
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- Hare, T.A. & Casey, B.J. (in press). The neurobiology and development of cognitive and affective control. *Cognition, Brain, Behavior*.
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- Kotsoni, E., Byrd, D & Casey, B.J. (in press). Considerations in Functional Magnetic Resonance Imaging of Pediatric Populations. *Journal of MR*.
- Ladouceur, C.D., Dahl, R.E., Williamson, D.E., Birmaher, B., Ryan, N.D., & Casey, B.J. (in press). Altered Emotional Processing in Pediatric Anxiety, Depression, and Comorbid Anxiety-Depression. *Journal of Abnormal Child Psychology*.
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