I. Overview.

Penn’s Center for Cognitive Neuroscience embodies many of the university’s highest ideals: interdisciplinary research crossing department and school boundaries, eminence in the wider academic community, and commitment to education at the undergraduate and graduate levels.

In this report we review the CCN’s activities and accomplishments for the period 1/2006-6/2007, focusing on the faculty (Section II), our contributions to other programs on campus (Section III), our educational accomplishments (Section IV), external funding (Section V) and our needs going forward (Section VI).

II. Faculty

Our 10 core faculty members include 7 internationally respected senior leaders in the field of cognitive neuroscience and 3 outstanding junior colleagues whose work is already influential. Core faculty are evenly divided between Psychology in SAS (Russell Epstein, Martha Farah, Amishi Jha, Michael Kahana, and Sharon Thompson-Schill) and Neurology in SOM (Geoffrey Aguirre, Anjan Chatterjee, Branch Coslett, John Detre and Murray Grossman). This census takes into account the loss of one of our junior faculty members, Matthew Botvinick, who had been an Assistant Professor in Psychiatry. Matt left for a position in the Princeton University Psychology Department, attracted by the “hard money” salary and the better facilities available there. There are also 2 Research Assistant Professors in the CCN (Daniel Kimberg, Neurology and Ingrid Olson, Psychology) who contribute to the scientific vitality of the Center, and many associated postdocs, students and staff. As a group we divided between the 3808-3810 Walnut Street, 3401 Walnut Street and the Gates and Maloney buildings of HUP. In addition there are now 39 affiliated faculty members from 13 departments at Penn.

CCN faculty are investigating the central questions of cognitive neuroscience: How do we perceive, remember, communicate, reason, and learn? Our recent progress toward answering these questions is documented in the 128 refereed articles by us published or in press in this reporting period, which are listed in Appendix I.

Although research is the foundation of our scientific leadership, our many other professional activities provide a useful gauge of our standing in the field of cognitive neuroscience. These activities include editing journals, serving our professional societies through committee work, and teaching our peers at national and international workshops and meetings.

Editorial service. CCN core faculty have been appointed editors of some of our field’s leading journals. From our group of 10 core faculty, 6 of us currently hold editorships or associate editorships:

- *Cognitive and Behavioral Neurology* (Grossman)
- *Cognitive Psychology* (Kahana)
- *Journal of Cognitive Neuroscience* (Chatterjee)
- *Journal of Cognitive Neuroscience* (Farah)
NeuroCase (Coslett)
Neuroscience Letters (Aguirre)

We also hold 16 additional editorial board positions:

American Journal of Bioethics-Neuroscience (Farah)
Behavioral and Cognitive Neuroscience Reviews (Farah)
Behavioral Neurology (Chatterjee)
Brain and Language (Coslett, Grossman)
Cognitive and Behavioral Neurology (Chatterjee)
Cognitive Neuropsychology (Chatterjee, Coslett, Farah)
Empirical Studies of the Arts (Chatterjee)
Journal of the International Neuropsychological Society (Grossman)
Journal of Neuroimaging (Detre)
Neuroethics (Farah)
Neurology (Grossman)
Neuropsychology (Chatterjee)
Psychonomic Bulletin and Review (Kahana)

Teaching and other service to national and international organizations. CCN faculty members are called upon by their peers to teach in professional courses and workshops at major national and international meetings. Major teaching venues this report period include the American Academy of Neurology (Chatterjee, Coslett, Detre), American Academy of Physiatrists (Detre), American Academy of Psychiatry (Aguirre), the Center for Mindfulness Workshop (Jha), the National Institutes of Health Workshops (Detre), and the Wellcome Trust Bioethics Summer School (Farah).

In addition, we have all traveled to give invited talks in the past 18 months, including a number keynote and plenary addresses at meetings (Aguirre, Farah, Grossman, Thompson-Schill).

Other national and international service ranged from writing the cognitive neurology questions for medical board exams to updating the Dalai Lama on advances in neuroscience.

American Academy of Neurology
Aging/Dementia and Cognition Working Group (Chatterjee)
Executive Committee, Cognitive and Behavioral Neurology (Coslett)
American Board of Psychiatry and Neurology
Question-writer (Chatterjee)
American Heart Association
Stroke Council (Detre)
American Neurological Association
Program Committee (Coslett)
Association for Frontotemporal Dementias
Medical Science Committee (Grossman)
Cognitive Science Society
Membership Committee (Farah)
Charles A. Dana Foundation
Grant Review (Detre)
Web Site Co-Editor (Grossman)
Foundation for the Advancement of Behavioral and Brain Science
    Council member (Farah)
Garrison Institute
    Program Committee (Jha)
Goldie Hawn Foundation
    External Advisory Committee (Jha)
Haverford College
    Board of Directors (Chatterjee)
Mind and Life Institute
    Conference Planning Committee (Jha)
    Dialogue leader, meeting w HH The Dalai Lama (Farah)
National Institutes of Health
    Grant Review Panel Member (Coslett, Detre, Jha, Kahana, Thompson-Schill)
    NINDS Progress Review Group (Detre)
    NICHD Mental Retardation Research Subcommittee (Detre)
National Science Foundation
    Grant Review Panel Member (Detre)
Neuroethics Society
    Founding member (Chatterjee)
    Founding member and Secretary (Farah)
Society for Neuroscience
    Education Committee (Thompson-Schill)
Sundance Film Festival
    Sloan Award Jury for Science in Film (Farah)

**Other honors and recognition.** We have been honored in other ways during this period, including being elected a Fellow of the American Neurological Association (Chatterjee), American Academy of Neurology (Coslett), and American Association for the Advancement of Science (Farah).

The outstanding quality of our teaching has been recognized with the Charles Ludwig Distinguished Teaching Award (Jha) and the Lindback Award for Distinguished Teaching (Thompson-Schill).

Our work continues to receive attention in the media including, during the period of this report, Time Magazine, the New York Times, the London Times, Science Magazine and Scientific American.

**III. Links with other organizations on campus**

The CCN enjoys many fruitful interactions and collaborations across the campus. From our list of 39 affiliated faculty from 13 departments, 33 individuals attended our full-day, off-campus retreat in January of this year. The retreat featured discussions of research infrastructure and educational programs for cognitive neuroscience at Penn, as well as opportunities to establish new research and teaching collaborations.
Our relations with the Institute for Research in Cognitive Science (IRCS) are close and collaborative. Among our joint projects are the Undergraduate Summer Workshop in Cognitive Science and Cognitive Neuroscience and the Brain and Language Discussion Group (both described later).

We continue to work closely with the Institute for Neurological Sciences (INS) and the Neuroscience Graduate Group (NGG), functioning as their cognitive “division” for purposes of graduate training and recruiting. Drs. Detre and Farah serve on the Advisory Board of the INS.

We also play leadership roles in our departments, with Dr. Coslett serving as Neurology’s Chief of Cognitive Neurology and Vice Chair for Research, and Dr. Thompson-Schill directing the Psychology Department’s undergraduate Honors Program.

Finally, we participate extensively in activities of the Center for Functional Neuroimaging (CfN). The CfN has become a vital asset to cognitive neuroscience research at Penn, and in addition to using its many valuable resources, we collaborate with them in teaching and fund-raising.

IV. Educational Impact

The CCN contributes to the educational mission of the University in a number of ways:

UNDERGRADUATE EDUCATION

In the past few years we have transformed the educational opportunities for mind-brain studies at the undergraduate level. The number of undergraduate course offerings in cognitive neuroscience has tripled, enrollments continue to climb, and our flagship introductory course is now taught both semesters.

The dedication of CCN faculty to undergraduate education is apparent in the new undergraduate image analysis laboratory facility developed by Amishi Jha, the two teaching awards won by Amishi Jha and Sharon Thompson-Schill, and the undergraduate thesis award won by Russell Epstein’s advisee, Whitney Parker.

Courses:

Undergraduate interest in cognitive neuroscience is high, and CCN faculty members are striving to satisfy the demand for courses and lab experiences. Since the founding of the CCN, two large introductory lecture courses have been developed, and one of them is now offered twice a year to meet growing demand.

PSY 149: Introduction to Cognitive Neuroscience, taught by Drs. Thompson-Schill and Epstein (Spring 06: 86 students; Fall 06: 57 students; Spring 07: 70 students).

COLL 002: Perspectives on Cognitive Neuroscience: Mind, Brain and Society, co-taught by Drs. Farah and Stephen Morse (not offered this period but typically enrolls about 90 students).
In addition, Penn undergraduates now have the opportunity to learn about cognitive neuroscience methods thanks to hands-on laboratory courses, including one that focuses specifically on functional neuroimaging. Undergraduate access to this cutting edge technology has been facilitated by an fMRI teaching lab designed by Dr. Jha.

**PSY 349: Research Experience in Functional Neuroimaging**, taught by Dr. Jha (Spring 07: 16 students)

As more undergraduates complete the introductory level courses there is increasing demand for advanced undergraduate instruction. Courses offered in this reporting period include:

**PSY 159: Human Memory**, taught by Dr. Kahana (Spring 07: 85 students)

**PSY 249: Cognitive Neuroscience of Meditation**, taught by Dr. Jha (Spring 06: 21 students)

**PSY 270: Neuroethics**, taught by Dr. Farah (Freshman Seminar version Spring 06: 10 students; Spring 07: 9 students)

**Degree program:**

Students can now major in Cognitive Neuroscience through Track 1 (Neuroscience) of the Cognitive Science (COGS) program. In addition, although BIBB does not feature tracks, many students focus their coursework and research on cognitive neuroscience.

**GRADUATE EDUCATION**

**Ph.D. programs:** Students can pursue a doctorate in Cognitive Neuroscience through either the Neuroscience or the Psychology Graduate Group. CCN faculty play an active role in both graduate groups, as primary advisors, committee members, and for neuroscience students, lab rotation advisors. For the past few years the cognitive neuroscience candidates have been among the strongest applicants to these two programs. An institutional training grant from NIMH, “A Training Program in Behavioral and Cognitive Neuroscience,” provides partial support for some cognitive neuroscience students.

This year we continued the new tradition of holding an annual graduate student research symposium series, jointly with Princeton University, called the “Cognitive Neuroscience at Penn and Princeton Graduate Student Symposium.” Penn hosted the event last November, which featured conference-type talks and symposia by graduate students from the two institutions.

**M.D. programs:** CCN faculty members play a key role in teaching medical students about the neural bases of cognition through guest lectures, rounds and supervision, as well as Dr. Detre’s course on functional neuroimaging, BMB/BE 581. Cognitive neurology is the most frequently specified interest among the top applicants to Penn’s residency program in neurology, and recent graduates of this program have gone on to top fellowships and faculty positions.

**NONDEGREE EDUCATION**
Undergraduate Summer Workshop in Cognitive Science and Cognitive Neuroscience. A joint program with IRCS, each June we bring 20-30 top students from colleges across the country to attend a two-week intensive residential course at Penn. We are currently teaching the 9th such workshop.

Cognitive Neuroscience Talk Series. We hold a monthly lunchtime talk series that is well attended by people from throughout the University.

Brain and Language Talk Series, another biweekly talk series, co-hosted with IRCS.

Neuroethics Lecture Series. A monthly speaker series featuring outside speakers.

Cognitive Neurology Rounds. Drs. Chatterjee and Coslett conduct biweekly Cognitive Neurology Rounds for residents and students at HUP.

V. Funding

Although basic science is harder to support these days than previously, the CCN is continuing to expand its funding base. Appendix II lists the current grants held by CCN faculty and shows the amount in each grant for the current grant year. Counting the no-cost extensions, our total grant funding for this year is almost $10 million.

VI. Looking forward

Since its inception in 1999 the CCN has grown and flourished. We are excelling in our individual careers, interacting fruitfully with each other, and training the next generation of cognitive neuroscientists. In addition, we collaborate actively with a number of other organizations on campus, and our work brings benefits to our home departments of Psychology and Neurology.

In order to continue, we need more and better located space, specifically space in which the SAS and SoM faculty can be contiguous. As should be clear from this report, we are an unusually communal and collaborative group of researchers, and this has tangible benefits. These benefits include improved interdisciplinary science resulting from intensive interaction between those with primary expertise in neuroscience and those with primary expertise in cognitive science, a more interdisciplinary and intellectually supportive environment for graduate students, post docs, and undergraduate research students, and the economies of scale made possible with shared facilities and resources.

In the early years of the CCN the faculty, as well as many of their students and staff, had offices at 3810 Walnut Street. Unfortunately we have long since outgrown this space and are now split among 3 locations. Our current fragmentation is slowly but surely eroding the patterns of cooperation and collaboration that have made the CCN what it is today. We are encouraged by the recent progress in identifying space for us in the Goddard and Richards buildings, but note that much remains to be accomplished in terms of allocating sufficient space and preparing it for occupancy.
Appendix I. Refereed Articles


42. Fellows LK & Farah MJ (in press). The role of ventromedial prefrontal cortex in decision making: Judgment under uncertainty, or judgment per se? *Cerebral Cortex*.


<table>
<thead>
<tr>
<th>PI / Role on Project</th>
<th>Grant</th>
<th>Title</th>
<th>Start Date</th>
<th>End Date</th>
<th>Directs</th>
<th>Indirects</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PI: Geoffrey K. Aguirre, M.D., Ph.D.</td>
<td>Burroughs-Wellcome Career Development Award</td>
<td>fMRI of neural information processing of face perception</td>
<td>9/1/2006</td>
<td>8/31/2007</td>
<td>$128,000</td>
<td>$0</td>
<td>$128,000</td>
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<tr>
<td>PI: Geoffrey K. Aguirre, M.D., Ph.D.</td>
<td>Dana Foundation--Brain and Immuno-Imaging Program</td>
<td>Perceptual learning and consolidation studied with perfusion fMRI</td>
<td>1/1/2007</td>
<td>12/31/2007</td>
<td>$33,330</td>
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<td>$33,330</td>
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<td>PI: Anjan Chatterjee, M.D.</td>
<td>NIH-HD, R01 HD050199</td>
<td>Spatial Language Developmental and Neural Studies</td>
<td>8/1/2006</td>
<td>7/31/2007</td>
<td>$174,270</td>
<td>$70,259</td>
<td>$244,529</td>
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<tr>
<td>PI: H. Branch Coslett, M.D.</td>
<td>NIH 1-R01-NS046049</td>
<td>Motor Imagery as a Measure of Pain Severity</td>
<td>2/1/2007</td>
<td>1/31/2008</td>
<td>$131,560</td>
<td>$76,963</td>
<td>$208,523</td>
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<td>PI: H. Branch Coslett, M.D.</td>
<td>R01MH076227-01</td>
<td>Cognitive Neuroscience of Temporal Processing</td>
<td>7/1/2006</td>
<td>6/30/2007</td>
<td>$225,000</td>
<td>$122,829</td>
<td>$347,829</td>
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<td>PI: John A. Detre, M.D.</td>
<td>NIH R01 DA015149-03</td>
<td>Perfusion fMRI in Cocaine Addiction</td>
<td>9/1/2005</td>
<td>8/31/2007</td>
<td>$250,000</td>
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## Appendix II: Current Grants

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<th>Directs</th>
<th>Indirects</th>
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<tr>
<td>PI: Martha J. Farah, Ph.D.</td>
<td>Dana Foundation</td>
<td>Coordinator for Neuroethics Society</td>
<td>12/1/2006</td>
<td>11/30/2007</td>
<td>$25,000</td>
<td>$0</td>
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<td>PI: Martha J. Farah, Ph.D.</td>
<td>John Templeton Foundation</td>
<td>Neuroethics: Ethical, Social and Spiritual Perspectives</td>
<td>1/1/2006</td>
<td>12/31/2007</td>
<td>$10,500</td>
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<td>PI: Martha J. Farah, Ph.D.</td>
<td>NIH 1-F31-MH073363 Seth Gillihan Fellowship</td>
<td>Serotonin Transporter Genotype and Mood Regulation</td>
<td>9/1/2006</td>
<td>8/31/2007</td>
<td>$29,163</td>
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<td>PI: Amishi Jha Ph.D.</td>
<td>Mind and Life Institute</td>
<td>Neural Effects of Mindfulness Meditation training on working memory</td>
<td>5/1/2006</td>
<td>4/30/2007</td>
<td>$10,000</td>
<td>$0</td>
<td>$10,000</td>
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<tr>
<td>PI: Amishi Jha Ph.D. -co PI w/ Michael baime</td>
<td>Indiana State University</td>
<td>Mindfulness Meditation: Regulating Eating and Obesity</td>
<td>9/29/2005</td>
<td>6/30/2007</td>
<td>$100,147</td>
<td>$57,084</td>
<td>$157,231</td>
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<td>PI: Amishi Jha Ph.D.</td>
<td>Kessler Fund Trust</td>
<td>Neurocognitive Effects if mindfulness based attention training</td>
<td>4/1/2007</td>
<td>3/31/2008</td>
<td>$10,000</td>
<td>$0</td>
<td>$10,000</td>
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# Appendix II: Current Grants

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<th>PI / Role on Project</th>
<th>Grant</th>
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<th>Start Date</th>
<th>End Date</th>
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<th>Indirects</th>
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<td>PI: Michael J. Kahana, Ph.D.</td>
<td>NIH 5-RO1-MH055687-12</td>
<td>Associative Processes in Episodic Memory</td>
<td>2/1/2007</td>
<td>1/31/2008</td>
<td>$174,000</td>
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<td>CARRYOVER from 5-RO1-MH55687-11</td>
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<td>PI: Michael J. Kahana, Ph.D.</td>
<td>NIH 5-RO1-MH061975-06</td>
<td>Intracranial Recordings Reveal Task Dependent Theta</td>
<td>12/1/2005</td>
<td>11/30/2007</td>
<td>$219,713</td>
<td>$92,657</td>
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<td>PI: Michael J. Kahana, Ph.D.</td>
<td>CG 187434NGA-03</td>
<td>Strategic and Implementation Plan for Celest: Center for Excellence for Learning</td>
<td>10/1/2006</td>
<td>9/30/2007</td>
<td>$90,564</td>
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<td>PI: Michael J. Kahana, Ph.D.</td>
<td>MH062196 AMEND # 1</td>
<td>Project 3: Retrieval Dynamics in Item and Source Memory</td>
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<td>PI: Michael J. Kahana, Ph.D.</td>
<td>Mind and Life Institute</td>
<td>Mathematical Modeling of Acute Effects of Meditation on Cognition</td>
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<td>PI: Sharon L. Thompson-Schill, Ph.D.</td>
<td>1 F32HD051364</td>
<td>The Organization of Semantic Memory</td>
<td>3/1/2007</td>
<td>2/28/2008</td>
<td>$45,976</td>
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<td>Eiling Yee NRSA Fellowship</td>
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**TOTAL:**  $6,547,673  $3,256,156  $9,803,829