

Harvard Medical School Curriculum Vitae

Date Prepared: October 30, 2015
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Place of Birth: East Orange, New Jersey

Education

| | | | |
|------|---------------------------|--|-----------------|
| 1997 | B.S. (<i>cum laude</i>) | Biology, Psychology | Duke University |
| 2004 | A.M. | Psychological & Brain Sciences | Duke University |
| 2006 | Ph.D. | Psychology & Neuroscience (<u>Advisor</u> : Kevin S. LaBar, Ph.D.) | Duke University |

Postdoctoral Training

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| 09/06-06/10 | Post-doctoral Fellow | Affective Neuroscience (<u>PI</u> : Diego A. Pizzagalli, Ph.D.) | Department of Psychology, Harvard University |
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Faculty Academic Appointments

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| 07/10 – 12/13 | Instructor | Psychiatry | Harvard Medical School |
| 01/14 – present | Assistant Professor | Psychiatry | Harvard Medical School |

Appointments at Hospitals/Affiliated Institutions

| | | | |
|--------------------|-----------------------------|--|-----------------|
| 07/10 – 12/13 | Assistant Neuroscientist | Research (Center for Depression, Anxiety and Stress Research) | McLean Hospital |
| 01/14 – present | Associate Neuroscientist | Research (Center for Depression, Anxiety and Stress Research) | McLean Hospital |

Other Professional Positions

| | | |
|-----------|--|---|
| 1997-1998 | Teaching Assistant | Duke University, Biology Department |
| 1998-1999 | Research Assistant | Duke University, Center for Human Genetics |
| 1999-2001 | Researcher | Harvard University Graduate School of Education, Project Zero |
| 2001-2006 | Graduate Research and Teaching Assistant | Duke University |

Committee Service

Local

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|-----------|---|--|
| 2003-2005 | Carnegie Initiative on the Doctorate | Duke University Leadership team member |
| 2005 | Graduate Student Recruitment Conference Organizer | Duke University Poster session committee member |
| 2015 | Co-organizer, CDSAR Speaker Series | McLean Hospital Harvard Medical School |

Professional Societies

| | | |
|--------------|------------------------------------|----------------------|
| 2013-present | Society of Biological Psychiatry | Regular member |
| 2003-present | Cognitive Neuroscience Society | |
| | 2003-2006 | Student member |
| | 2008-2010 | Post-doctoral member |
| | 2011-present | Faculty member |
| 2002-present | Society for Neuroscience | |
| | 2002-2005 | Student member |
| | 2007-2009 | Post-doctoral member |
| | 2014- | Faculty member |
| 2004-2006 | American Psychological Association | Student affiliate |

Grant Review Activities

| | | |
|------|---|----------------------|
| 2013 | Centers of Biomedical Research Excellence (COBRE) [P20] Study Section | NIH |
| | 2013 (June 20-21, 2013) | <i>Ad hoc</i> Member |

Editorial Activities

Ad hoc reviewer

Archives of General Psychiatry
American Journal of Psychiatry
Biological Psychology
BMC Psychiatry
Brain Research
Cerebral Cortex
Clinical EEG and Neuroscience
Cognition

Cognition & Emotion
Cognitive, Affective, & Behavioral Neuroscience
Cognitive Electrodynamics
Depression & Anxiety
Emotion
Experimental Brain Research
International Journal of Neuropsychopharmacology
International Journal of Psychophysiology

JAMA Psychiatry
Journal of Child Psychology and Psychiatry
Journal of Experimental Psychology: General
Journal of Social and Clinical Psychology
Motivation & Emotion
Neuroimage
Neuroimage: Clinical
Neuropsychologia
Neuroscience & Biobehavioral Reviews
Neuroscience Letters
Psychological Medicine
Psychological Science
Psychonomic Bulletin & Review
Psychophysiology
Schizophrenia Research
Social Cognitive and Affective Neuroscience
Theory & Psychology

Other Editorial Roles

| | | |
|----------------|------------------------|--|
| 2006 | <i>Ad hoc</i> reviewer | R. Cabeza & A. Kingstone (Eds.). (2006). <i>Handbook of Functional Neuroimaging of Cognition</i> (2 nd Ed.). Cambridge, Massachusetts: MIT Press |
| 2013 - present | Consulting Editor | <i>Emotion</i> |

Honors and Prizes

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|------------|--|-------------------------------------|----------------------|
| 1994-1996 | Dean's List | Duke University | Scholarship |
| 1995, 1997 | Dean's List with Distinction | Duke University | Scholarship |
| 2001-2005 | James B. Duke Graduate Fellowship | Duke University | Research/Scholarship |
| 2002 | Honorable Mention (Graduate Research Fellowship) | National Science Foundation | Research |
| 2002 | Fellowship (Summer Institute in Cognitive Neuroscience) | National Institute of Mental Health | Research |
| 2003 | Travel Fellowship (Attendance at the Annual Meeting of the Society for Neuroscience) | Duke University | Research |
| 2004 | Travel Fellowship (Conference on Biological Basis of Personality & | National Institute of Mental Health | Research |

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|------|---|------------------------------------|----------|
| 2004 | Individual Differences) Dissertation Research Award | American Psychological Association | Research |
| 2007 | HealthEmotions Research Institute Symposium Fellow | University of Wisconsin | Research |
| 2009 | Post-doctoral Travel Grant (Attendance at the Annual Meeting of the Cognitive Neuroscience Society) | Harvard University | Research |

Report of Funded and Unfunded Projects

Funding Information

Past

- 2008-2010 *Emotion Regulation in Depression: Neural Bases of Reappraisal*
NIH/NIMH Ruth L. Kirchstein Individual Post-doctoral National Research Service Award (NRSA) (5F32MH081394-02)
Total Direct Costs: \$88,361
Role: Principal Investigator
Faculty Sponsor: Diego A. Pizzagalli, Ph.D.
Faculty Co-sponsor: Randy L. Buckner, Ph.D.
Goals: This multi-modal (behavior, fMRI, ERP) project examined the neurocognitive mechanisms implicated in emotion regulation failures in major depressive disorder.
- 2009-2012 *Toward a Functional Dissection of Anhedonia in Major Depression: Dissociating Decision-Making Deficits from Reward Insensitivity*
NARSAD Young Investigator Award
Total Direct Costs: \$59,530
Role: Principal Investigator
Faculty Sponsor: Diego A. Pizzagalli, Ph.D.
Goals: This combined behavioral/fMRI study investigated the negative effects of depression on episodic memory for stimuli paired with rewarding outcomes.
- 2012-2014 *Neuroscience of Reward-Related Learning and Memory in Depression*
NIH/NIMH Pathway to Independence Award (K99) (1K99MH094438-01A1)
Total Direct Costs: \$167,962
Role: Principal Investigator
Faculty Sponsor: Diego A. Pizzagalli, Ph.D.
Faculty Co-Sponsor: Michael J. Frank, Ph.D.
Goals: This project combined computational modeling, fMRI, and behavioral measures to investigate neurocognitive mechanisms that support reward-driven reinforcement learning and episodic memory in a community sample.

Current

2014-2017 *Neuroscience of Reward-Related Learning and Memory in Depression*
 NIH/NIMH Pathway to Independence Award (R00) (4R00MH094438-03)
Total Direct Costs: \$519,440
Role: Principal Investigator
Goals: This project combines computational modeling, fMRI, and behavioral measures to investigate dysfunction in reward-driven reinforcement learning and episodic memory in adults with unipolar depression.

Report of Local Teaching and Training

Teaching of Students in Courses

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| 1997-1998 | <i>Principles of Biology</i> [Biology 25L] Undergraduate students | Duke University Teaching assistant. 2 hours per week for 30 weeks. |
| 2002 | <i>Drugs, Brain, and Behavior</i> [Psychology 127] Undergraduate students | Duke University Teaching assistant. 1 hour per week for 15 weeks. |
| 2002 | <i>Cognitive Psychology</i> [Psychology 92] Undergraduate students | Duke University Teaching assistant. 2 hours per week for 15 weeks. |
| 2003 | <i>Biological Bases of Behavior</i> [Psychology 91] Undergraduate students | Duke University Teaching assistant. 2 hours per week for 15 weeks. |
| 2004-2005 | <i>Teaching and Ethics Workshop</i> Graduate students | Duke University Co-instructor. 1 hour a month for 9 months. |

Laboratory and Other Research Supervisory and Training Responsibilities

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|-----------|---|---------------------------------------|
| 2002-2003 | Mentor to undergraduate performing cognitive neuroscience research/Duke University | Multiple weekly meetings for 9 months |
| 2005-2006 | Mentor to undergraduate performing cognitive neuroscience research/Duke University | Multiple weekly meetings for 5 months |
| 2008-2009 | Mentor to undergraduate performing cognitive neuroscience research/Harvard University | Weekly mentorship for 9 months |
| 2009 | Mentor to visiting graduate student performing cognitive neuroscience research/Harvard University | Daily mentorship for 3 months |

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| 2010-2011 | Instructor, informal seminar on functional magnetic resonance imaging/Harvard University, Department of Psychology (2010) & McLean Hospital, Center for Depression, Anxiety and Stress Research (2011) | Developed and delivered six 1-hour seminars during spring semesters |
| 2011 | Mentor to visiting undergraduate performing cognitive neuroscience research/McLean Hospital, Center for Depression, Anxiety and Stress Research | Daily mentorship for 2 months |
| 2012-2013 | Mentor to two post-baccalaureate research assistants/McLean Hospital, Center for Depression, Anxiety and Stress Research & Harvard University | Approximately bi-weekly meetings for 5 months |
| 2013-2014 | Mentor to three undergraduate research assistants/McLean Hospital, Center for Depression, Anxiety and Stress Research & Harvard University | Approximately bi-weekly meetings |
| 2015 | Mentor to undergraduate student visitor | Weekly meetings for 3 months |

Formally Supervised Trainees

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|-----------|---|
| 2005-2006 | Brian Johnson, B.A. Undergraduate research under my supervision, co-author on publication #4. |
| 2009 | Oliver Hager, doctoral student in Neuroeconomics and Social Neuroscience, University of Zurich Visiting graduate student under my supervision, co-author on poster presentation (Dillon, Hager, & Pizzagalli, 2010). |
| 2015 | Michelle Basta Undergraduate student visitor, summer 2015, working under my supervision on an electrophysiological study of source memory retrieval in healthy and depressed adults. |

Local Invited Presentations

No presentations below were sponsored by outside entities.

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|------|--|
| 2009 | <i>Emotion meets cognition: probing reward processing and emotion regulation</i> /Invited seminar Center for Sleep and Cognition, Beth Israel Deaconess Medical Center, Harvard Medical School (Director: Robert Stickgold, Ph.D.) |
| 2010 | <i>Motivation meets cognition: Probing reward processing and emotion regulation in depression</i> /Colloquium talk Department of Psychology, Harvard University |
| 2010 | <i>Motivation meets cognition: Probing reward processing and emotion regulation in depression</i> /Lunchtime speaker series Laboratories of Cognitive Neuroscience, Children's Hospital, Harvard Medical School (Director: Charles Nelson, Ph.D.) |
| 2010 | <i>Emotion regulation in depression</i> /Invited talk McLean Hospital, Harvard Medical School |
| 2011 | <i>Motivation meets cognition: probing reward processing and emotion regulation in</i> |

- depression/Student Visitor Seminar Series
McLean Hospital, Harvard Medical School
- 2012 *A functional neuroimaging investigation of explicit memory for rewards in depression*/Invited seminar
Behavioral Genetics Laboratory, McLean Hospital, Harvard Medical School (Director: William Carlezon, Ph.D.)
- 2013 *Remember to look on the bright side: Blunted reward memory in depressed adults*/Invited talk, 2013 McLean Hospital Research Day
McLean Hospital, Harvard Medical School
- 2013 *Depression, anhedonia, and reward-driven learning and memory*/Invited seminar, Neuroscience Work-in-Progress Series
McLean Hospital, Harvard Medical School
- 2014 *Emotional memory in depression*/Invited talk, Affective and Social Neuroscience seminar (Professor: Dr. Christine Hooker)
Department of Psychology, Harvard University
- 2015 *On the nature of episodic memory in depression*/Invited seminar, Neuroscience Work-in-Progress Series
McLean Hospital, Harvard Medical School
- 2015 *A neural mechanism for positive memory deficits in depression*/ Student Visitor Seminar Series, McLean Hospital

Report of Regional, National and International Invited Teaching and Presentations

Invited Presentations and Courses

No presentations below were sponsored by outside entities.

Regional

- 2004 *Conscious regulation of emotions elicited by pictures is sensitive to arousal but not valence*/Conference presentation
Annual Meeting of the North Carolina Cognition Group, Raleigh, NC
- 2009 *The affective neuroscience of reward processing in health and depression: Conceptual foundations and empirical findings*/Colloquium talk
Philosophy & Psychology Departments, Simmons College, Boston, MA
- 2010 *Motivation meets cognition: Probing reward processing and emotion regulation*/Colloquium talk
Department of Psychology, Harvard University, Cambridge, MA
- 2012 *A functional neuroimaging investigation of explicit memory for rewards in depression*/Invited seminar
Laboratory for Neural Computation and Cognition
Brown University (Director: Michael Frank, Ph.D.)
- 2013 *Depression, anhedonia, and reward-driven learning and memory*/Invited seminar
Joint meeting of the Lab for Neural Computation and Cognition (Director: Michael Frank, Ph.D.) and the Cognitive Neuroscience of Cognitive Control & Memory Lab (Director: David Badre, Ph.D.)
Brown University
- 2014 *Searching for the silver lining: poor memory for positive material as a foundation for*

- depression research/Invited seminar*
 Laboratory for Neural Computation and Cognition
 Brown University (Director: Michael Frank, Ph.D.)
- 2014 *Searching for the silver lining: poor memory for positive material as a foundation for depression research/Invited seminar*
 Cognitive Neuroscience of Cognitive Control & Memory Lab
 Brown University (Director: David Badre, Ph.D.)
- 2015 *Positive reinforcement enhances encoding of upcoming information/Symposium talk*
 8th Annual Meeting of the Social & Affective Neuroscience Society (Boston, MA)
- 2015 *On the nature of episodic memory deficits in depression/Colloquium talk*
 Yale University, Department of Psychology (New Haven, CT)
- 2015 *Investigating the formation of episodic memories during feedback-driven learning/Invited seminar*
 Cognitive Neuroscience of Cognitive Control & Memory Lab
 Brown University (Director: David Badre, Ph.D.)

National

- 2004 *Duke University Department of Psychological and Brain Sciences: Key Ideas/Conference presentation*
 Winter Convening of the Carnegie Initiative on the Doctorate, Palo Alto, CA
- 2009 *Motivation meets cognition: probing reward processing and emotion regulation/Colloquium talk*
 Department of Psychology, Brooklyn College, Brooklyn, NY

International

- 2008 *Action monitoring, reward processing, and attention in depression/Invited seminar*
 Department of Experimental and Clinical Health Psychology, Ghent University, Belgium
- 2013 *Blunted reward source memory in major depressive disorder reflects weak reward responses in the parahippocampus, midbrain, and anterior cingulate cortex at encoding/Symposium talk*
 53rd Annual Meeting, Society for Psychophysiological Research, Florence, Italy

Report of Scholarship

Publications

Peer reviewed publications in print or other media

Research investigations

1. Fichtenholtz, H. M., Dean, H. L., **Dillon, D. G.**, Yamasaki, H., McCarthy, G., & LaBar, K. S. (2004). Emotion-attention network interactions during a visual oddball task. *Cogn Brain Res*, 20, 67-80.
2. **Dillon, D. G.**, & LaBar, K. S. (2005). Startle modulation during conscious emotion regulation is arousal-dependent. *Behav Neurosci*, 119, 1118-1124.

3. **Dillon, D. G.**, Cooper, J. J., Grent-t'-Jong, T., Woldorff, M. G., & LaBar, K. S. (2006). Dissociation of event-related potentials indexing arousal and semantic cohesion during emotional word encoding. *Brain Cogn*, 62, 43-57.
4. **Dillon, D. G.**, Ritchey, M., Johnson, B. D., & LaBar, K. S. (2007). Dissociable effects of conscious emotion regulation strategies on explicit and implicit memory. *Emotion*, 7, 354-365.
5. **Dillon, D. G.**, Holmes, A. J., Jahn, A. L., Bogdan, R., Wald, L. L., & Pizzagalli, D. A. (2008). Dissociation of neural regions associated with anticipatory versus consummatory phases of incentive processing. *Psychophysiology*, 45, 36-49.
6. Santesso, D. L., **Dillon, D. G.**, Birk, J. L., Holmes, A. J., Goetz, E., Bogdan, R., & Pizzagalli, D. A. (2008). Individual differences in reinforcement learning: Behavioral, electrophysiological, and neuroimaging correlates. *Neuroimage*, 42, 807-816.
7. Wacker, J., **Dillon, D. G.**, & Pizzagalli, D. A. (2009). The role of the nucleus accumbens and rostral anterior cingulate cortex in anhedonia: Integration of resting EEG, fMRI, and volumetric techniques. *Neuroimage*, 46, 327-337.
8. Pizzagalli, D. A., Holmes, A. J., **Dillon, D. G.**, Goetz, E. L., Birk, J. L., Bogdan, R., Dougherty, D. D., Iosifescu, D. V., Rauch, S. L., & Fava, M. (2009). Reduced caudate and nucleus accumbens response to rewards in unmedicated subjects with Major Depressive Disorder. *Am J Psychiatry*, 166, 702-710.
9. **Dillon, D. G.**, Holmes, A. J., Birk, J. L., Brooks, N., Lyons-Ruth, K., & Pizzagalli, D. A. (2009). Childhood adversity is associated with left basal ganglia dysfunction during reward anticipation. *Biol Psychiatry*, 66, 206-213.
10. **Dillon, D. G.***, Bogdan, R. H., Fagerness, J., Holmes, A. J., Perlis, R. H., & Pizzagalli, D. A. (2010). Variation in TREK1 gene linked to depression-resistant phenotype is associated with potentiated neural responses to rewards in humans. *Hum Brain Mapp*, 31, 210-221.
11. Vanderhasselt, M. A., De Raedt, R., **Dillon, D. G.**, Dutra, S. J., Brooks, N., Pizzagalli, D. A. (2012). Decreased cognitive control in response to negative information in remitted depression: an event-related potential study. *J Psychiatry Neurosci*, 37, 250-258.
12. **Dillon, D. G.**, & Pizzagalli, D. A. (2013). Evidence of successful modulation of brain activation and subjective experience during reappraisal of negative emotion in unmedicated depression. *Psychiatry Res*, 212, 99-107.
13. **Dillon, D. G.**, Dobbins, I. G., & Pizzagalli, D. A. (2014). Weak reward source memory in depression reflects blunted activation of VTA/SN and parahippocampus. *Soc Cogn Affect Neurosci*, 9, 1576-1583.
14. Treadway, M. T., Waskom, M. L., **Dillon, D. G.**, Holmes, A. J., Park, M. T. M., Chakravarty, M. M., Dutra, S. J., Polli, F. E., Iosifescu, D. V., Fava, M., Gabrieli, J. D. E., Pizzagalli, D. A. (2015). Illness progression, recent stress and morphometry of hippocampal subfields and medial prefrontal

cortex in major depression. *Biol Psychiatry*, 77, 285-294.

15. Admon, R., Nickerson, L. D., **Dillon, D. G.**, Holmes, A. J., Bogdan, R., Kumar, P., Dougherty, D. D., Iosifescu, D. V., Mischoulon, D., Fava, M., & Pizzagalli, D. A. (2015). Dissociable cortico-striatal connectivity abnormalities in major depression in response to monetary gains and penalties. *Psychol Med*, 45, 121-131.
16. Beard, C., Donahue, R. J., **Dillon, D. G.**, Van't Veer, A., Webber, C., Lee, J., Barrick, E., Hsu, K. J., Foti, D., Carroll, F. I., Carlezon, W. A., Jr., Björgvinsson, & Pizzagalli, D. A. (2015). Abnormal error processing in depressive states: a translational examination in humans and rats. *Transl Psychiatry*, 5, e564; doi:10.1038/tp.2015.54
17. **Dillon, D. G.***, Wiecki, T. W.*, Pechtel, P., Webb, C., Goer, F., Murray, L., Trivedi, M., Fava, M., McGrath, P.J., Weissman, M., Parsey, R., Kurian, B., Adams, P., Carmody, T., Weyandt, S., Shores-Wilson, K., Toups, M., McInnis, M., Oquendo, M. A., Cusin, C., Deldin, P., Bruder, G., & Pizzagalli, D. A. (2015). A computational analysis of flanker interference in depression. *Psychol Med*, 45, 2333-2344.
18. Webb, C. A., **Dillon, D. G.**, Pechtel, P., Goer, F., Murray, L., Huys, Q. J. M., Fava, M., McGrath, P. J., Weissman, M., Parsey, R., Kurian, B., Adams, P., Weyandt, S., Trombello, J., Grannemann, B., Cooper, C., Deldin, P., Tenke, C., Trivedi, M., Bruder, G., & Pizzagalli, D.A. (2015). Neural correlates of three promising endophenotypes of depression: evidence from the EMBARC study. *Neuropsychopharmacology*, doi:10.1038/npp.2015.165.
19. Hsu, K. J., Beard, C., Rifkin, L., **Dillon, D. G.**, Pizzagalli, D. A., & Björgvinsson, T. (2015). Transdiagnostic mechanisms in depression and anxiety: the role of rumination and attention control. *J Affect Disord*, 188, 22-27.

*The first two authors made equal contributions to this manuscript.

Other peer-reviewed publications

1. **Dillon, D. G.**, & Pizzagalli, D. A. (2007). Inhibition of action, thought, and feeling: A selective neurobiological review. *Appl Prev Psychol*, 12, 99-114.
2. **Dillon, D. G.**, Rosso, I. M., Pechtel, P., Killgore, W. D. S., Rauch, S. L., & Pizzagalli, D. A. (2014). Peril and pleasure: an RDoC-inspired examination of threat responses and reward processing in anxiety and depression. *Depress Anxiety*, 31, 233-249.
3. **Dillon, D. G.** (2015). The neuroscience of positive memory deficits in depression. *Front Psychol*, 6, 1295.

Non-peer reviewed scientific or medical publications/materials in print or other media

Reviews and chapters

1. **Dillon, D. G.**, & Pizzagalli, D. A. (2010). Maximizing positive emotions: a translational, transdiagnostic look at positive emotion regulation. In A. M. Kring & D. M. Sloan (Eds.),

Emotion Regulation and Psychopathology. New York: Guilford Press.

2. **Dillon, D. G.**, Deveney, C. M., & Pizzagalli, D. A. (2011). From basic processes to real-world problems: How research on emotion and emotion regulation can inform understanding of psychopathology, and vice versa. *Emot Rev*, 3, 74-82.
3. Pizzagalli, D. A., **Dillon, D. G.**, Bogdan, R., & Holmes, A. J. (2011). Reward and punishment processing in the human brain: clues from affective neuroscience and implications for depression research. In O. Vartanian & D. R. Mandel (Eds.), *Neuroscience of Decision Making* (pp. 199-220). New York: Psychology Press.
4. Rosso, I., **Dillon, D. G.**, Pizzagalli, D. A., & Rauch, S. L. (2015). Translational perspectives on anxiety disorders and the Research Domain Criteria construct of potential threat. In K. J. Ressler, D. Pine, and B. O. Rothbaum (Eds.), *Anxiety Disorders: Translational Perspectives on Diagnosis and Treatment*. New York, Oxford University Press.

Thesis

Dillon, D. G. (Doctoral thesis). Voluntary emotion regulation: Physiological correlates and mnemonic consequences. Durham, NC: Department of Psychology & Neuroscience, Duke University.

Abstracts, Poster Presentations and Exhibits Presented at Professional Meetings

Below are listed accepted abstracts/poster presentations within the last three years which have not already been published as full length manuscripts.

Pizzagalli, D.A., Tenke, C.E., Kayser, J., Pechtel, P., **Dillon, D.**, Cooper, C., Deldin, P., Fava, M., Kurian, B.T., McGrath, P., Parsey, R., Petkova, E., Trivedi, M., Weissman, M., Weyandt, S., Bruder, G. (2013). *Reliability of electrophysiological predictors of treatment response in the EMBARC study*. Poster presented at the 52nd Annual Meeting of American College of Neuropsychopharmacology, Hollywood, FL.

McGrath, P., Bruder, G., **Dillon, D.**, Pechtel, P., Adams, P., Carmody, T., Cooper, C., Deldin, P., Fava, M., Kurian, B.T., McInnis, M., Morris, D., Parsey, R., Trivedi, M., Weissman, M., Pizzagalli, D.A. (2013). *Reliability of behavioral phenotyping predictors of treatment response in the EMBARC study*. Poster presented at the 52nd Annual Meeting of American College of Neuropsychopharmacology, Hollywood, FL.

Connolly, S. L., **Dillon, D. G.**, Berghorst, L. H., & Pizzagalli, D. A. (2014). *Associations between rumination, negative inhibition impairments, and recall biases in an emotional flanker task*. Poster presented (by S. L. Connolly) at the 48th Annual Meeting of the Association for Behavioral and Cognitive Therapies, Philadelphia, PA.

Barrick, E., & **Dillon, D. G.** (2015). *Investigating source memory and hypofrontality in unipolar depression*. Poster presented (by E. Barrick) at McLean Research Day, Belmont, MA.

Dillon, D. G., Frank, M. J., & Pizzagalli, D. A. (2015). *Prepare for success: reward delivery facilitates*

episodic encoding of upcoming information. Poster presented at McLean Research Day, Belmont, MA.

Dillon, D. G., Frank, M. J., & Pizzagalli, D. A. (2015). *Reward delivery enhances encoding of upcoming information: a novel paradigm for detecting memory deficits in anhedonic depression*. Poster presented at the 70th Annual Meeting of the Society of Biological Psychiatry, Toronto, Canada.

Dillon, D. G., Frank, M. J., Badre, D., & Pizzagalli, D. A. (2015). *Positive reinforcement enhances encoding of upcoming information*. Poster presented at the 45th Annual Meeting of the Society for Neuroscience, Chicago, Illinois.

Narrative Report

- I am a cognitive neuroscientist focused on learning and memory in major depressive disorder (MDD). Upon completing my doctoral research with Dr. Kevin LaBar at Duke University in 2006, I joined Dr. Diego Pizzagalli at Harvard University as a post-doctoral fellow. In 2010, I was appointed Instructor at Harvard Medical School and Assistant Neuroscientist at McLean Hospital, and in 2014 I was promoted to Assistant Professor of Psychiatry (Harvard Medical School) and Associate Neuroscientist (McLean). Currently, all of my effort is devoted to research: I combine behavioral methods, neuroimaging, and computational modeling to investigate the impact of depression on learning and memory. My particular interest is determining whether dopaminergic abnormalities in depression impair reinforcement learning, the formation and retention of episodic memories, and episodic retrieval.

Area of Excellence: Investigation

Successful adaptation to the demands of modern life depends on learning and memory. This is especially obvious at work, where the need to learn new skills and commit information to memory has never been more acute. But it is also true in our personal lives, where a history of shared positive memories forms the structure supporting our most important relationships. Memory, though, is not just about the past—we tap our memories to plan for the future, relying on recollection of what worked well before to guide decisions about what to do next.

My central hypothesis is that the consequences of learning and memory failures are evident in unipolar depression, and in 2014 I launched the Motivated Learning & Memory Laboratory at McLean Hospital to test this hypothesis. Depression is a pernicious and increasingly prevalent problem that can compromise a person's ability to work, play, and plan. I propose that these deficits emerge, at least in part, because depression disrupts the ability to form and retain positive memories (Dillon, 2015). This proposal rests on two foundations. First, a growing body of work in non-human animals has shown that positive ('rewarding') experiences elicit phasic dopamine bursts that drive learning and ensure memory retention, and there is increasing evidence that these bursts are diminished in response to chronic stress, which is a potent cause of depression (Dillon, Rosso et al., 2014). Second, there is now a large neuroimaging literature in humans indicating that delivery of monetary rewards activates brain regions that receive projections from dopamine neurons, and this activation is typically weaker in depressed adults relative to healthy controls. I contributed directly to this work as a post-doctoral fellow, using functional magnetic resonance imaging (fMRI) to reveal blunted striatal reward responses in individuals who were depressed (Pizzagalli et al., 2009) or vulnerable to depression due to childhood maltreatment (Dillon et al., 2009) or possession of certain genotypes (Dillon et al., 2010). Considering these two lines of work alongside each other, I proposed that depression should not only blunt the initial response to rewards in dopamine-rich brain regions, but should also compromise memory for the stimuli (or actions)

that elicited reward delivery in the first place.

Using a NARSAD grant, I secured initial evidence in favor of this hypothesis by showing that weak reward responses in the dopaminergic midbrain are associated with poor memory for rewarded stimuli in depression (Dillon, Dobbins et al., 2014). Currently, I am using an NIH K99/R00 award to build on these promising results (K99 mentors: Drs. Diego Pizzagalli and Michael J. Frank). Using the K99 funding, I developed a new paradigm that again related reward delivery to improved long-term memory. This pilot work was conducted in two healthy samples, and I am currently using the R00 award to extend this approach to depressed adults.

Finally, I am also launching a series of studies investigating the effects of depression on memory retrieval, which is informed by consideration of cortical function in MDD. Memory retrieval depends heavily on executive control, which is supported by the frontal lobes. In prior work, I found that depression impairs executive control (Dillon, Wiecki et al., 2015), and that more severe depression is associated with weaker activation of the dorsolateral prefrontal cortex during reappraisal (Dillon & Pizzagalli, 2013). Synthesizing these findings, I expect that memory retrieval will be disrupted in depressed adults due to blunted frontal activation during retrieval attempts, and I am using a combination of behavioral testing and electroencephalography to test this hypothesis. In future studies, I will extend this work by developing inferential reasoning paradigms in which participants must retrieve and then integrate multiple memories in order to behave adaptively in new environments. My aim is to model a central challenge involved in psychotherapy for depression: How to increase the likelihood that patients who have learned skills in one context (e.g., the therapist's office) will first be able to recognize opportunities to use those skills in other contexts (e.g., at home or in the workplace), and will then be able to retrieve what they have learned in order to use it effectively? By targeting the role of the frontal cortex in memory retrieval and inferential reasoning, I hope to provide some new insight into this issue.

Teaching and Education

I am deeply committed to teaching and education. As Director of the Motivated Learning & Memory Laboratory, I am now engaged in daily mentorship of a full-time research assistant. I also hold weekly lab meetings together with Dr. Justin Baker's group at McLean Hospital, and we use these meetings to discuss ongoing projects and recent developments in the literature with a growing group of technicians, research assistants, post-doctoral fellows, and psychiatry residents. My research has also involved direct mentorship of undergraduates, post-baccalaureate students, and a visiting graduate student. Furthermore, I enjoyed leading seminars in psychology, biology, and neuroscience as a graduate student at Duke University, and I delivered a multi-week seminar series on fMRI methods at Harvard University and McLean Hospital. Overall, I greatly enjoy teaching and believe it contributes positively to my research.

Conclusion

Depression is a major public health problem and the focus of a great deal of research, but that research has largely overlooked a central component of the illness: the key role played by disruptions in reward-guided learning and memory for positive experiences. My aim is to fill that gap, and in so doing provide data that may be used to improve our ability to prevent, diagnose, and treat depressive illness.