

# Benjamin T. Saunders, PhD

Assistant Professor  
Department of Neuroscience  
Medical Discovery Team on Addiction  
University of Minnesota  
Minneapolis, MN, USA

bts@umn.edu  
saunderslab.com  
@saunderslab\_  
he/him

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## Education and Training

- 2017-2018 Assistant Research Scientist, Johns Hopkins University  
2015-2017 Postdoctoral Fellow, Johns Hopkins University  
2013-2014 Postdoctoral Fellow, University of California, San Francisco  
Supervisor: Patricia H. Janak, PhD
- 2007-2012 Graduate Student, University of Michigan  
PhD in psychology/biopsychology  
Supervisor: Terry E. Robinson, PhD
- 2005-2007 West Virginia University  
BS in biology, BS in psychology: 2007  
*Summa cum laude*, University Honors Scholar

## Research Support

- 2017-2021 NIH Pathway to Independence Award (R00 DA042895)  
2016-2018 NARSAD Young Investigator Award  
2014-2017 NIH National Research Service Award Postdoctoral Fellowship (F32 DA036996)  
2011-2013 NIH National Research Service Award Predoctoral Fellowship (F31 DA030801)  
2011-2012 Rackham Graduate School Research Grant, University of Michigan  
2007-2008 NIDA Predoctoral Training Grant (T32 DA007281)

## Publications

\*Google Scholar: <https://scholar.google.com/citations?user=JudkIMUAAAAJ&hl=en>

\*Total Citations (5/2021): ~2300; from first/last-author publications: ~1000; \*h-index: 17

22. Collins AL & **Saunders BT**. (2020). Heterogeneity in striatal dopamine circuits: Form and function in dynamic reward seeking. *Journal of Neuroscience Research*, 98, 1046-1069. PMID: PMC7183907.
21. Collins AL & **Saunders BT**. (2019). Brain reward network effects underlie septo-hippocampal control of flexible decision making. *Neuropsychopharmacology*, 44, 2153-2154.
20. Collins AL, Wolff AR, & **Saunders BT**. (2019). Ring of power: a band of peptidergic midbrain neurons that binds motivation. *Neuron*, 103, 364-366.
19. **Saunders BT**, Richard JM, Margolis EB, & Janak PH. (2018). Dopamine neurons create Pavlovian conditioned stimuli with circuit-defined motivational properties. *Nature Neuroscience*, 21(8): 1072-1083. PMID: PMC6082399 [Available on 2019-01-23]
- *Highlighted in: Ostlund SB. Learn Behav (2019).*
  - *Highlighted in: Albin RL. Mov Disorder (2019).*
  - *Faculty Opinions Recommended*
18. **Saunders BT**, Richard JM, & Janak PH. (2015). Contemporary approaches to neural circuit manipulation and mapping: focus on reward and addiction. *Proc Roy Soc Phil Trans B*. doi: 10.1098/rstb.2014.0210. PMID: PMC4528822 [Available on 2016-09-19]
17. **Saunders BT**, O'Donnell EG, Aurbach EL, & Robinson TE. (2014). A cocaine context renews drug seeking preferentially in a subset of individuals. *Neuropsychopharmacology*, 39, 2816-2823. PMID: PMC4200491 [Available on 2015/11/01]

16. Morrow JD, **Saunders BT**, Maren S, & Robinson TE. (2014). Sign-tracking to an appetitive cue predicts incubation of conditioned fear in rats. *Behavioural Brain Research*, 276, 59-66. PMID: PMC4201891 [Available on 2016/01/01]
15. Steinberg EE, Boivin JR, **Saunders BT**, Witten IB, Deisseroth K, & Janak PH. (2014). Positive reinforcement mediated by midbrain dopamine neurons requires D1 and D2 receptor activation in the nucleus accumbens. *PLOS One*. 9(4): e94771. PMID: PMC3986242
14. **Saunders BT** & Janak PH. (2014). Nucleus accumbens plasticity underlies multifaceted behavioral changes associated with addiction. *Biological Psychiatry*, 75, 92-93.
13. Robinson TE, Yager LM, Cogan ES, & **Saunders BT**. (2014). On the incentive motivational properties of food and drug cues. *Neuropharmacology*, 76, 450-499. PMID: PMC3796005 [Available on 2014/12/7]
12. Fitzpatrick CJ, Gopalakrishnan S, Cogan ES, Yager LM, Meyer PJ, Lovic V, **Saunders BT**, Parker CC, Gonzales NM, Aryee E, Flagel SB, Palmer AA, Robinson TE, & Morrow JD. (2013). Variation in the form of Pavlovian conditioned approach behavior among outbred male Sprague Dawley rats from different vendors and colonies: Sign-tracking vs. goal-tracking. *PLOS One*. 8(10): e75042. PMID: PMC3787975
11. **Saunders BT**, Yager LM, & Robinson TE. (2013). Cue-evoked cocaine "craving": role of dopamine in the accumbens core. *Journal of Neuroscience*, 33, 13989-14000. PMID: PMC3756749
10. **Saunders BT** & Robinson TE. (2013). Individual variation in resisting temptation: Implications for addiction. *Neuroscience and Biobehavioral Reviews*, 37, 1955-1975. PMID: PMC3732519 [Available on 2014/11/1]
9. **Saunders BT**, Yager LM, & Robinson TE. (2013). Preclinical studies shed light on individual variation in addiction vulnerability. *Neuropsychopharmacology*, 38, 249-250. PMID: PMC3521973
8. Badrinarayan A, Wescott SA, Vander Weele CM, **Saunders BT**, Couturier BE, Maren S, & Aragona BJ. (2012). Aversive stimuli differentially modulate real-time dopamine transmission dynamics within the nucleus accumbens core and shell. *Journal of Neuroscience*, 32, 15779-15790. PMID: PMC3752139
7. **Saunders BT** & Robinson TE. (2012). The role of dopamine in the accumbens core in the performance of Pavlovian-conditioned responses. *European Journal of Neuroscience*, 36, 2521-2532. PMID: PMC3424374
6. Meyer PJ, Lovic V, **Saunders BT**, Yager LM, Flagel SB, Morrow JD, & Robinson TE. (2012). Quantifying individual variation in the propensity to attribute incentive salience to reward cues. *PLOS One*, 7(6): e38987. PMID: PMC3382216
5. **Saunders BT** & Richard JM. (2011). Shedding light on the role of ventral tegmental area dopamine in reward. *Journal of Neuroscience*, 31, 18195-18197. PMID: PMC3263377
4. Lovic V, **Saunders BT**, Yager LM, & Robinson TE. (2011). Rats prone to attribute incentive salience to reward cues are also prone to impulsive action. *Behavioural Brain Research*, 223, 255-261. PMID: PMC3119757
3. **Saunders BT** & Robinson TE. (2011). Individual variation in the motivational properties of cocaine. *Neuropsychopharmacology*, 36, 1668-1676. PMID: PMC3138662
2. **Saunders BT** & Robinson TE. (2010). A cocaine cue acts as an incentive stimulus in some but not others: Implications for addiction. *Biological Psychiatry*, 67, 730-736. PMID: PMC2849872
1. Diller JW, **Saunders BT**, & Anderson KG. (2008). Effects of acute and repeated administration of caffeine on temporal discounting in rats. *Pharmacology, Biochemistry, & Behavior*, 89, 546-555

### Manuscripts in Preparation

- Collins V, Bornhoft KN, Sinha S, Wolff A, & **Saunders BT**. Hierarchical cue relationships gate drug-seeking motivation.
- Fraser KM, Collins V, Pat F, Janak PJ, & **Saunders BT**. Hierarchical control of mesolimbic dopamine and striatal encoding of reward-paired cues governs behavioral flexibility.
- Poisson C, Engel L, & **Saunders BT**. Input-mediated functional heterogeneity among midbrain dopamine neurons.

### Preprints

- **Saunders BT**, Richard JM, Margolis EB, & Janak PH. (2017). Instantiation of incentive value and movement invigoration by distinct dopamine circuits, *bioRxiv*, 186502: doi.org/10.1101/186502.

## **Awards and Honors**

- 2015 American College of Neuropsychopharmacology Travel Award
- 2014 Winter Conference on Brain Research Travel Award
- 2013 Wyvell Award for Outstanding Dissertation in Biopsychology, University of Michigan
- 2010 Pat Gurin Distinguished Lecturer Award, University of Michigan
- 2009 Rackham Graduate School Travel Grant, University of Michigan (also in 2010, 2011, 2012)
- 2009 NIDA Early Career Investigators Travel Award

## **Selected Talks/Seminars**

- 2021 Dopamine 2021, Montreal, Canada (*postponed due to COVID-19*)
- 2019 Japanese Neuroscience Society, Niigata, Japan
- 2019 Osaka University, Osaka, Japan
- 2019 Winter Conference on Brain Research, Snowmass, CO
- 2018 University of Minnesota, Graduate Program in Neuroscience Colloquium, Minneapolis, MN
- 2017 Gordon Research Conference on Catecholamines, Newry, ME
- 2017 University of Connecticut, Department of Psychology, Storrs, CT
- 2015 National Institute on Drug Abuse, Baltimore, MD
- 2015 Professional Development Workshop, Society for Neuroscience, Chicago, IL
- 2015 Catecholamines Gordon Research Seminar, Newry, ME
- 2015 Winter Conference on Brain Research, Big Sky, MO
- 2014 Professional Development Workshop, Society for Neuroscience, Washington, DC
- 2014 Winter Conference on Brain Research, Steamboat Springs, CO
- 2012 University of Michigan, Ann Arbor, MI
- 2011 University of California-San Francisco, Gallo Center, Emeryville, CA

## **Teaching**

- 2021 Instructor, "Human Neuroanatomy", University of Minnesota  
Primary lectures on motor systems, basal ganglia, cerebellum, learning, and addiction  
Wet lab instructor
- 2020- Instructor, "Human Neuroanatomy", University of Minnesota  
Primary lectures on motor systems, basal ganglia, cerebellum, learning, and addiction
- 2019- Instructor, "Human Neuroanatomy", University of Minnesota  
Primary lectures on motor systems, basal ganglia, cerebellum, learning, and addiction
- 2013 Lecturer, "Introduction to Neuroscience. Essential Concepts & Methods", University of California, San Francisco
- 2010 Graduate student instructor: "Drugs of Abuse, Brain, & Behavior", University of Michigan  
Guest lecturer; responsible for exam preparation, leading review sessions, grading, and private tutoring
- 2010 Graduate student instructor: "Introduction to Biopsychology", University of Michigan  
Responsible for teaching 3 weekly 1-hour discussion sections (~90 total students), leading laboratory demonstrations, review sessions, grading, and private tutoring
- 2009 Graduate student instructor: "Animal Behavior", University of Michigan  
Responsible for teaching 3 weekly 1-hour discussion sections (~90 total students), leading review sessions, grading, and private tutoring
- 2008 Graduate student instructor: "Animal Behavior", University of Michigan  
Responsible for teaching 3 weekly 1-hour discussion sections (~90 total students), leading review sessions, grading, and private tutoring

## **Supervising and Mentorship**

*Formal (University of Minnesota)*

2018- Post-doctoral fellows

Tim O'Neal, PhD

Val Collins, PhD (F32 NRSA fellow)

Graduate students

Megan Brickner, BS, Graduate program in neuroscience

Margaret Stelzner, BA, Graduate program in neuroscience

Carli Poisson, BA, Graduate program in neuroscience (T32 training fellow)

## Research technicians

Liv Engel, BA

## Undergraduate research assistants

Madelyn Blake

Sonal Sinha

Michael Dahl (honors thesis student)

Kaisa Bornhoft (UROP, honors thesis student)

Cassandra Herubin

Emily Schwartz

## *Informal*

2015-2018 2 graduate students, 5 undergraduate research assistants (Johns Hopkins University)

2013-2015 2 graduate students (University of California, San Francisco)

2008-2012 16 undergraduate research assistants, 1 honors thesis student (University of Michigan)

## **Journal Peer Review**

*Addiction, Animal Cognition, Behavioural Brain Research, Behavioral Neuroscience, Biological Psychiatry, Cell Reports, eLife, eNeuro, Frontiers in Decision Neuroscience, Journal of Experimental Psychology: General, Journal of Neuroscience, Journal of Psychopharmacology, Nature Methods, Nature Neuroscience, Neurobiology of Learning and Memory, Neuron, Neuropharmacology, Neuropsychopharmacology, Physiology & Behavior, PLOS One, Progress in Neuro-psychopharmacology, Psychopharmacology*

## **Professional Memberships**

2006- Society for Neuroscience

2016 New York Academy of Sciences

2014 Association for Psychological Science

## **Service**

### University

2020- Recruitment Committee, Graduate Program in Neuroscience (University of Minnesota)

2020 Ad Hoc Committee on Diversity, Retention, and Systemic Racism (University of Minnesota)

2019- Ad Hoc Committee for the Improvement of Post-Doctoral Training (University of Minnesota)

2018- Medical Discovery Team on Addiction Seminar Series Sub-committee (University of Minnesota)

2010 Biopsychology area Department of Psychology PhD admissions committee (University of Michigan)

2009 Departmental Associate, Department of Psychology (University of Michigan)

### Conferences

2020 Moderator, Virtual Dopamine (ViDA) Conference

2019 Poster Judge, Wallin Discovery Research Symposium, University of Minnesota

2019 Poster Judge, Medical Discovery Team on Addiction Research Symposium, University of Minnesota

2017 Organizing committee for the Gordon Research Seminar on Catecholamines

2013 Organizing committee for the Gordon Research Seminar on Catecholamines

### Outreach and Science Communication

2017 Contributor, Interstellate Magazine, Vol 2 [http://pub.lucidpress.com/Interstellate\\_Volume2/](http://pub.lucidpress.com/Interstellate_Volume2/)

2016 Contributor and editor, Interstellate Magazine, Vol. 1 [http://pub.lucidpress.com/Interstellate\\_Volume1/](http://pub.lucidpress.com/Interstellate_Volume1/)

2015 Society for Neuroscience meeting professional development workshop panel

2014 Society for Neuroscience meeting professional development workshop panel

2012 BrainsRule! Volunteer, University of Michigan

2008 Michigan Mentorship Program

## **Conference Abstracts**

39. Engel L, Wolff A, Sinha S, Collins V, & **Saunders BT.** (2021). Progressive recruitment of dorsolateral striatum dopamine signaling underlies cue-evoked movement invigoration. Virtual Dopamine (ViDA) Conference.

38. Poisson CL, Herubin CR, & **Saunders BT.** (2021). The role of superior colliculus inputs to the ventral

- tegmental area in appetitive Pavlovian conditioning. Society for Neuroscience Virtual Meeting.
37. Fraser KM, Collins V, Pat F, Janak PH, & **Saunders BT**. (2021). Hierarchical control of mesolimbic dopamine and striatal encoding of reward-paired cues governs behavioral flexibility. Society for Neuroscience Virtual Meeting.
  36. Collins VL, Bornhoft KN, & **Saunders BT**. (2021). Hierarchical cue control of cocaine seeking in the face of cost. Society for Neuroscience Virtual Meeting.
  35. Engel L, Wolff A, Sinha S, Collins V, & **Saunders BT**. (2021). Parallel and serial dopamine circuit control of conditioned behavior during Pavlovian learning. Society for Neuroscience Virtual Meeting.
  34. Fraser KM, Collins V, Pat F, Janak PH, & **Saunders BT**. (2020). Hierarchical control of mesolimbic dopamine and striatal encoding of reward-paired cues governs behavioral flexibility. American College of Neuropsychopharmacology Meeting.
  33. Fraser KM, Collins V, Pat F, Janak PH, & **Saunders BT**. (2020). A role for mesolimbic dopamine and striatal encoding of reward-paired cues in the hierarchical control of behavior. Pavlovian Society Annual Meeting.
  32. Engel L, Wolff A, & **Saunders BT**. (2020). Parallel and serial dopamine circuit control of conditioned movements during Pavlovian learning. Virtual Dopamine (ViDA) Conference.
  31. Collins AL & **Saunders BT**. (2020). Hierarchical cue control of cocaine seeking in the face of cost. Virtual Dopamine (ViDA) Conference.
  30. Collins AL & **Saunders BT**. (2020). Hierarchical cue control of cocaine seeking in the face of cost. Winter Conference on Brain Research. Big Sky, MT.
  29. Collins AL, Bornhoft K & **Saunders BT**. (2019). Hierarchical cue control of cocaine seeking in the face of cost. American College of Neuropsychopharmacology Meeting, Orlando, FL.
  28. Collins AL & **Saunders BT**. (2019). Hierarchical cue control of cocaine seeking in the face of cost. Society for Neuroscience meeting, Chicago, IL.
  27. **Saunders BT**, Richard JM & Janak PH. (2017). Encoding of conditioned motivation by midbrain dopamine neurons. American College of Neuropsychopharmacology Meeting, Palm Springs, CA.
  26. **Saunders BT**, Richard JM & Janak PH. (2017). Encoding of conditioned motivation by midbrain dopamine neurons. Society for Neuroscience meeting, Washington, DC
  25. Richard JM, **Saunders BT** & Janak PH. (2016). Ventral pallidum roles in cue-elicited reward seeking and reinforcement. American College of Neuropsychopharmacology Meeting, Hollywood, FL.
  24. **Saunders BT** & Janak PH. (2016). Exploring midbrain circuit dynamics of conditioned motivation. Society for Neuroscience meeting, San Diego, CA
  23. **Saunders BT** & Janak PH. (2016). Projection-specific control of conditioned motivation and action invigoration among midbrain neurons. Action selection across the animal Kingdom. Janelia Research Campus Conference, Ashburn, VA.
  22. **Saunders BT** & Janak PH. (2016). Functional heterogeneity among midbrain dopamine neurons. Dopamine 2016, Vienna, Austria.
  21. **Saunders BT**, Margolis EB, & Janak PH. (2015). Exploring functional heterogeneity among midbrain neurons in motivation. American College of Neuropsychopharmacology Meeting, Hollywood, FL.
  20. **Saunders BT**, Vitale KR, & Janak PH. (2015). Orbitofrontal cortex mediates inhibition within the basolateral amygdala to promote appetitive Pavlovian conditioning. Society for Neuroscience meeting, Chicago, IL
  19. **Saunders BT** & Janak PH. (2014). Distinct midbrain dopamine neuron subpopulations contribute to cue attraction, psychomotor activation, and reinforcement. Winter Conference on Brain Research, Big Sky, MT
  18. **Saunders BT** & Janak PH. (2014). Distinct midbrain dopamine neuron subpopulations contribute to cue attraction, psychomotor activation, and reinforcement. Society for Neuroscience meeting, Washington, DC
  17. **Saunders BT** & Janak PH. (2013). Optogenetic manipulation of dopamine neurons reveals dual roles for dopamine in reinforcement and conditioned motivation. Society for Neuroscience meeting, San Diego, CA
  16. O'Donnell EG, **Saunders BT**, & Robinson TE. (2013). Dorsomedial striatal control of cue-directed versus goal-directed Pavlovian approach behavior. Society for Neuroscience meeting, San Diego, CA
  15. **Saunders BT** & Janak PH. (2013). Dopamine neurons both directly reinforce actions and instantiate neutral cues with reinforcing value. Society for Neuroscience meeting, San Diego, CA. Gordon Research

- Seminar and Gordon Research Conference on Catecholamines, Mount Snow Resort, West Dover, VT
14. O'Donnell EG, **Saunders BT**, & Robinson TE. (2013). Dorsomedial striatal control of cue-directed versus goal-directed Pavlovian approach behavior. Michigan Society for Neuroscience meeting, Detroit, MI
  13. **Saunders BT**, Aurbach EL, & Robinson TE. (2012). Individual variation in the influence of a cocaine-associated context on behavior. Society for Neuroscience meeting, New Orleans, LA
  12. Couturier BE, Vander Weele CM, **Saunders BT**, & Aragona BJ. (2012). In vitro identification of carbon-fiber micro-electrodes with sensitivity sufficient for voltammetric detection of dopamine transients in vivo. Society for Neuroscience meeting, New Orleans, LA
  11. Badrinarayan A, Wescott SA, Vander Weele CM, **Saunders BT**, Couturier BE, Maren S, & Aragona BJ. (2012) Aversive stimuli differentially modulate real-time dopamine transmission dynamics within the nucleus accumbens core and shell. Molecular and Cellular Cognition Society meeting, New Orleans, LA
  10. **Saunders BT** & Robinson TE. (2012). Individual variation in the influence of a cocaine-associated context on behavior. Michigan Society for Neuroscience meeting, Ann Arbor, MI
  9. **Saunders BT** & Robinson TE. (2011). A cue evokes relapse in the face of adverse consequences preferentially in rats prone to attribute incentive salience to reward cues: Role of nucleus accumbens dopamine. Society for Neuroscience meeting, Washington, D.C
  8. **Saunders BT** & Robinson TE. (2011). Nucleus accumbens dopamine receptor blockade selectively disrupts the expression of approach to an incentive stimulus. Society for Neuroscience meeting, Washington, D.C
  7. **Saunders BT** & Robinson TE. (2011). A cue evokes relapse in the face of adverse consequences preferentially in rats prone to attribute incentive salience to reward cues. University of Michigan Substance Abuse Research Center Symposium, Ann Arbor, MI
  6. **Saunders BT** & Robinson TE. (2011). Nucleus accumbens dopamine blockade selectively disrupts the expression of approach to an incentive stimulus. Gordon Research Seminar and Gordon Research Conference on Catecholamines, Bates College, Lewiston, ME
  5. **Saunders BT** & Robinson TE. (2010). Variation in attributing incentive salience to a food-related cue predicts motivation for cocaine and cocaine-induced drug seeking. Society for Neuroscience meeting, San Diego, CA
  4. Lovic V, **Saunders BT**, Yager LM, Czuj AK, & Robinson TE. (2010). Variation in attributing incentive salience to a food cue is associated with action impulsivity. Society for Neuroscience meeting, San Diego, CA
  3. **Saunders BT** & Robinson TE. (2009). Individual differences in attributing incentive salience to a food-related cue predict the ability of a cocaine-associated cue to maintain and reinstate self-administration. Society for Neuroscience meeting, Chicago, IL
  2. **Saunders BT** & Robinson TE. (2009). Individual differences in responsivity to a cocaine-associated cue: Implications for vulnerability to addiction. American Psychological Association/National Institute on Drug Abuse Early Career Investigators, Toronto, ON, Canada
  1. Diller JW, **Saunders BT**, & Anderson KG. (2007). The effects of acute and repeated caffeine administration on delay discounting in rats. Association for Behavior Analysis meeting, Atlanta, GA