

## Noam Miller

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### EDUCATION

- 2010 Ph.D., Experimental Psychology, University of Toronto, Toronto, ON, Canada.
- 2005 M.A., Experimental Psychology, University of Toronto, Toronto, ON, Canada.
- 2003 B.Mus., Performance, Thompson Rivers University, BC, Canada.
- 2002 Performance Diploma (Clarinet). The Glenn Gould School at the Royal Conservatory of Music, Toronto, ON, Canada.
- 1997 B.Sc., Biology, Tel-Aviv University, Tel-Aviv, Israel.

### EMPLOYMENT HISTORY

- 2019-present Associate professor, Departments of Psychology & Biology, Wilfrid Laurier University, Waterloo, ON, Canada.
- 2014-2019 Assistant professor, Department of Psychology, Wilfrid Laurier University, Waterloo, ON, Canada [cross-appointed in the Biology Department since September 2017].
- 2012-2014 Post-doctoral researcher (NSF), Ecology & Evolutionary Biology Department, Princeton University, Princeton, NJ, USA (supervisor: Iain Couzin).
- 2010-2012 NSERC Post-doctoral fellow, Ecology & Evolutionary Biology Department, Princeton University, Princeton, NJ, USA (supervisor: Iain Couzin).
- 2002-2004 Library manager, Royal Conservatory of Music, Toronto, ON, Canada.
- 2000-2004 Research assistant for Sara Shettleworth (part-time), Department of Psychology, University of Toronto, Toronto, ON, Canada.
- 1996-1998 Research assistant for Ilan Golani (part-time), Department of Zoology, Tel-Aviv University, Tel-Aviv, Israel.

### RESEARCH FUNDING and AWARDS

- 2023 – 2028 NSERC Discovery Grant. Principal Investigator. \$165,000.
- 2021 Wilfrid Laurier University Internal Grant. \$6,100
- 2020 Wilfrid Laurier University Early Career Research Award. \$2,500
- 2019 Wilfrid Laurier University Faculty of Science Teaching Award, Early Career.
- 2019 – 2024 ORF Research Excellence Grant. Collaborator [PI: Manuel Riemer]. \$999,749.
- 2018 – 2021 SSHRC Partnership Development Grant. Collaborator [PI: Manuel Riemer]. \$199,759.
- 2016 – 2023 NSERC Discovery Grant. Principal Investigator. \$189,000.
- 2016 – 2017 Banting Research Foundation Award. Principal Investigator. \$21,000.
- 2012 – 2013 NSF EAGER grant. Co-author [PI: Iain Couzin]. \$180,000.
- 2010 – 2012 NSERC post-doctoral Fellowship. \$80,000.
- 2008, 2009 Ontario Graduate Scholarship. \$15,000 (X 2).
- 2007, 2010 IBNS Student Travel Award. \$1,000 (X 2).

**PUBLICATIONS**

*Names of graduate students are bolded; undergraduate students are underlined.*

Peer reviewed publications

1. **Nagabaskaran G, Skinner M**, Miller N (2022). Western hognose snakes (*Heterodon nasicus*) prefer environmental enrichment. *Animals*, 12:3347.
2. **Damphousse CC**, Miller N, Marrone DF (2022). Functional dissociation along the rostrocaudal axis of Japanese quail hippocampus. *PLoS One*, 17:e0277414.
3. **Skinner M, Brown S, Kumpan T**, Miller N (2022). Snake personality: Differential effects of development and social experience. *Behavioral Ecology & Sociobiology*, 76:135.
4. Miller N, Ayoub R, **Sentinathan G**, Mallet P (2022). Behavioral evidence for two distinct memory systems in rats. *Animal Cognition*, 25:1599-1608.
5. **Damphousse CC**, Miller N, Marrone DF (2022). Protocol for inducing hippocampal formation lesions and associated behavioral testing in Japanese quail. *STAR protocols*, 3:101553.
6. **Damphousse CC**, Miller N, Marrone DF (2022). Experience-dependent Egr1 expression in the hippocampus of Japanese Quail. *Frontiers in Psychology: Comparative Psychology*, 13:887790
7. **Damphousse CC**, Miller N, Marrone DF (2022). Dissociation of spatial and object memory in the hippocampal formation of Japanese quail. *iScience*, 25:103805
8. **Skinner M**, Miller N (2022). Stability and change in gartersnake social networks across ontogeny. *Ethology*, 128:257-267
9. **Damphousse CC**, Miller N, Marrone DF (2021). Reaction to novelty as a behavioral assay of recognition memory in homing pigeons and Japanese quail. *Learning & Behavior*, 50:167-177.
10. Kadak K, Miller N (2020). Follow the straggler: zebrafish use a simple heuristic for collective decision-making. *Proceedings of the Royal Society B*, 287:20202690.
11. **Skinner M**, Miller N (2020). Aggregation and social interaction in garter snakes (*Thamnophis sirtalis sirtalis*). *Behavioral Ecology & Sociobiology*, 74:51.
12. **Damphousse C**, Marrone D, Miller N (2019). Pair foraging degrades socially transmitted food preferences in rats. *Animal Cognition*, 22:1027-1037.
13. Ayoub R, Armstrong E, Miller N (2019). Out of sight, out of mind: mechanisms of social choice in fish. *Animal Behaviour*, 155:163-169.
14. Miller N (2018). Social learning and associative processes: a synthesis. *Journal of Experimental Psychology: Animal Learning and Cognition*, 44:105-113.
15. **Delcourt J**, Miller NY, Couzin ID, Garnier S (2018). Methods for the effective study of collective behavior in a radial arm maze. *Behavior Research Methods*, 50:1673-1685.
16. White DJ, Watts E, Pitchforth K, Agyapong S, Miller N (2017). 'Sociability' affects the intensity of mate-choice copying in female guppies, *Poecilia reticulata*. *Behavioural Processes*, 141:251-257.
17. **Guayasamin OL**, Couzin ID, Miller N (2017). Behavioural plasticity across social contexts is regulated by the directionality of inter-individual differences. *Behavioural Processes*, 141:196-204.
18. **Kao A**, Miller N, Torney C, **Hartnett A**, Couzin ID (2014). Collective learning and optimal consensus decisions in social animal groups. *PLoS Computational Biology*, 10(8): doi:10.1371/journal.pcbi.1003762
19. Miller N, Shettleworth SJ (2013). An associative model of instrumental choice: a response to Dupuis and Dawson. *Journal of Experimental Psychology: Animal Behavior Processes*, 39, 287-293.
20. Miller N, Garnier S, **Hartnett A**, Couzin ID (2013). Both information and social cohesion determine collective decisions in animal groups. *PNAS*, 110, 5263-5268.

21. Kalueff AV, Gebhardt M, Stewart AM, Cachat JM, Brimmer M, Chawla JS, Craddock C, Kyzar EJ, Roth A, Landsman A, Gaikwad S, Robinson K, Baatrup E, Tierney K, Shamchuk A, Norton W, Miller N, Nicolson T, Braubach O, Gilman CP, Pittman J, Rosemberg DB, Gerlai R, Echevarria D, Lamb E, Neuhauss SCF, Weng W, Bally-Cuif L, Schneider H, ZIRC (2013). Towards a comprehensive catalog of zebrafish behavior 1.0, and beyond. *Zebrafish*, *10*, 70-86.
22. Miller N, Greene K, Dydinski A, Gerlai R (2013). Effects of nicotine and alcohol on zebrafish (*Danio rerio*) schooling. *Behavioural Brain Research*, *240*, 192-196.
23. Miller N, Gerlai R (2012). From schooling to shoaling: patterns of collective motion in zebrafish (*Danio rerio*). *PLoS ONE*, *7*(11): doi:10.1371/journal.pone.0048865
24. Miller NY, Gerlai R (2011). Redefining membership in animal groups. *Behavior Research Methods*, *43*, 964-970.
25. Miller NY, Gerlai R (2011). Shoaling in zebrafish: what we don't know. *Reviews in the Neurosciences*, *22*, 17-25.
26. Miller NY (2009). Modeling the effects of enclosure size on geometry learning. *Behavioral Processes*, *80*, 306-313.
27. Miller NY, Gerlai R (2008). Oscillations in shoal cohesion in zebrafish (*Danio rerio*). *Behavioural Brain Research*, *193*, 148-151.
28. Miller NY, Shettleworth SJ (2008). An associative model of geometry learning: a modified choice rule. *Journal of Experimental Psychology: Animal Behavior Processes*, *34*, 419-422.
29. Miller NY, Gerlai R (2007). Quantification of shoaling behavior in zebrafish (*Danio rerio*). *Behavioural Brain Research*, *184*, 157-166.
30. Miller NY, Shettleworth SJ (2007). Learning about Environmental Geometry: An Associative Model. *Journal of Experimental Psychology: Animal Behavior Processes*, *33*, 191-212.
31. **Skov-Rackette SI**, Miller NY, Shettleworth SJ (2006). What-where-when memory in pigeons. *Journal of Experimental Psychology: Animal Behavior Processes*, *32*, 345-358.

#### Invited publications

32. Miller N (2021). Taking shortcuts in the study of animal navigation. *Learning & Behavior*, *49*:261-262. [outlook paper; commentary].
33. Miller N (2018). Raising the bar on studying cultural evolution. *Learning & Behavior*, *46*:5-6 [outlook paper; commentary].
34. Miller N (2017). Cognition in fishes. *Behavioral Processes*, *141*:137-140 [introduction to a special issue on fish cognition].
35. **Pérez-Escudero A**, Miller N, **Hartnett AT**, Garnier S, Couzin ID, de Polavieja GG (2013). Estimation models describe well collective decisions among three options. *PNAS*, *110*:E3466-3467 [letter; commentary].

#### Book chapters and other contributions

36. Miller N (2020). Social behavior and its psychopharmacological and genetic analysis in zebrafish. In R Gerlai (Ed), *Behavioral and Neural Genetics of Zebrafish*, pp. 173-185. Elsevier [book chapter].
37. Miller N (2019). Sara Shettleworth. In J Vonk & TK Shackelford (Eds.), *Encyclopedia of Animal Cognition and Behavior*. Springer International Publishing [biographical encyclopedia entry].
38. Miller N (2018). Birds of a Feather: collective cognition in avian species. In N Bueno-Guerra & F Amici (Eds.), *Field and Laboratory Methods in Animal Cognition*. Cambridge: Cambridge University Press [information box in a chapter on avian cognition].

39. Miller N, Gerlai R (2012). Automated tracking of zebrafish shoals and the analysis of shoaling behavior. In AV Kalueff & AM Stewart (Eds.), *Zebrafish Protocols for Neurobehavioral Research*. New York: Humana Press [book chapter].

### INVITED TALKS

*I have given several invited colloquia/seminar talks at various departments, generally titled "Collective Animal Cognition". Below is a list of these. Other invited talks are listed separately below.*

- Neuroscience and Applied Cognitive Science Program Seminar Series. University of Guelph, Guelph, ON. January 2020.
- Psychology, Neuroscience, & Behavior (PNB) Colloquium Series. McMaster University, Hamilton, ON. February 2018.
- Marschak Colloquium. UCLA, Los Angeles, CA. October 2017.
- Department of Collective Behavior Seminar. Max Planck Institute for Ornithology, Konstanz, Germany. July 2016.
- Graduate Colloquium Series. Brooklyn College (CUNY), Brooklyn, NY. February 2016.
- Seminar. Leibniz Institute for Freshwater Ecology, Berlin, Germany. September 2014.
- Ecology and Evolutionary Biology Seminar. University of Toronto, Toronto, ON. February 2014.
- Psychology Department Seminar. Temple University, Philadelphia, PA. January 2014.
- Department of Zoology Seminar. Tel-Aviv University, Tel-Aviv, Israel. January 2013.
- Modeling and Computational Science Seminar. The University of Ontario Institute of Technology (UOIT), Oshawa, ON. October 2012.

"Social animals: what animal behavior can teach us about collective decision making". Public lecture, Royal Canadian Institute for Science *RCiScience Talks* series. Waterloo, ON. October 2019.

"Social information use in fish". Public lecture; part of the Royal Canadian Institute for Science *RCiScience Talks* series. Toronto, ON. February 2017.

"Mechanisms of collective decision-making". Psychology Department Graduate Seminar, Wilfrid Laurier University, Waterloo, ON. October 2016.

"Some determinants of leadership in fish schools". Integrated Behavior Research Group, Princeton University, Princeton, NJ. April 2013.

"Mechanisms of collective intelligence". Integrated Behavior Research Group, Princeton University, Princeton, NJ. February 2012.

"Schooling and shoaling in zebrafish". Integrated Behavior Research Group, Princeton University, Princeton, NJ. March 2011.

### CONFERENCE PRESENTATIONS

*Graduate student names are bolded; undergraduates are underlined.*

**Shoot T**, Miller N [Talk]. The impact of individual personality on group behavior in two species of fish. Animal Behavior Society, Portland, OR, USA, July 2023.

**Kumpan L**, **Skinner M**, Teichroeb J, Miller N [Talk]. Personality development and the effects of social experience on personality traits in *Python regius*. Animal Behavior Society, Portland, OR, USA, July 2023.

Miller N, Sekulovski B [Talk]. Losing my mind: loss of unused cognitive skills in blind cavefish. Conference on Comparative Cognition, Melbourne, FL, USA, April 2023.

- Shoot T**, Miller N [Talk]. How does the personality composition of a group affect collective behaviour? Conference on Comparative Cognition, Melbourne, FL, USA, April 2023.
- Nagabaskaran G**, **Skinner M**, Gantert T, Miller N [Poster]. Bolder together: boldness is affected by social context in garter snakes. Conference on Comparative Cognition, Melbourne, FL, USA, April 2023.
- Freiburger T, **Skinner M**, Miller N [Poster]. A comparative test of odor self-recognition in two species of snake. Conference on Comparative Cognition, Melbourne, FL, USA, April 2023.
- Johnston M-R**, **Skinner M**, Miller N [Poster]. Juvenile corn snakes fail the 3-chamber task. Conference on Comparative Cognition, Melbourne, FL, USA, April 2023.
- Miller N, **Skinner M**, Brown S, **Kumpan T**. Environmental effects on the expression of personality in snakes. Conference on Comparative Cognition [virtual], April 2022.
- Shoot T**, Miller N, Long TA. Food quality affects the structure of fruit fly groups when foraging collectively. Conference on Comparative Cognition [virtual], April 2022.
- Damphousse CC**, Miller N, Marrone DF. Functional dissociation in the Japanese quail hippocampal formation. Conference on Comparative Cognition [virtual], April 2022.
- Skinner M**, Miller N. Having a ball (python): social behavior in non-social snakes. CO3 2022
- Sekulovski B, Miller N. The blind avoiding the blind: schooling behavior in zebrafish and blind cavefish. Conference on Comparative Cognition [virtual], April 2022.
- Nagabaskaran G**, **Skinner M**, Miller N. Enrichment and cognition in Western hognose snakes. Conference on Comparative Cognition [virtual], April 2022.
- Damphousse CC**, Miller N, Marrone DF. Novelty detection in two avian species. Canadian Association for Neuroscience [Virtual], August 2021.
- Damphousse CC**, Miller N, Marrone DF. Differences in spontaneous preference for novel locations in two avian species. International Student Symposium on Animal Behaviour and Cognition (ISSABC) [Virtual], May 2021. Also presented at the Conference on Comparative Cognition [virtual], April 2021.
- Damphousse CC**, Miller N, Marrone DF. Preference for novel locations in Japanese Quail (*Coturnix japonica*) and Silver King Pigeons (*Columba livia*). Animal Behaviour Society Conference [Virtual], August 2021.
- Skinner M**, Miller N. Garter snakes change their social groups across development. Conference on Comparative Cognition [virtual], April 2021.
- Freiburger T, **Skinner M**, Miller N. Olfactory self-recognition in Eastern garter snakes. Conference on Comparative Cognition [virtual], April 2021.
- Shoot T**, Long TAF, Miller N. The effect of population density on cluster size and timing of collective digging in *Drosophila melanogaster*: A theoretical approach. Conference on Comparative Cognition [virtual], April 2021.
- Miller N. Panelist for symposium “Getting our bearings: advances in understanding spatial reorientation”. Cognitive Science Society. Virtual meeting, August 2020.
- Kadak K, Miller N “Live to tell the tail: Testing Bayesian models of socially-driven decisions in zebrafish” [Poster]. Canadian Society for Brain, Behavior, and Cognitive Science. Waterloo, ON, July 2019.
- Katzman H**, Miller N “The effects of telencephalon lesions on zebrafish social behavior” [Poster]. Southern Ontario Neuroscience Association, Windsor, ON, May 2019.
- Lavery JM**, Braithwaite V, Miller N, Mason G “Identifying enriched housing conditions for zebrafish (*Danio rerio*) that vary along a scale of preference” [talk]. Ontario Ecology, Ethology and Evolution Colloquium, Hamilton, ON, May 2019 [1st place oral presentation award]. Also presented at the CCSAW Research Symposium, Guelph, ON, May 2019 [tied for 1st place oral presentation award]. Also presented at the Congress of the International Society for Applied Ethology, Bergen, Norway, August 2019.

- Miller N, Kadak K “Testing models of collective decision-making in fish” [Talk]. Conference on Comparative Cognition, Melbourne, FL, April 2019.
- Skinner M**, Miller N “Snake personality: boldness and sociability in two contexts” [Poster]. Conference on Comparative Cognition, Melbourne, FL, April 2019.
- Damphousse C**, Marrone D, Miller N “Neurological and behavioural applications of avian spatial memory” [Poster]. Southern Ontario Neuroscience Association, Guelph, ON, May 2018. Also presented at the Conference on Comparative Cognition, Melbourne, FL, April 2018.
- Miller N, Ayoub R, **Sentinathan G**, Mallet P “I do (not) declare: implicit memory in rats” [Talk]. Conference on Comparative Cognition, Melbourne, FL, April 2018.
- Skinner M**, Miller N “Snakes are social! Aggregation behavior in Eastern garter snakes” [Poster]. Conference on Comparative Cognition, Melbourne, FL, April 2018.
- Kleinhandler E, Wilkie M, Miller N “Anoxic hibernation: friend or foe of goldfish (*Carassius auratus*) memory?” [Poster]. Annual Comparative Physiology and Biochemistry Workshop, Rice Lake, ON, January 2018.
- Miller N, Schultz M “Knowing your place: how personality and dominance interact with learning in Japanese quail” [Talk]. Comparative Cognition Society, Vancouver, BC, November 2017.
- Miller N, **Damphousse C**, Micks N, Kleinhandler E, Marrone D. “Egr1 expression in avian granule cells is consistent with pattern separation” [Poster]. Society for Neuroscience, Washington, D.C., November 2017.
- Damphousse C**, Kleinhandler E, Micks N, Miller N, Marrone D. “Social preference alters Arc expression in the olfactory bulb” [Poster]. Society for Neuroscience, Washington, D.C., November 2017. Also presented at the Canadian Association for Neuroscience, Montreal, QC, May 2017.
- Damphousse C**, Marrone D, Miller N. “Factors affecting the social transmission of food preferences” [Poster]. Animal Behavior Society, Scarborough, ON, June 2017.
- Miller N, Ayoub R “Out of sight, out of mind: flexible use of social information and learning in zebrafish” [Talk]. Animal Behavior Society, Scarborough, ON, June 2017; also presented as a poster at Psychonomics, Boston, MA, November 2016.
- Miller N “Information is information: how pigeons combine personal and ‘social-like’ cues” [Talk]. Conference on Comparative Cognition, Melbourne, FL, April 2016.
- Miller N, **Guayasamin O**, Couzin ID “I am plastic: zebrafish behavioral flexibility as a function of social context” [Talk]. Conference on Comparative Cognition, Melbourne, FL, April 2015.
- Miller N, **Strandburg-Peshkin A**, Couzin ID “Collective learning and the emergence of producer-scrounger dynamics” [Talk]. Animal Behavior Society, Princeton University, Princeton, NJ, August 2014; also presented at Collective Intelligence, MIT, Cambridge, MA, June 2014; and at Psychonomics, Toronto, ON, November 2013.
- Miller N “Collective foraging and the evolution of visual search” [Talk]. Collective Dynamics of Communities and Populations, Princeton University, Princeton, NJ, April 2014; also presented at the Conference on Comparative Cognition, Melbourne, FL, March 2014.
- Miller N “A model of collective learning” [Talk]. Conference on Comparative Cognition, Melbourne, FL, March 2013.
- Miller N, Garnier S, **Hartnett A**, Couzin ID “Risk and information determine collective decisions in animal groups” [Talk]. Animal Swarms Workshop, Kfar-Blum, Israel, February 2013.
- Miller N, **Kao A**, Torney C, **Hartnett A**, Couzin ID “Collective learning” [Talk]. Canadian Applied and Industrial Mathematics Conference, Toronto, ON, June 2012.
- Miller N, Gerlai R “Characterization of shoaling in zebrafish: a medium-throughput behavioral assay” [Talk and poster; travel award winner]. International Behavior Neuroscience Society meeting, Villasimius, Italy, June 2010.
- Miller N, Gerlai R “Explaining the Dynamics of Inter-Individual Distance (IID) in Zebrafish Shoals” [Poster]. International Ethological Conference, Rennes, France, August 2009.

Miller N, Gerlai R “Fluctuations in school cohesion in zebrafish (*Danio rerio*)” [Poster]. Conference on Comparative Cognition, Melbourne, FL, March 2008.

Miller N, Gerlai R “Operant conditioning in zebrafish (*Danio rerio*)” [Talk and poster; travel award winner]. International Behavior Neuroscience Society meeting, Rio de Janeiro, Brazil, July 2007.

Miller N, Shettleworth SJ “An associative model of geometry learning” [Poster]. Conference on Comparative Cognition, Melbourne, FL, March 2007.

Miller N, Shettleworth SJ “What is geometry?” [Talk]. Conference on Comparative Cognition, Melbourne, FL, March 2005.

## **PROFESSIONAL MEMBERSHIPS**

Animal Behavior Society  
Comparative Cognition Society  
Society for Neuroscience

## **SERVICE POSITIONS**

2015 – present: Review Editorial Board member, *Frontiers in Comparative Psychology*

2016: Guest Editor, *Behavioural Processes*.

2017 – 2019: Editorial Board member, *Journal of Experimental Psychology: Animal Learning & Cognition*

2018 – 2020: Member-at-Large, Comparative Cognition Society

2020 – 2023: Associate Editor, *Animal Cognition*

2020 – 2023: Secretary, Comparative cognition Society

2023 – present: President-Elect, Comparative Cognition Society

2023 – present: Series Editor, *Routledge Research in Comparative Cognition* (book series).

**November 2023**