

CURRICULUM VITAE

Fred C. Dyer

Born 9 August 1955

Address, etc.

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Current Position

Chairperson and Professor, Michigan State University (since 2003)

Previous Affiliations

1999-2003 Professor, Michigan State University

1992-1999 Associate Professor, Michigan State University

1995-1996 Visiting Associate Professor, University of California, San Diego

1986-1992 Assistant Professor, Michigan State University

1984-1986 Post-doctoral Associate, Yale University

1982-1983 Fulbright Fellow, Indian Institute of Science

1978-1984 Graduate Student, Princeton University

Education

Denison University, Granville, Ohio (B.S. 1977, with honors)

Princeton University, graduate student 1978-1984

1981 M.A. (Major fields: Behavior, Neurobiology)

1984 Ph.D. (Dissertation: Comparative studies of the dance language and orientation of four species of honey bees)

Extramural Research Awards

Smithsonian Institution, \$7,250, 1982, "Comparative ethology and ecology of three species of *Apis* in India: research development"

Fulbright Full Grant for year of research in India, 1982-83

NSF Psychobiology Grant, \$60,000, 1984-86 (co-PI with T.D. Seeley), "Social foraging in honey bees: comparative studies in the Asian tropics"

Smithsonian Institution (travel grant for research in India), \$6,310, 1988, "Comparative studies of dance orientation and vision in the Asian honey bees"

NSF Animal Behavior, \$106,375, 1989-92, "Visual orientation in honey bees" (includes Research Experiences for Undergraduates supplements)

NSF Systematic Biology, \$244,000, 1990-94, "Dance language, eusociality, and systematics of *Apis* and the Apidae" (includes Research Experiences for Undergraduates supplement)

NSF Animal Behavior, \$69,000, 1993-95, "Visual-spatial memory in an invertebrate" (includes Research Experiences for Undergraduates supplements)

NSF Animal Behaviour, \$10,000, 1995-96, Dissertation research: the development of spatial memory in honey bees" (for Elizabeth Capaldi)

NSF Animal Behavior, \$158,500, 1997-2000, "Development of sun-compass orientation: an invertebrate model for the study of spatial cognition"

National Geographic Society, \$9,300, 1998-99, "Pollination Ecology in Asian honey bees" (co-PI with Puja Batra)

Conservation, Food, and Health Foundation, 1998-99, \$7,000, "Pollination ecology in Asian honey bees" (co-PI with Puja Batra)

NSF Knowledge and Distributed Intelligence/Learning and Intelligent Systems, 1998-2002, \$800,000, "Sequential Decision Making in Animals and Machines (co-PI with John Henderson and Sridhar Mahadevan)

NSF IGERT Training Grant, 2001-2008, \$3.1 million, "A Unified Approach to Sequential Decision-Making in Cognitive Science" (PI and Project Director; co-PIs are Fernanda Ferreira (PSY), Tom Getty (ZOL), John Henderson (PSY), and Aude Oliva (PSY))

NSF Dissertation Improvement Grant, 2002-2003, \$6,500, "Modulation of learning flights in honey bees" (with Cynthia Wei)

NSF STC (invited full proposal submitted spring 2009); Senior Investigator with several others (Erik Goodman, PI, C. Ofria, R. Lenski, R. Pennock, K. Holekamp, T. Getty, B. Cheng, P. McKinley), \$25 million, BEACON: An NSF Center for the Study of Evolution in Action

Intramural Research Awards

Seesel-Anonymous Grant, Yale University (salary), \$6,000, 1986

AURIG Grant, Michigan State University, \$3,860, 1987, "Nocturnal orientation and vision in Asian honey bees"

AURIG, Michigan State University, \$11,000, 1995, "Sun-compass learning in honey bees"

Research Excellence Funds, Michigan State University, \$50,000, 2002-2004, Sequential Decision-Making in Cognitive Science

Publications (Chronological)

Dyer, F.C., J.L. Gould. 1981. Honey bee orientation: a backup system for cloudy days. *Science* 214 : 1041-42.

Dyer, F.C., J.L. Gould. 1983. Honey bee navigation. *American Scientist* 71 : 587-97.

Dyer, F.C. 1985a. Mechanisms of dance orientation in the Asian honey bee *Apis florea*. *Journal of Comparative Physiology A* 152 : 183-98.

Dyer, F.C. 1985b. Nocturnal orientation by the Asian honey bee *Apis dorsata*. *Animal Behavior* 33 : 769-74.

Gould, J.L., F.C. Dyer, and W.F. Towne. 1985. Recent progress in the study of the dance language. *Fortschritte der Zoologie* 31 : 141-61.

Dyer, F.C. 1987a. Memory and sun compensation by honey bees. *Journal of Comparative Physiology A* 160 : 621-33.

Dyer, F.C. 1987b. New perspectives on the dance orientation of the Asian honey bees. In: *Neurobiology and Behavior in Honey Bees* (Ed. by R. Menzel and A. Mercer), pp. 54-65. Berlin: Springer-Verlag.

- Dyer, F.C., T.D. Seeley. 1987. Interspecific comparisons of endothermy in honey bees (*Apis*): Deviations from the expected size-related patterns. *Journal of Experimental Biology* 127 : 1-26.
- Dyer, F.C., T.D. Seeley. 1989a. Orientation and foraging in honey bees. In: *Insect Flight* (Ed. by G. Goldsworthy and C. Wheeler), pp. 205-30. Fort Lauderdale: CRC Press.
- Dyer, F.C., T.D. Seeley. 1989b. On the evolution of the dance language. *The American Naturalist* 133 : 580-90.
- Dyer, F.C. 1990a. Comparative analyses of the honey bee dance language: phylogeny, function, mechanism. In: *Social Insects and the Environment* (Ed. by G.K. Veeresh, B. Mallik, and C.A. Viraktamath) , pp. 99-100. New Delhi: Oxford & IBH Publishing Co.
- Dyer, F.C. 1990b. How honey bees learn about a landscape. In: *Social Insects and the Environment* (Ed. by G.K. Veeresh, B. Mallik, and C.A. Viraktamath) , pp. 198-199. New Delhi: Oxford & IBH Publishing Co.
- Dyer, F.C. 1991a. Honey bees acquire route-based memories but not cognitive maps in a familiar landscape. *Animal Behaviour* 41 : 239-246.
- Dyer, F.C. 1991b. Comparative studies of dance communication: analysis of phylogeny and function. In: *Diversity in the Genus Apis* (Ed. by D.R. Smith), pp. 177-198. Boulder: Westview Press.
- Dyer, F.C. 1991c. Coadaptation of colony design and worker performance in honey bees. In: *Diversity in the Genus Apis* (Ed. by D.R. Smith) pp. 213-245. Boulder: Westview Press.
- Dyer, F.C., T.D. Seeley. 1991a. Dance dialects and foraging range in three Asian honey bee species. *Behavioral Ecology and Sociobiology* 28 : 227-233.
- Dyer, F.C., T.D. Seeley. 1991b. Nesting behavior and the evolution of worker tempo in four honey bee species. *Ecology* 72 : 156-170.
- Dyer, F.C. 1993a. How honey bees find familiar feeding sites after changing nesting sites with a swarm. *Animal Behaviour* 46 : 813-816.
- Dyer, F.C. 1993b. Large-scale spatial memory and navigation in honey bees. In: *Orientation and Navigation: Birds, Humans, and Other Animals* (Proceedings of the 1993 Conference of the Royal Institute of Navigation). London: The Royal Institute of Navigation.
- Dyer, F.C., N.A. Berry, A.S. Richard. 1993. Honey bee spatial memory: use of route-based memories after displacement. *Animal Behaviour* 45 : 1028-1030.
- Robinson, G.E., F.C. Dyer. 1993. Plasticity of spatial memory in honey bees: reorientation following colony fission. *Animal Behaviour* 46 : 311-320.
- Dyer, F.C., T.D. Seeley. 1994. Colony migration in the tropical honey bee *Apis dorsata* F. (Hymenoptera: Apidae). *Insectes Sociaux* 41 : 129-140.
- Dyer, F.C. 1994. Spatial cognition and navigation in insects. In: *Behavioral Mechanisms in Evolutionary Ecology* (Ed. by L. A. Real), pp. 66-98. Chicago: University of Chicago Press.

- Dyer, F.C., J.A. Dickinson. 1994. Development of sun compensation by honeybees: How partially experienced bees estimate the sun's course. *Proceedings of the National Academy of Science USA* 91 : 4471-4474.
- Dyer, F.C., B.H. Smith. 1994. Review of: *Anatomy of a Controversy*, by A.M. Wenner and P.G. Wells. *Animal Behaviour* 47 : 1242-1244.
- Capaldi, E.A., F.C. Dyer. 1995. Landmarks and dance orientation in *Apis mellifera*. *Naturwissenschaften* 82 : 245-247.
- Dyer, F. C. 1996. Spatial memory and navigation by honeybees on the scale of the foraging range. *Journal of Experimental Biology* 199: 147-154.
- Dyer, F.C., J.A. Brockmann. 1996. Orientation, sensory processes, and communication. In: *Foundations of Animal Behavior* (Ed. by L.D. Houck and L.C. Drickamer). Chicago: University of Chicago Press.
- Dyer, F. C., J. A. Dickinson. 1996. Sun-compass learning in insects: representation in a simple mind. *Current Directions in Psychological Science* 5: 67-72.
- Dickinson, J. A., F. C. Dyer. 1996. How insects learn about the sun's course: alternative modeling approaches. In: *From Animals to Animats 4* (Ed. P. Maes, M. J. Mataric, J.-A. Meyer, J. Pollack and S. W. Wilson), pp. 193-203. Cambridge, MA: MIT Press.
- Dyer, F. C. 1997. The seat of insect learning? *Natural History* 106(8): 58-59.
- Dyer, F. C. 1997. Birds do it, bees do it, even turtles in the sea do it. *Natural History* 106(8): 60-52.
- Dyer, F. C. 1998. Cognitive ecology of navigation. In: *Cognitive Ecology* (Ed. by R. Dukas), pp. 201-260. Chicago: University of Chicago Press.
- Dyer, F. C. 1998. Spatial cognition: lessons from central-place foraging insects. In: *A Synthetic Approach to Studying Animal Cognition* (Ed. by I. Pepperberg, A. Kamil, and R. Balda), pp. 119-154. London: Academic Press.
- Capaldi, E. A., and F. C. Dyer. 1999. The role of orientation flights on homing performance in honey bees. *Journal of Experimental Biology* 202: 1655-1666.
- Dyer, F. C. 2000. Individual cognition and group movement: insights from social insects. In: *Group Movement in Social Primates and Other Animals: Patterns, Processes, and Cognitive Implications*. (Ed. by P. Garber and S. Boinski). Chicago: University of Chicago Press.
- Budzynski, C.A., F. C. Dyer, and V.P. Bingman. 2000. Partial experience with the sun's arc is sufficient for all day sun compass orientation in homing pigeons, *Columba livia*. *Journal of Experimental Biology* 203: 2341-2348.
- Minut, S., S. Mahadevan, J.M. Henderson, and F.C. Dyer. 2000. Face recognition using foveal vision. In: *Biologically motivated computer vision* (Ed. by S-W. Lee, H. H. Bulthoff, & T. Poggio), pp. 424-433. Berlin: Springer-Verlag.
- Henderson, J. M., R. Falk, S. Minut, F.C. Dyer, and S. Mahadevan. (2001). Gaze control for face learning and recognition in humans and machines. In: *From fragments to objects: Segmentation processes in vision* (Ed. By T. Shipley and P. Kellman). New York: Elsevier.
- Dyer, F. C. (2002): The biology of the dance language. *Annual Review of Entomology*.47: 917-949.

- Dyer, F. C. (2002) Motivation and spatial cognition in honey bees. *Naturwissenschaften* 89: 262-264.
- Wei, C.A., S. L. Rafalko, and F.C. Dyer. (2002). Deciding to learn: modulation of learning flights in honeybees, *Apis mellifera*. *Journal of Comparative Physiology A* 188: 725-737.
- Dyer, F.C. (2002). When it pays to waggle. *Nature* 419: 885-886.
- Wharton, K., F.C. Dyer, Z.-Y. Huang, and T. Getty (2007) The honeybee queen influences the regulation of colony drone production. *Behavioral Ecology* 18: 1092–1099.
- Wharton, K, F.C. **Dyer**, and T. Getty (2008). Male elimination in the honey bee. *Behavioral Ecology* 19: 1075-1079.
- Wei, C.A. and F.C. **Dyer**. (2009). Investing in learning: why do honeybees, *Apis mellifera*, vary the durations of learning flight? *Animal Behaviour* 77: 1165-1177.
- Bartlett, F.A., and F. C. Dyer (in preparation) How bees use en route landmarks to improve their search for a goal.
- Dyer, F.C. (in preparation) Behavioral dissection of visual inputs into the sun compass of honey bees. *Journal of Experimental Biology*
- Townsend-Mehler, J., and F.C. Dyer (in preparation). An integrated study of decision-making in a naturalistic environment. *Behavioral Ecology*.
- Bartlett, F.A., M. Mack, and F.C. Dyer (in preparation): Evaluating the “snapshot model” of landmark guidance in foraging honey bees. *Journal of Experimental Biology*.

Membership in Professional Societies

- Animal Behavior Society
- International Union for the Study of Social Insects (IUSSI)
- International Society for Neuroethology
- Society for Comparative Cognition

Invited Talks and Other Presentations (since 1997)

- 1997. Ohio State University (Zoology)
 - University of Pennsylvania (Institute for Research in Cognitive Science)
 - University of California, Davis (Entomology)
 - University of Maryland (Zoology)
- 1998. Eastern Michigan University (Biology)
 - Junior Science Symposium, Wayne State University (plenary/banquet Speaker)
- 1999. Gordon Conference on Neuroethology, Queen's College Oxford (September 1999)
 - Midwest Regional Animal Behavior Society meeting (Symposium on Cognitive Neuroscience); Bowling Green, OH September 1999
 - Brown University (Cognitive and Linguistic Sciences)
- 2000. University of Minnesota (Cognitive Science Program)

- 2001. 6th International Congress on Neuroethology, Bonn, Germany
North Carolina State University (Behavior Program)
- 2002. Symposium on Neural Mechanisms of Behavior. Society for Comparative and Integrative Biology; Anaheim, CA January 2002
- 2003. Virginia Tech (Biology)
University of Massachusetts Medical School (Neuroscience)
- 2004. 7th International Congress on Neuroethology, Nyborg, Denmark (August 2004)
Denison University (Alumni Distinguished Speaker)
- 2005. Gordon Conference in Neuroethology, Magdalen College Oxford (August 2005)
- 2006. Society of Comparative Cognition Annual Meeting; Melbourne, FL, March 2006
Symposium on Individual and Collective Intelligence, International Union for the Study of Social Insects; Washington, DC, August 2006.
University of Western Ontario (Psychology)
- 2007. University of California at San Diego (Ecology, Behavior, and Evolution)
Ohio State University (Entomology)

Other Extramural Activities Since 1995

- Associate Editor, *Behavioral Ecology and Sociobiology* (2001-2002)
- Associate Editor, *Animal Behaviour* (1993-1997)
- Member of pre-proposal review panel, Knowledge and Distributed Intelligence Program, National Science Foundation (May 1999)
- NIMH Workshop on Data Archiving in Animal Cognition (July 2001)
- Annual PI Meeting for IGERT PIs, National Science Foundation: 2001-2006.
- Reviewed manuscripts for the following journals: *Science, Nature, Journal of Comparative Physiology A, Journal of Comparative Psychology, Insectes Sociaux, Journal of Experimental Psychology, Animal Learning and Behavior, Ethology, Journal of Theoretical Biology, Ethology, Physiological Entomology, Canadian Journal of Zoology*
- Reviewed grant proposals for National Science Foundation (Animal Behavior, Behavioral Endocrinology Program), Swiss National Science Foundation, Whitehall Foundation, National Geographic Society
- Reviewed book proposals for Springer Verlag (1), Oxford University Press (3), Norton (1)

Teaching

- Ecological Aspects of Animal Behavior (ZOL 415; 1987-97; MSU)
- Topics in Ethology and Behavioral Ecology (ZOL 822; 1989, 1991-99; MSU)
- Introduction to Animal Behavior (ZOL 313; 1990-92, 1998-2004; MSU)
- Sequential Decision-Making in Animals and Machines (Computer Science 941, 1999, MSU)
- Sociobiology (BIEB 164; 1996; UC San Diego)
- Sociobiology Lab (BIEB 165; 1996; UC San Diego)
- Nature and Practice of Cognitive Science (ZOL 867; 2003, 2005, 2007; MSU)
- Interdisciplinary Research in Cognitive Science (ZOL 890; 2004; MSU)
- Integrative Studies in Biology (non-majors) (ISB 202; 2004-09 MSU)

Graduate Advising

- 1987-1990. Karen Cebra (M.S.) Foraging for cryptic prey by domestic fowl: investigations of the role of search images.
- 1990-1996. Elizabeth Capaldi (Ph.D. received 1996) Landmark learning by honey bees
- 1991-1996. Jeffrey Dickinson (Ph.D. received 1996) Sun-compass orientation in honey bees
- 1999-2002 Dina Grayson (M.S. student) Distance and foraging economics of honey bees
- 1999-2002 Matthew Rees (M.S. student)
- 1995-2002. Puja Batra (Ph.D. received 2002) Pollination ecology of Asian honey bees
- 1998-2006. Frank Bartlett (Ph.D. received 2006) Navigational decision-making in honey bees.
- 1998-2004. Cynthia Wei (Ph.D. received 2004) Visual learning in honey bees
- 2001-2003 Kevin Gusé (M.S. received 2003) Comparative studies of visual behavior in bees
- 2002-present John Townsend-Mehler (Ph.D. student). Comparative studies of foraging decisions in bees.
- 2003-2008 Kathryn Wharton (Ph.D. Student co-advised with Tom Getty). Reproductive decisions by queen honey bees.
- 2005-present Stephanie Kortering (M.S.. Student). Visually guided behavior in chameleons.
- 2006-present Mercedes Ramirez (M.S. Student). Visual communication in honey bees.
- 2006-2009 Laura Grabowski (Ph.D. Student in Computer Science and Engineering: co-advised with Charles Ofria): Evolution of behavioral flexibility in Avidians.

Other Intramural and Outreach Activities

- Lecturer for “Spartan Speakers” (providing research seminars at Michigan liberal arts colleges), 1992-94
- Head of Seminar Committee, Program in Ecology and Evolutionary Biology, 1991-93
- Co-founder, seminar organizer, of interdepartmental Behavioral Biology Discussion Group, 1993-95
- Advisory Committee, Program in Ecology, Evolutionary Biology and Behavior (EEBB), 1998-present
- Seminar Committee, Program in Ecology, Evolutionary Biology and Behavior (EEBB), 1997-present
- Member of four committees for the Cognitive Science Program: Organizing Committee (1997-98), Seminar Committee (1998-2002), and Graduate Committee (1998-2002); Steering Committee (2004-present)
- Acting Director of Cognitive Science Program (Jan-July 1999)
- Zoology Department Graduate Affairs Committee (1996-98)
- Zoology Department Advisory Committee (1999-2002)

Head, Genetics Search Committee, Department of Zoology (1997-98)
Member of Apiculture Search Committee, Department of Entomology (1997-98)
Head, Chairperson Search Committee, Department of Zoology (1999-2002)
Member of Committee on College Reorganization (2004)
Member of CNS Task Force on Life Science Education (2005-07)
Member of Search Committee for Dean of College of Natural Science (2006-07)
Member of Search Committee for Associate Dean for Undergraduate Programs, CNS (2007)