

MARTIN A. NOWAK
Curriculum Vitae

Personal Information

Name: Martin Andreas Nowak
Address: Department of Mathematics, Harvard University
Cambridge, Massachusetts, United States
Email: martin_nowak@harvard.edu
Websites: www.math.harvard.edu/people/nowak-martin/
www.martinnowak.com/
Degrees: M.Sc. Vienna
Ph.D. Vienna (Dr. rer. Nat.)
M.A. (honoris causa) Oxford
A.M. (honoris causa) Harvard
Ph.D. (honoris causa) Cuza University of Iasi
Ph.D. (honoris causa) Dominican School of Philosophy and Theology

Current Position

Professor of Mathematics and of Biology, Harvard University

Education

1975-1983 Albertus Magnus Gymnasium in Vienna
1983-1989 University of Vienna, studying Biochemistry and Mathematics
1985 First Diploma: Biochemistry (first class honors)
1987 Diploma thesis: Theoretical Chemistry
1987 Second Diploma: Biochemistry (first class honors; finished one year faster)
1987-1989 Doctoral thesis: Mathematics
1989 Final exams for degree *Doctor rerum naturalium* (with highest honors)
Promotion "sub auspiciis praesidentis"

Scientific Career

University of Vienna:

1987-1988 Institute for Theoretical Chemistry, Peter Schuster
1987-1989 Institute for Mathematics, Karl Sigmund
1988 Max Planck Institute for Biophysical Chemistry, Göttingen, Manfred Eigen
1993 "Habilitation" at the Institute of Mathematics, University of Vienna

University of Oxford:

- 1989-1990 Erwin Schrödinger Scholarship to work with Robert May (Lord May of Oxford)
- 1990-1992 Guy Newton Junior Research Fellow, Wolfson College
- 1991 Royal Society Research Grant
- 1992-1998 Wellcome Trust Senior Research Fellow in Biomedical Sciences
- 1993-1996 E. P. Abraham Junior Research Fellow, Keble College
- 1995-1998 Head of Mathematical Biology Group
- 1996-1998 Senior Research Fellow, Keble College
- 1997-1998 Professor of Mathematical Biology

Institute for Advanced Study, Princeton:

- 1998-2003 Head, Program in Theoretical Biology, Institute for Advanced Study
- 1999-2003 Associated Faculty, Princeton University, Ecology and Evolutionary Biology
- 2000-2003 Associated Faculty, Princeton University, Program in Applied and Computational Mathematics

Harvard University:

- 2003 - Professor of Mathematics and of Biology
- 2003 - 2020 Director, Program for Evolutionary Dynamics

Prizes, Named Lectures, Memberships

- 1990 *Promotion sub auspiciis praesidentis rei publicae*
- 1990 Prize from the Austrian Science Minister
- 1995 Richardson Lecture, Keble College
- 1996 Weldon Memorial Prize, Oxford University
- 1997 Shanks Lecture, Vanderbilt University, Nashville, Tennessee
- 1998 Albert Wander Prize and Memorial Lecture, University of Bern, Switzerland
- 1999 Porter Lecture, Rice University, Houston, Texas
- 1999 Erwin Schroedinger Lecture, University of Vienna, Austria
- 1999 Akira Okubo Prize, International and Japanese Society for Mathematical Biology
- 1999 Roger F. Murray Prize, Institute for Quantitative Research in Finance
- 2000 Gergen Lecture, Duke University
- 2001 Benjamin Pinkel Lecture, University of Pennsylvania
- 2001 Corresponding Member, Austrian Academy of Sciences
- 2001 Rainich Lectures, University of Michigan, Ann Arbor
- 2001 David Starr Jordan Prize, Stanford University, Cornell University, Indiana University
- 2003 Henry Dale Prize, The Royal Institution, London
- 2006 Invited Lecture, Congress for Mathematics, Madrid
- 2006 R.R. Hawkins Award for *Evolutionary Dynamics*
- 2007 Radon Lecture, Austrian Academy of Sciences
- 2008 Coxeter Lectures, Fields Institute, Toronto

- 2010 Templeton Lectures, Johns Hopkins University
- 2010 Doctor Honoris Causa, Alexandru Ioan Cuza University of Iasi, Romania
- 2011 Max Planck Lecture, Stuttgart, Germany
- 2012 MBI 10th Anniversary Keynote talk, Ohio State University
- 2012 Plenary speaker, Canadian Mathematical Society
- 2013 Plenary speaker, International Congress of Ecology, London, England
- 2013 Simons Lecture, Institute for Mathematics and its Applications, Minneapolis
- 2013 Andre-Aisenstadt Chair, Centre de Recherches Mathématiques, Montreal
- 2014 Plenary Opening Talk, Nephrology Conference, Baden, Austria
- 2014 Keynote Lecture, 11th Austrian Research and Innovation Talk (ARIT)
- 2015 Plenary speaker, Collins Lecture Series, Massachusetts General Hospital
- 2015 Plenary speaker, Drug Discovery and World Therapy Congress, Boston
- 2016 Invited Lecture, Fermilab, Illinois
- 2016 Sewall Wright Speaker, University of Chicago
- 2016 Fannie Cox Prize for Excellence in Science Teaching
- 2017 AACR Team Science Award
- 2018 The Edmund R. Michalik Distinguished Lecture Series, University of Pittsburgh

Research Interests

Evolution; Evolutionary dynamics; Evolutionary game theory; Adaptive dynamics; Stochastic evolution; Finite populations; Evolutionary graph theory; Evolutionary set theory; Evolution of cooperation; Direct reciprocity; Indirect reciprocity; Spatial selection; Reputation; Fairness; Group selection; Cancer genetics, evolution, treatment; Infection dynamics; Virus dynamics, evolution, treatment; HIV, HBV, COVID-19; Quasispecies theory; Genetic redundancy; Evolution of language; Experimental games; Origin of evolution, pre-life; Evolution of eusociality; Clonal hematopoiesis; Science and philosophy; Science and religion.

Books

Nowak M. A & R. M. May (2000). *Virus Dynamics: Mathematical Principles of Immunology and Virology*. Oxford: Oxford University Press.

Nowak, M. A. (2006). *Evolutionary Dynamics: Exploring the Equations of Life*. Cambridge, MA: Harvard University Press.

Nowak, M. A. & R. Highfield (2011). *SuperCooperators: Why We Need Each Other to Succeed*. Simon & Schuster.

Coakley, S. & **M. A. Nowak**, eds. (2013). *Evolution, Games, and God: The Principle of Cooperation*. Harvard University Press.

Selected Publications

Schmid, L., Hilbe, C., Chatterjee, K. & **Nowak**, M.A. (2021). A unified framework of direct and indirect reciprocity. *Nat Hum Behav* DOI: 10.1038/s41562-021-01114-8

Heyde, A., Rohde, D., Cameron, S.M., Zhang, S., Hoyer, F.F., Gerold, J.M., Cheek, D., Iwamoto, Y., Schloss, M.J., Vandoorne, K., Iborra-Egea, O., Munoz-Guijosa, C., Bayes-Genis, A., Reiter, J.G., Craig, M., Swirski, F.K., Nahrendorf, M., **Nowak**, M.A., Naxerova, K. (2021). Increased stem cell proliferation in atherosclerosis accelerates clonal hematopoiesis. *Cell*. 184(5): 1348-1361. DOI: 10.1016/j.cell.2021.01.049

McAvoy, A., Allen, B. & **Nowak**, M.A. (2020). Social goods dilemmas in heterogeneous societies. *Nat. Hum. Behav.* 4: 819-831. DOI: 10.1038/s41562-020-0881-2

Hauser, O.P., Hilbe, C., Chatterjee, K. & **M.A. Nowak** (2019). Social dilemmas among unequals. *Nature* DOI: 10.1038/s41586-019-1488-5

Hilbe, C., Chatterjee, K. & **M. A. Nowak** (2018). Partners and rivals in direct reciprocity. *Nature Human Behaviour* 1. DOI: 10.1038/s41562-018-0320-9

Noble, C., Olejarz, J., Esvelt, K., Church, G. & **M. A. Nowak** (2017). Evolutionary dynamics of CRISPR gene drives. *3 Science Advances* 4. e1601964. DOI: 10.1126/sciadv.1601964

Allen B, G Lippner, Chen, Y-T., Fotouhi, B., N Momeni, S-T Yau & **M. A. Nowak** (2017). Evolutionary dynamics on any population structure. *Nature* 544: 227–230. DOI: 10.1038/nature21723

Waclaw, B., Bozic, I., Pittman, M. E., Rhuban, R. H., Vogelstein, B. & **M. A. Nowak** (2015). A spatial model predicts that dispersal and cell turnover limit intratumour heterogeneity. *Nature*. DOI: 10.1038/nature14971

Hauser, O. P., Rand, D. G., Peysakhovich, A. & **M. A. Nowak** (2014). Cooperating with the future. *Nature* DOI: 10.1038/nature13530

Diaz Jr., L. A., Williams, R. T., Wu J., Kinde, I., Hecht, J. R. Berlin, J., Allen, B., Bozic, I., Reiter, J. G., **Nowak**, M. A., Kinzler, K. W., Oliner, K. S. & B. Vogelstein (2012). The molecular evolution of acquired resistance to targeted EGFR blockade in colorectal cancers. *Nature* 486 (7404): 537-540. DOI: 10.1038/nature11219

Rand, D. G., Greene, J. D. & **M. A. Nowak** (2012). Spontaneous giving and calculated greed. *Nature* 489 (7416): 427-430. DOI: 10.1038/nature11467

Rosenbloom, D. I. S., Hill, A. L., Rabi, S. A., Siliciano, R. F. & **M. A. Nowak** (2012). Antiretroviral dynamics determines HIV evolution and predicts therapy outcome. *Nat. Med.* 9: 1378-1385. DOI: 10.1038/nm.2892

Michel, J. B., Shen, Y. K., Presser Aiden, A., Veres, A. & M. K. Gray, The Google Books Team, Pickett, J. P., Hoiberg, D., Clancy, D., Norvig, P., Orwant, J., Pinker, **Nowak, M. A.** & E. Lieberman Aiden (2011). Quantitative analysis of culture using millions of digitized books. *Science* 6014: 176-182. DOI: 10.1126/science.1199644

Nowak, M. A., Tarnita, C. E. & E. O. Wilson (2010). The evolution of eusociality. *Nature* 466: 1057-1062. DOI: 10.1038/nature09205

Yachida, S., Jones, S., Bozic, I., Antal, T., Leary, R., Fu, B., Kamiyama, M., Hruban, R. H., Eshleman, J. R., **Nowak, M. A.**, Velculescu, V. E., Kinzler, K. W., Vogelstein, B. & Iacobuzio-Donahue, C. A. (2010). Distant metastasis occurs late during the genetic evolution of pancreatic cancer. *Nature* 467: 1114–1117. DOI: 10.1038/nature09515

Ohtsuki, H., Iwasa, Y. & **M. A. Nowak** (2009). Indirect reciprocity provides only a narrow margin of efficiency for costly punishment. *Nature* 457: 79-82. DOI: 10.1038/nature07601

Rand, D. G., Dreber, A., Ellingsen, T., Fudenberg, D. & **M. A. Nowak** (2009). Positive interactions promote public cooperation. *Science* 325: 1272-1275. DOI: 10.1126/science.1177418

Tarnita, C. E., Antal, T., Ohtsuki, H. & **M. A. Nowak** (2009). Evolutionary dynamics in set structured populations. *Proc. Natl. Acad. Sci. USA* 106: 8601-8604. DOI: 10.1073/pnas.0903019106

Dreber, A., Rand, D. G., Fudenberg, D. & **M. A. Nowak** (2008). Winners don't punish. *Nature* 452: 348-351. DOI: 10.1038/nature06723

Nowak, M. A. & H. Ohtsuki (2008). Prevolutionary dynamics and the origin of evolution. *Proc. Natl. Acad. Sci. USA* 105: 14924-14927. DOI: 10.1073/pnas.0806714105

Hauert, C., Traulsen, A., Brandt, H., **Nowak, M. A.** & K. Sigmund (2007). Via freedom to coercion: The emergence of costly punishment. *Science* 316: 1905-1907. DOI: 10.1126/science.1141588

Lieberman, E., Michel, J. B., Jackson, J., Tang, T. & **M. A. Nowak** (2007). Quantifying the evolutionary dynamics of language. *Nature* 449: 713-716. DOI: 10.1038/nature06137

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science* 314: 1560-1563. DOI: 10.1126/science.1133755

Ohtsuki, H., Hauert, C., Lieberman, E. & **M. A. Nowak** (2006). A simple rule for the evolution of cooperation on graphs and social networks. *Nature* 441: 502-505. DOI: 10.1016/j.jtbi.2005.11.012

Lieberman, E., Hauert, C. & **M. A. Nowak** (2005). Evolutionary dynamics on graphs. *Nature* 433: 312-316. DOI: 10.1038/nature03204

Michor, F., Hughes, T. P., Iwasa, Y., Branford, S., Shah, N. P., Sawyers, C. L. & **M. A. Nowak** (2005). Dynamics of chronic myeloid leukemia. *Nature* 435: 1267-1270. DOI: 10.1038/nature03669

Nowak, M. A. & K. Sigmund (2005). Evolution of indirect reciprocity. *Nature* 437: 1291-1298. DOI: 10.1038/nature04131

Nowak, M. A., Michor, F., & Y. Iwasa (2004). Evolutionary dynamics of tumor suppressor gene inactivation. *Proc. Natl. Acad. Sci. USA* 101: 10635-10638. DOI: 10.1073/pnas.0400747101

Nowak, M. A., Sasaki, A., Taylor, C. & D. Fudenberg (2004). Emergence of cooperation and evolutionary stability in finite populations. *Nature* 428: 646-650. DOI: 10.1038/nature02414

Nowak, M. A. & K. Sigmund (2004). Evolutionary dynamics of biological games. *Science* 303: 793-799. DOI: 10.1126/science.1093411

Wei, X., Decker, J. M., Wang, S., Hui, H., Kappes, J. C., Xiaoyun, W., Salazar, J. F., Salazar, M. G., Kilby, J. M., Saag, M. S., Komarova, N. L., **Nowak, M. A.**, Hahn, B. H., Kwong, P. D. & G. M. Shaw (2003). Antibody neutralization and escape by HIV-1. *Nature* 422: 307-312. DOI: 10.1038/nature01470

Nowak, M. A., Komarova, N. L. & P. Niyogi (2002). Computational and evolutionary aspects of language. *Nature* 417: 611-617. DOI: 10.1038/nature00771

Nowak, M. A., Komarova, N. L. & P. Niyogi (2001). Evolution of universal grammar. *Science* 291: 114-118. DOI: 10.1126/science.291.5501.114

Nowak, M. A., Page, K. M. & K. Sigmund (2000). Fairness versus reason in the ultimatum game. *Science* 289: 1773-1775. DOI: 10.1126/science.289.5485.1773

Nowak, M. A., Plotkin, J. B. & V. A. A. Jansen (2000). The evolution of syntactic communication. *Nature* 404: 495-498. DOI: 10.1038/35006635

Nowak, M. A. & K. Sigmund (1998). Evolution of indirect reciprocity by image scoring. *Nature* 393: 573-577. DOI: 10.1038/31225

Nowak, M. A., Boerlijst, M. C., Cooke, J. & J. Maynard Smith (1997). Evolution of genetic redundancy. *Nature* 388: 167-171. DOI: 10.1038/40618

Nowak, M. A. & C. R. M. Bangham (1996). Population dynamics of immune responses to persistent viruses. *Science* 272: 74-79. DOI: 10.1126/science.272.5258.74

Nowak, M. A., Bonhoeffer, S., Hill, A. M., Boehme, R., Thomas, H. C. & H. McDade (1996). Viral dynamics in hepatitis B virus infection. *Proc. Natl. Acad. Sci. USA* 93: 4398-4402. DOI: 10.1073/pnas.93.9.4398

Nowak, M. A., May, R. M., Phillips, R. E., Rowland-Jones, S., Lalloo, D. G., McAdam, S., Klenerman, P., Köppe, B., K., Sigmund, K., Bangham, C. R. M. & A. J. McMichael (1995). Antigenic oscillations and shifting immunodominance in HIV-1 infections. *Nature* 375: 606-611. DOI: 10.1038/375606a0

Wei, X., Ghosh, S. K., Taylor, M. E., Johnson, V. A., Emini, E. A., Deutsch, P., Arnaout, R. A., Bonhoeffer, S., **Nowak, M. A.**, Hahn, B. H., Saag, M. S. & G. M. Shaw (1995). Viral dynamics in human immunodeficiency virus type 1 infection. *Nature* 373: 117-122. DOI: 10.1038/373117a0

Nowak, M. A. & R. M. May (1994). Superinfection and the evolution of parasite virulence. *Proc. R. Soc. B.* 255: 81-89. DOI: 10.1098/rspb.1994.0012

Tilman, D., May, R. M., Lehman, C. L. & **M. A. Nowak** (1994). Habitat destruction and the extinction debt. *Nature* 371: 65-66. DOI: 10.1038/371065a0

Nowak, M. A. & K. Sigmund (1993). A strategy of win-stay, lose-shift that outperforms tit for tat in the Prisoner's Dilemma game. *Nature* 364: 56-58. DOI: 10.1038/364056a0

Nowak, M. A. & R. M. May (1992). Evolutionary games and spatial chaos. *Nature* 359: 826-829. DOI: 10.1038/359826a0

Nowak, M. A. & K. Sigmund (1992). Tit for tat in heterogeneous populations. *Nature* 355: 250-253. DOI: 10.1038/355250a0

Nowak, M. A., Anderson, R. M., McLean, A. R., Wolfs, T. F.W., Goudsmit, J., & R. M. May (1991). Antigenic diversity thresholds and the development of AIDS. *Science* 254: 963-969. DOI: 10.1126/science.1683006.

Total publications: > 500; Citations > 140000, h-index > 165 (Google Scholar)