

# Jorge Peña

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August 27, 2023

## Academic Positions

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### Assistant Professor/Tenure-Track Researcher

*Institute for Advanced Study in Toulouse (IAS), University of Toulouse 1 Capitole*

**Toulouse, France**

*since September 2017*

### Guest Researcher

*Max Planck Institute for Evolutionary Anthropology*  
Department of Human Behavior, Ecology and Culture

**Leipzig, Germany**

*since March 2023*

### Research Fellow

*Institute for Advanced Study (IAS), University of Amsterdam*

**Amsterdam, Netherlands**

*September 2022 – February 2023*

### Postdoctoral Researcher

*Geomar Helmholtz Centre for Ocean Research Kiel*

**Kiel, Germany**

*September 2016 – August 2017*

### Postdoctoral Researcher

*Max Planck Institute for Evolutionary Biology*  
Department of Evolutionary Theory

**Plön, Germany**

*September 2013 – August 2016*

### Postdoctoral Researcher

*Faculty of Business and Economics, University of Basel*

**Basel, Switzerland**

*April 2012 – August 2013*

### Graduate Assistant

*Faculty of Social and Political Sciences, University of Lausanne*

**Lausanne, Switzerland**

*September 2006 – August 2011*

### Fixed-term Part-time Lecturer

*Faculty of Electronics Engineering, Universidad Pontificia Bolivariana*

**Medellín, Colombia**

*January 2004 – August 2005*

## Education

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### Ph.D. in Applied Mathematics for the Human and Social Sciences

*Faculty of Social and Political Sciences, University of Lausanne, Lausanne, Switzerland*

*2012*

Dissertation title: "Conformity, upstream reciprocity and social diversity: secondary mechanisms for the evolution of cooperation"

### M.A.S. in Embedded Systems Design

*University of Lugano, Lugano, Switzerland*

*2006*

### Electronics Engineering

*Universidad Pontificia Bolivariana, Medellín, Colombia*

*2004*

5-year degree

## Research Interests

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Mathematical models of cooperation and conflict (evolutionary ecology, theoretical biology, evolutionary game theory, cultural evolution)

## Publications

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### Preprints

**Peña, J.**, Heifetz, A., Nöldeke, G. (2023). The shirker's dilemma and the prospect of cooperation in large groups. *bioRxiv*, 2023.04.06.535867

## Refereed Articles in Journals

- Peña, J.**, Nöldeke, G. (2023). Cooperative dilemmas with binary actions and multiple players. *Dynamic Games and Applications*. <https://doi.org/10.1007/s13235-023-00524-9>
- Cooper, G.A., Liu, M., **Peña, J.**, West, S. A. (2022). The evolution of mechanisms to produce phenotypic heterogeneity in microorganisms. *Nature Communications* 13, 195
- González-Forero, M., **Peña, J.** (2021). Eusociality through conflict dissolution. *Proceedings of the Royal Society B*. 288: 2021038620210386
- Nöldeke, G., **Peña, J.** (2020). Group size and collective action in a binary contribution game. *Journal of Mathematical Economics* 88, 42-51
- Peña, J.**, Nöldeke, G., Puebla, O. (2020). The evolution of egg trading in simultaneous hermaphrodites. *The American Naturalist* 195(3), 524-533
- Estrela, S., Libby, E., Van Cleve, J., Débarre, F., Deforet, M., Harcombe, W. R., **Peña, J.**, Brown, S. P., Hochberg, M. E. (2019). Environmentally mediated social dilemmas. *Trends in Ecology & Evolution*, 34(1), 6-18
- Peña, J.**, Nöldeke, G. (2018). Group size effects in social evolution. *Journal of Theoretical Biology*, 457, 211-220
- Pichugin, Y., **Peña, J.**, Rainey, P., Traulsen, A. (2017). Fragmentation modes and the evolution of life cycles. *PLOS Computational Biology* 13(11): e1005860
- dos Santos, M., **Peña, J.** (2017). Antisocial rewarding in structured populations. *Scientific Reports* 7: 6212
- Peña, J.**, Wu, B., Arranz, J., Traulsen, A. (2016). Evolutionary games of multiplayer cooperation on graphs. *PLOS Computational Biology* 12(8): e1005059
- Nöldeke, G., **Peña, J.** (2016). The symmetric equilibria of symmetric voter participation games with complete information. *Games and Economic Behavior*, 99, 71-81
- Peña, J.**, Wu, B., Traulsen, A. (2016). Ordering structured populations in multiplayer cooperation games. *Journal of the Royal Society Interface*, 13: 20150881
- Peña, J.**, Nöldeke, G. (2016). Variability in group size and the evolution of collective action. *Journal of Theoretical Biology*, 389, 72-82
- Peña, J.**, Nöldeke, G., Lehmann, L. (2015). Evolutionary dynamics of collective action in spatially structured populations. *Journal of Theoretical Biology*, 382, 122-136
- Peña, J.**, Lehmann, L., Nöldeke, G. (2014). Gains from switching and evolutionary stability in multi-player matrix games. *Journal of Theoretical Biology*, 346, 23-33
- Peña, J.**, Rochat, Y. (2012). Bipartite graphs as models of population structures in evolutionary multiplayer games. *PLOS ONE*, 7(9): e44514
- Peña, J.** (2012). "Group-size diversity in public goods games." *Evolution*, 66, 623-636
- Buesser, P., **Peña, J.**, Pestelacci, E., Tomassini, M. (2011). The influence of tie strength on evolutionary games on networks: an empirical investigation. *Physica A*, 390, 4502-4513
- Peña, J.**, Pestelacci, E., Berchtold, A., Tomassini, M. (2011). Participation costs can suppress the evolution of upstream reciprocity. *Journal of Theoretical Biology*, 273, 197-206
- Peña, J.**, Volken, H., Pestelacci, E., Tomassini, M. (2009). Conformity hinders the evolution of cooperation on scale-free networks. *Physical Review E*, 80, 016110

## Recommendations

- Peña, J.** (2022). Population dynamics of *Wolbachia* symbionts playing Dr. Jekyll and Mr. Hyde. *Peer Community in Ecology*, 100104.

## Refereed Articles in Proceedings of Computer Science Conferences

- Peña, J.**, Pestelacci, E., Tomassini, M., Volken, H. (2009). Conformity and network effects in the prisoner's dilemma. In *Proceedings of the IEEE Congress on Evolutionary Computation, 2009*, pp. 506-513
- Montes De Oca, M. A., **Peña, J.**, Stützle, T., Pinciroli, C., Dorigo, M. (2009). Heterogeneous particle swarm optimizers. In *Proceedings of the IEEE Congress on Evolutionary Computation, 2009*, pp. 698-705
- Peña, J.** (2008). Conformist transmission and the evolution of cooperation. In *Artificial Life XI: Proceedings of the Eleventh International on the Simulation and Synthesis of Living Systems*, pp. 458-465. MIT Press, Cambridge, MA
- Peña, J. C., **Peña, J.**, Upegui, A. (2008). Evolutionary graph models with dynamic topologies on the ubichip. In *Evolvable Systems: From Biology to Hardware. Proceedings of the 8th International Conference, ICES 2008. Lecture Notes in Computer Science 5216*, pp. 59-70
- Peña, J.** (2008). Simple dynamic particle swarms without velocity. In *Ant Colony Optimization and Swarm Intelligence. Proceedings of the 6th International Conference, ANTS 2008. Lecture Notes in Computer Science 5217*, pp. 144-154
- Peña, J.** (2008). Theoretical and empirical study of particle swarms with additive stochasticity and different recombination operators. In *Proceedings of the 10th Annual Conference on Genetic and Evolutionary Computation, GECCO '08*, pp. 95-102. ACM, New York, NY
- Peña, J.**, Upegui, A. (2007). A population-oriented architecture for particle swarms. In *Proceedings of the Second NASA/ESA Conference on Adaptive Hardware and Systems, 2007*, pp. 563-570
- Peña, J.**, Upegui, A., Sanchez, E. (2006). Particle swarm optimization with discrete recombination: an online optimizer for evolvable hardware. In *Proceedings of the First NASA/ESA Conference on Adaptive Hardware and Systems, 2006*, pp. 163-170
- Peña, J.**, Vanegas, M., Valencia, A. (2006). Digital hardware architectures for Kohonen's self-organizing feature maps with exponential neighboring function. In *Proceedings of the IEEE International Conference on Reconfigurable Computing and FPGAs, 2006*, pp. 1-8

## Talks and Posters

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### Invited Seminars

- Leiden University, Conflict and Cooperation Laboratory, January 31, 2003
- University of Münster, Münster Graduate School of Evolution, The Growth of Evolutionary Thought public lecture series, January 23, 2023
- Max Planck Institute for Evolutionary Biology, Dynamics of Social Behavior Research Group, July 14, 2022
- University of Graz, COLIBRI seminar (online), April 1, 2022
- Queen Mary University of London, Complex Systems Seminar, December 2020
- Sorbonne Université, Laboratoire Jean Perrin, February 2019
- University Claude Bernard Lyon, Laboratoire de Biométrie et Biologie Évolutive, October 2018
- Aarhus University, Department of Bioscience, April 2018
- Toulouse School of Economics, MAD-Stat seminar series, March 2018
- University of St Andrews, School of Biology, July 2017
- Monash University, Faculty of Information Technology, November 2016
- Santa Fe Institute, June 2016
- Institute for Advanced Study in Toulouse, May 2015
- University of Lausanne, Department of Ecology and Evolution, June 2013

Max Planck Institute for Evolutionary Biology, Research Group for Evolutionary Theory, May 2013  
Universidad Carlos III de Madrid, Department of Mathematics, May 2012  
Université Pierre & Marie Curie, Séminaires Ecologie et Evolution, May 2012  
Universidad Pontificia Bolivariana, Escuela de Ingenierías, February 2012  
Max Planck Institute for Evolutionary Biology, Research Group for Evolutionary Theory, November 2011  
Universidad Pontificia Bolivariana, Escuela de Ingenierías, March 2011  
Universidad EAFIT, Departamento de Ciencias Matemáticas, March 2011  
Universidad de Antioquia, Departamento de Matemáticas, March 2011

## Workshops and Conferences

ICSD 2022 (Copenhagen), International Conference on Social Dilemmas, talk  
SMB 2021, Virtual Society for Mathematical Biology Meeting, online talk  
ESEB 2019 (Turku), Congress of the European Society for Evolutionary Biology, talk  
MMEE 2019 (Lyon), Mathematical Models in Ecology and Evolution Conference, talk  
Edinburgh Napier University, Workshop on Evolution and Dynamics of Institutions, May 2019, talk  
EHBEA 2019 (Toulouse), 14th Annual Conference for the European Human Behaviour and Evolution Association, poster  
Evolution 2018 (Montpellier), II Joint Congress on Evolutionary Biology, talk  
SHOW 2018 (Paris), Simultaneously Hermaphroditic Organisms Workshop, talk  
MMEE 2017 (London), Mathematical Models in Ecology and Evolution Conference, talk and poster  
Max Planck Institute for Evolutionary Biology (Plön), Workshop on Conflict, Competition, Cooperation & Complexity Workshop, January 2016, talk  
MMEE 2015 (Paris), Mathematical Models in Ecology and Evolution Conference, talk  
Institute for Advanced Study in Toulouse, Toulouse Economics and Biology Workshop, June 2015, poster  
ECMTB 2014 (Gothenburg), 9th European Conference on Mathematical and Theoretical Biology, talk  
Max Planck Institute for Evolutionary Biology (Plön), Spatial Human Cooperation Meeting, May 2014, talk  
Institute for Advanced Study in Toulouse, Toulouse Economics and Biology Workshop, May 2014, poster  
Max Planck Institute for Evolutionary Biology (Plön), 6th Workshop on Theoretical Biology, talk  
Inclusive Fitness and Game Theory Workshop (Arolla), May 2013, talk  
University of Basel, 4th Bernoulli Workshop in Economics and Psychology, June 2012, talk  
MMEE 2011 (Groningen), Mathematical Models in Ecology and Evolution Conference, poster  
Social Decision Making: Bridging Economics and Biology Workshop (Monte Verità), March 2011, poster  
ECCS 2010 (Lisbon), European Conference on Complex Systems, poster  
SUNBELT XXX (Riva del Garda), SUNBELT Conference of the International Network for Social Network Analysis, talk  
Evolution of Cooperation – Models and Theories Conference (Laxenburg), September 2009, poster  
CEC 2009 (Trondheim), IEEE Congress on Evolutionary Computation, talk  
ANTS 2008 (Brussels), 6th International Conference on Ant Colony Optimization and Swarm Intelligence, talk and poster  
ALIFE 2008 (Winchester), 11th International Conference on Artificial Life, talk  
GECCO 2008 (Atlanta), 10th Annual Conference on Genetic and Evolutionary Computation, talk

AHS 2007 (Edinburgh), 2nd NASA/ESA Conference on Adaptive Hardware and Systems, talk

AHS 2006 (Istanbul), 1st NASA/ESA Conference on Adaptive Hardware and Systems, talk

## Grants and Awards

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Swiss National Science Foundation – Early Mobility.Postdoc Fellowship. PBLAP3-145860: “Multiplayer game theory and the evolution of collective action.” 42,500 CHF. 2013–2014

Swiss Government Excellence Scholarship for Foreign Scholars and Artists. 21,840 CHF. 2005–2006

Beca Municipio de Medellín a los Mejores Bachilleres. 1999–2003

## Teaching Experience

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“Mathematical models of social evolution” (Spring 2022, 7 CM hours; Spring 2021, 9 CM hours), Toulouse Summer School in Quantitative Social Sciences

“Population demography and evolutionary ecology” (Fall 2021, 24 CM hours; Fall 2020, 24 CM hours; Fall 2019, 24 CM hours; Fall 2018, 18 CM hours), Toulouse School of Economics, Master 2 Environmental and Natural Resource Economics (ERNA), Ecology and Economics path (EEC). (Segment: Matrix population models)

“Introduction to ecology for economists (M2EIGF2)” (Fall 2021, 15 CM hours; Fall 2020, 15 CM hours; Fall 2019, 15 CM hours; Fall 2018, 15 CM hours), Toulouse School of Economics, Master 2 Environmental and Natural Resource Economics (ERNA), Ecology and Economics path (EEC). (Segment: Introduction to population ecology)

“Mathématiques TD 15h (L1EPDD1)” (Fall 2019, 15 TD hours), Toulouse School of Economics, undergraduate course (Licence 1)

“Probabilités de gestion (LMAT04) - TD (L2GC062)” (Fall 2020, 7.5 TD hours, 3 groups; Fall 2019, 7.5 TD hours, 3 groups), Toulouse School of Management, undergraduate course (Licence 2)

“Probabilités TD (LEE2AED)” (Fall 2018, 15 TD hours, 2 groups), Toulouse School of Economics

“Advanced behavioral and experimental economics II (DUEB0309)” (Spring 2018, 6 CM hours), Toulouse School of Economics, Doctoral program DEEQA. (Segment: Social evolution theory)

“Economics and the environment for economists (M2EIGA2)” (Fall 2017, 15 CM hours), Toulouse School of Economics, Master 2 Environmental and Natural Resource Economics (ERNA), Ecology and Economics path (EEC). (Segment: Introduction to population ecology)

“Economics and evolution (DUEB0274)” (Spring 2017, 7.5 CM hours), Toulouse School of Economics, Doctoral program DEEQA. (Segment: Population and evolutionary dynamics)

“Evolutionary dynamics: Game theory (MA4454)” (Fall 2014, 8 hours), University of Lübeck, Mathematics in Medicine and the Life Sciences. (Invited lectures)

“Mathematics II (Graphs and networks)”, “Mathematics IV (Complexity)” (2006–2011), University of Lausanne, Faculty of Social and Political Sciences. (Teaching assistant for Henri Volken)

“Statistics I” (2006–2011), University of Lausanne, Faculty of Social and Political Sciences. (Teaching assistant for Jean-Philippe Antonietti)

“Electronic circuits II Lab”, “Automatic Control Systems Lab”, “Artificial Intelligence” (2004–2005), Universidad Pontificia Bolivariana, Faculty of Electronics Engineering. Fixed-term part-time lecturer (Profesor de Cátedra)

## Professional Service

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Journal referee for *The American Naturalist*, *Artificial Life*, *Behavioral Ecology and Sociobiology*, *Biology & Philosophy*, *BioSystems*, *Communications Biology*, *Cognition*, *Current Opinion in Insect Science*, *Dynamic Games and Applications*, *Ecology Letters*, *Europhysics Letters*, *Evolution*, *Games*, *IEEE Access*, *IEEE Technology and Society Magazine*, *IEEE Transactions on Automatic Control*, *IEEE Transactions on Evolutionary Computation*,

*IEEE Transactions on Systems, Man and Cybernetics, Journal of Economic Behavior & Organization, Journal of Mathematical Biology, Journal of the Royal Society Interface, Journal of Theoretical Biology, Journal of Theoretical Politics, Management Science, Mathematical Biosciences, Mathematical Social Sciences, Nature Communications, Neural Computing & Applications, Oikos, PeerJ, Philosophical Transactions of the Royal Society B, PLOS Computational Biology, PLOS ONE, Proceedings of the National Academy of Sciences of the USA, Proceedings of the Royal Society B, Royal Society Open Science, Science Advances, Scientific Reports, Swarm Intelligence, Theoretical Population Biology, Theoretical Economics*

Recommender for *PCI Ecology, PCI Evolutionary Biology*

Book proposal referee for *Oxford University Press, Springer Nature*

Grant proposal referee for *Research Foundation – Flanders (FWO), European Research Council (ERC)*

Workshop co-organizer: “The Biology and Economics of Mutualisms Workshop” at the Max Planck Institute for Evolutionary Biology (November 2017); Mini-symposium “Social Evolution in Subdivided Populations: Beyond the Usual Assumptions” at MMEE 2017 (July 2017); “9th Economics and Biology Workshop” at the Institute for Advanced Study in Toulouse (June 2022)

Member of the program committee at computer science conferences: ANTS (2016, 2012), ICANGA 2013, GECCO (2008–2013), CEC (2009–2011)