

# ISTVÁN ZACHAR



ORCID: [0000-0002-3505-0628](https://orcid.org/0000-0002-3505-0628)

Ph.D. in biology, presently employed as senior research fellow at MTA ÖK Centre for Ecological Research, Institute of Evolution (IE, Budapest, Hungary) and at MTA-ELTE Theoretical Biology and Evolutionary Ecology Research Group (ELTE, Budapest, Hungary).

## CONTACT INFORMATION

### Institute address:

- Centre for Ecological Research, Institute of Evolution (IE), Konkoly-Thege Miklós út 29-33., 1121 Budapest, Hungary
- Eötvös Loránd University (ELTE), **Department of Plant Systematics, Ecology and Theoretical Biology**, Pázmány Péter sétány 1/C, Budapest H1117, Hungary

**Institute phone:** IE: +36 30 165 4424 / ; ELTE: +36 1 / 209 0555 / 1707

**Institute fax:** ELTE: +36 1 / 381 2188

**Institute website:** <https://www.eti.ecolres.hu/en>

**Personal website:** [http://plantsys.elte.hu/drupal/en/munkatarsak/istvanzachar\\_en](http://plantsys.elte.hu/drupal/en/munkatarsak/istvanzachar_en)

**Institutional website:** <https://www.okologia.mta.hu/en/Istvan.ZACHAR>

**e-mail:** [istvan.zachar80@gmail.com](mailto:istvan.zachar80@gmail.com) ([istvan.peter.zachar@ttk.elte.hu](mailto:istvan.peter.zachar@ttk.elte.hu), [zachar.istvan@ecolres.hu](mailto:zachar.istvan@ecolres.hu))

**Skype:** [istvan\\_zachar](https://www.skype.com/user/istvan_zachar)

## PERSONAL INFORMATION

**Surname:** Zachar

**Nationality:** Hungarian

**Place and date of birth:** Budapest, Hungary, 28<sup>th</sup> October 1980

**Private address:** Terv u. 17E, H-1223 Budapest, Hungary

**Private phone:** +36 30 496 0779

**Family:** father of a daughter (2018) and a son (2020)

## STATUS

**Highest degree:** Ph.D., Eötvös Loránd University (ELTE), Budapest, Hungary, 2011

**Current appointments:** Senior research fellow at the **MTA ÖK Centre for Ecological Research, Institute of Evolution (IE)** (Budapest, Hungary); Senior research fellow at the **MTA-ELTE Theoretical Biology and Evolutionary Ecology Research Group** (Budapest, Hungary), till 2022.

**Date employed from:** 1<sup>st</sup> October 2017

## IDS

**ORCID ID:** [0000-0002-3505-0628](https://orcid.org/0000-0002-3505-0628)

**Google Scholar:** <https://scholar.google.com/citations?user=DLfNQUcAAAAJ>

**ResearchGate:** [https://www.researchgate.net/profile/Istvan\\_Zachar](https://www.researchgate.net/profile/Istvan_Zachar)

**ResearcherID:** [P-5101-2015](https://www.researcherid.com/rid/P-5101-2015)

**Mendeley:** <https://www.mendeley.com/profiles/istvn-zachar/stats>

**MTMT ID:** [10018723](https://mtmt.hu/mtmt/10018723)

**MTA/AAT ID:** 10053711

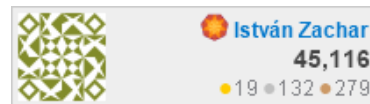
**Scopus ID:** [35747641700](https://scopus.com/authid/detail.url?authorID=35747641700)

**MTA Köztestületi ID:** 22321

**Neptun ID:** CH7GML

**GitHub:** <https://github.com/IstvanZachar>

**StackExchange:**




## PUBLICATION RECORD

peer-reviewed journal articles:	17	cumulative impact factor:	52.3
patents:	1	citations:	306
unpublished manuscripts:	5	h-index:	11
book chapters:	2	i10-index:	12
theses:	2	RG score:	22.34
software:	1	(Data from Google Scholar and ResearchGate)	

### Peer-reviewed journal articles

- [1] 2022 **Zachar, I.** & Boza, G. The evolution of microbial facilitation: sociogenesis, symbiogenesis, and transition in individuality. Under revision at *Frontiers in Ecology and Evolution*.
- [2] 2020 **Zachar, I.\*** & Boza, G. Endosymbiosis before eukaryotes: Mitochondrial endosymbiosis establishment in protoeukaryotes. *Cellular and Molecular Life Sciences*, doi: [10.1007/s00018-020-03462-6](https://doi.org/10.1007/s00018-020-03462-6).  
IF: 7.014; SJR: 3.01, Class: Q1; All citations: N/A; independent citations: N/A
- [3] 2019 Czégel, D., **Zachar, I.** & Szathmáry, E. Multilevel selection as Bayesian inference, major transitions in individuality as structure learning. *Royal Society Open Science*, 6(8), doi: [10.1098/rsos.190202](https://doi.org/10.1098/rsos.190202).  
IF: 2.515; SJR: 1.13, Class: Q1; All citations: N/A; independent citations: N/A
- [4] 2019 Számadó, Sz., Czégel, D. & **Zachar, I.** One problem, too many solutions: How costly is honest signalling of need? *PLoS ONE*, 14(1), doi: [10.1371/journal.pone.0208443](https://doi.org/10.1371/journal.pone.0208443).  
IF: 2.766; SJR: 1.164, Class: Q1; All citations: N/A; independent citations: N/A

- [5] 2019 Vig-Milkovics, Zs., **Zachar, I.\***, Kun, Á., Szilágyi, A., & Szathmáry, E. Moderate sex between protocells can balance between a decrease in assortment load and an increase in parasite spread. *Journal of Theoretical Biology*, 462, 304–310, doi: [10.1016/j.jtbi.2018.11.020](https://doi.org/10.1016/j.jtbi.2018.11.020).  
IF: 2.049, SJR: 0.746, Q1; All citations: N/A; Independent citations: N/A
- [6] 2018 **Zachar, I.\***, Szilágyi, A., Számadó, Sz. & Szathmáry, E. Farming by the host cell as the origin of mitochondrial endosymbiosis by natural selection.  *Proceedings of the National Academy of Sciences*, 115(7), E1504–E1510. doi: [10.1073/pnas.1718707115](https://doi.org/10.1073/pnas.1718707115).  
IF: 9.661, SJR: 6.092, Class: D1; All citations: 8; Independent citations: 7; Twice recommended by F1000
- [7] 2018 **Zachar, I.\***, Szilágyi, A., Számadó, S. & Szathmáry, E. Reply to Garg and Martin: The mechanism works. *Proceedings of the National Academy of Sciences of the United States of America*, 20, E4545–E4546, doi: [10.1073/pnas.1805021115](https://doi.org/10.1073/pnas.1805021115).  
IF: N/A, SJR: 6.092, D1; All citations: N/A; Independent citations: N/A
- [8] 2017 Szilágyi, A., **Zachar, I.**, Scheuring, I., Kun, Á., Könnnyű, B. & Czárán, T. Ecology and evolution in the RNA World: Dynamics and stability of prebiotic replicator systems. *Life* 7(4):48 doi: [10.3390/life7040048](https://doi.org/10.3390/life7040048).  
IF: CiteScore (Scopus) 3.24, SJR: 1.63, Q1; All citations: 11; Independent citations: 7
- [9] 2017 **Zachar, I.\*** & Szathmáry, E. Breath-giving cooperation: Critical review of origin of mitochondria hypotheses. *Biology Direct*, 12(1), doi: [10.1186/s13062-017-0190-5](https://doi.org/10.1186/s13062-017-0190-5).  
IF: 2.856, Class: D1; All citations: 14; Independent citations: 12
- [10] 2017 Fedor, A., **Zachar, I.**, Szilágyi, A., Öllinger, M., de Vladar, H. P. and Szathmáry, E. Cognitive architecture with evolutionary dynamics solves insight problem. *Frontiers in Psychology*, 8, p. 427, doi: [10.3389/fpsyg.2017.00427](https://doi.org/10.3389/fpsyg.2017.00427).  
IF: 2.463, SJR: 1.043, Class: Q1; All citations: 4; Independent citations: 1
- [11] 2016 de Vladar, H. P., Fedor, A., Szilágyi, A., **Zachar, I.** and Szathmáry, E. An attractor network-based model with Darwinian dynamics. Proceedings of the 16th Annual Conference on Genetic and Evolutionary Computation (GECCO '16), ACM, doi: [10.1145/2908961.2931672](https://doi.org/10.1145/2908961.2931672).  
IF: N/A, Class: N/A; All citations: 3; Independent citations: 0
- [12] 2016 Szilágyi, A., **Zachar, I.**, Fedor, A., de Vladar, H. P. and Szathmáry, E. Breeding novel solutions in the brain: A model of Darwinian neurodynamics. *F1000Research*, 5, doi: [10.12688/f1000research.9630.1](https://doi.org/10.12688/f1000research.9630.1).  
ResearchGate IF: 1.13, SJR: 0.93, Class: Q1; All citations: 7; Independent citations: 0
- [13] 2015 Kun, Á., Szilágyi, A., Könnnyű, B., Boza, G., **Zachar, I.** and Szathmáry, E. The dynamics of the RNA world: insights and challenges. *Annals of the New York Academy of Sciences*, 1341(1), pp. 75–95, doi: [10.1111/nyas.12700](https://doi.org/10.1111/nyas.12700).  
IF: 4.383, SJR: 2.11, Class: Q1; All citations: 28; Independent citations: 16
- [14] 2015 Vasas, V., Fernando, C., Szilágyi, A., **Zachar, I.**, Santos, M. and Szathmáry, E. Primordial evolvability: impasses and challenges. *Journal of Theoretical Biology*, 381, pp. 29–38., doi: [10.1016/j.jtbi.2015.06.047](https://doi.org/10.1016/j.jtbi.2015.06.047).  
IF: 2.239, SJR: 0.75, Class: Q1; All citations: 15; Independent citations: 11

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\* Corresponding author

- [15] 2013 Szilágyi, A., **Zachar, I.** & Szathmáry, E. Gause's principle and the effect of resource partitioning on the dynamical coexistence of replicating templates. *PLoS Computational Biology*, **9**(8), e1003193, doi: [10.1371/journal.pcbi.1003193](https://doi.org/10.1371/journal.pcbi.1003193).  
IF: 4.867, SJR: 3.1, Class: D1; All citations: 7; Independent citations: 4
- [16] 2011 **Zachar, I.\***, Fedor, A. & Szathmáry, E. Two different template replicators coexisting in the same protocell: Stochastic simulation of an extended chemoton model. *PLoS ONE*, **6**(7), e21380, doi: [10.1371/journal.pone.0021380](https://doi.org/10.1371/journal.pone.0021380).  
IF: 4.092, SJR: 1.16, Class: D1; All citations: 11; Independent citations: 8
- [17] 2011 **Zachar, I.\*** The feasibility of segmentation of protolanguage. *Interaction Studies* **12**(1), 1–35, doi: [10.1075/is.12.1.01zac](https://doi.org/10.1075/is.12.1.01zac).  
IF: 1.105, SJR: 0.25, Class: Q2; All citations: 1; Independent citations: 1
- [18] 2010 **Zachar, I.** & Szathmáry, E. A New Replicator: A theoretical framework for analyzing replication. *BMC Biology* **8**(21), pp. 21, doi: [10.1186/1741-7007-8-21](https://doi.org/10.1186/1741-7007-8-21).  
IF: 5.203, SJR: 3.84, Class: D1; All citations: 33; Independent citations: 20

### Manuscripts to be published

- [1] **Zachar, I.** & Számadó, Sz. A Darwinian model of cultural replication [submitted to *BMC Biology*].
- [2] Számadó, Sz., **Zachar, I.**, Czégel, D. & Penn, D. J. General solution to biological signalling games [in preparation].
- [3] Vig-Milkovics, Zs., Szathmáry, E., Szilágyi, A. & **Zachar, I.** The viability of the evolutionary ribocell model [in preparation].
- [4] Fehér, K., **Zachar, I.**, Czégel, D. & Számadó, Sz. Darwinian approach in sociolinguistics: from essentialism to population thinking, variation and evolution [in preparation].

### Book chapters

- [1] 2013 **Zachar, I.**, Kun, Á., Fernando, C. & Szathmáry, E. Replicators: From molecules to organisms, in: Kernbach, S. (ed.), *Handbook of Collective Robotics: Fundamentals and challenges*. Pan Stanford Publishing, Singapore, pp. 473–501.  
All citations: 2; Independent citations: 0
- [2] 2007 Szathmáry, E., Szatmáry, Z., Ittész, P., Orbán, G., **Zachar, I.**, Huszár, F., Fedor, A, Varga, M. & Számadó, S. *In silico* evolutionary developmental neurobiology and the origin of natural language, in: Lyon, C., Nehaniv, C. & Cangelosi, A. (eds), *Emergence of communication and language*, chapter 8, Springer Verlag, London, pp. 151–187, doi: [10.1007/978-1-84628-779-4\\_8](https://doi.org/10.1007/978-1-84628-779-4_8).  
All citations: 10; Independent citations: 4

### Patents

- [1] 2017 Szathmáry, E., Szilágyi, A., **Zachar, I.**, Fedor, A. & de Vladar, H. P. *Electronic devices, artificial evolutionary neural networks, methods and computer programs for implementing evolutionary search and optimisation*. Pub. No. WO/2017/148536, International Application No. PCT/EP2016/054694, Publication Date: 08.09.2017, International Filing Date: 04.03.2016, url: [WO2017148536](https://www.patent.gov.uk/wip/index.jsp?wo=2017148536).

## Theses

- [1] 2011 **Zachar, I.** *Replicator Formalism: A general account of replication*. Ph.D. thesis, Eötvös Loránd University (ELTE), Biology Doctoral School, Budapest. pp. 147. doi: [10.13140/RG.2.1.3981.5209](https://doi.org/10.13140/RG.2.1.3981.5209).
- [2] 2004 **Zachar, I.** *Identifying Tertiary Myliobatoids* [in Hungarian]. M.Sc. thesis, Eötvös Loránd University (ELTE), Department of Paleontology, Budapest. pp. 49. doi: [10.13140/10.13140/RG.2.1.2687.7520](https://doi.org/10.13140/10.13140/RG.2.1.2687.7520).

## Software

- [1] **Phylogenetics**, a software package to do phylogenetics with the Wolfram Language (Wolfram Research); freely available at my [GitHub profile](#).

## FUNDING

- 2019-07-01-2024-06-30. Participant in **NKFI KKP #129848** Evolution and learning (PI: Eörs Szathmáry, 5 years, total funding 283 002 K HUF (~775 000 EUR)).
- 2019.12.01-2022.11.30. Participant in **NKFI K #132250** *Signalling games: honesty and reputation* (PI: Szabolcs Számadó, 3 years, total funding 24 463 K HUF (~67 000 EUR)).
- 2017.10.01-2021.09.30. Participant in **NKFI K #124438**: „*Competitive-cooperative dynamics on several levels of evolutionary and ecological organization*” (PI: Tamás Czárán, 5 years, total funding: 32 332 K HUF (~100 000 €)).
- 2014.9.1-2017.9.30: Project leader in **NKFI PD #112788**: “*The origin of mitochondria*” (PI: István Zachar, 3 years, total funding: 16 458 K HUF (~52 000 €)).
- 2007.12.1-2011.6.30: Participant in **NKFI K #76785**: “*The Social and Mental Dynamics of Cooperation*” (PI: Eörs Szathmáry, 5 years, total funding: 7 500 K HUF (~23 700 €)).
- 2010 Nemzeti Kulturális Alap grant **NKA-2533/0008**: „*Interactive investigation of ecological systems*” educational software development (Gergely Boza, Balázs Könnnyű, Vera Vasas, István Zachar).

## CONFERENCES, WORKSHOPS, INVITED TALKS

- 2020.02.04. Invited talk at the **Institute of Parasitology, Biology Centre of the Czech Academy of Sciences**, České Budějovice, CZ. Title: *Evolutionary and ecological issues at the origin of mitochondria*.
- 2020.02.11-13. Presentation at the **Darwin Days**, Tihany, Hungary, organized by Institute of Evolution, MTA Centre for Ecological Research. Title: *Evolutionary and ecological issues at the origin of mitochondria*.
- 2018.04.15-18. Invited speaker at the **US Janelia: New Opportunities to Study Origins of the Eukaryotic Cell** conference (Ashburn, Virginia, USA). Title: *The origin of mitochondria from an eco-evolutionary point of view* ([link](#)).
- 2018.05.10. István Zachar: *A mitokondrium és az eukarióta sejtek eredete* ([link](#), [video](#)). Presentation at the **Budapest Science Meetup**, MTA, Budapest.
- 2017.11.16. István Zachar: *The ecological model of the origin of the eukaryotic cell*. Presentation at the conference **Integrative Ecology** of the MTA ÖK Centre for Ecological Research, part of the *Festival of Hungarian Science 2017*.

- 2016.7.20-24. 16th Annual Conference on Genetic and Evolutionary Computation (GECCO '16): de Vladar, H. P., Fedor, A., Szilágyi, A., Zachar, I. and Szathmáry, E. *An attractor network-based model with Darwinian dynamics*. Proceedings of the 16th Annual Conference on Genetic and Evolutionary Computation, ACM, doi: [10.1145/2908961.2931672](https://doi.org/10.1145/2908961.2931672).
- 2013.5.7-12. Presentation at the Systems Chemistry Workshop at Badacsony, Lake Balaton, Hungary. Zachar, I.: *Generalized replicator theory*.
- 2012.6. Poster presentation at the Spring School on Early Life (Lyon). Szilágyi, A., Zachar, I. & Szathmáry, E. *Coexistence of template replicators in the chemoton*.
- 2011.10. Poster presentation at the COST-ESF Conference: Systems Chemistry III, Heraklion (Crete). Zachar, I. *The emergence of division of labour in template replication*.
- 2011.10. Poster presentation at the COST-ESF Conference: Systems Chemistry III, Heraklion (Crete). Zachar, I., Fedor, A. & Szathmáry, E. *Two different template replicators coexisting in the same protocell*.
- 2010.9. Presentation at "The Evolution of Cooperation and Trading" (TECT). Szathmáry, E, Fernando, C. & Zachar, I. *Emergence of language and evolutionary dynamics in the brain during ontogeny*.
- 2009.10.18-23. Poster presentation at the COST-ESF Conference: Systems Chemistry II: Evolution And Systems, Balatonfüred (Hungary). Zachar, I. *Replicator Formalism*.
- 2009.8.29-9.4. Poster presentation at the International Summer School on Embodied Language Games and Construction Grammar (organized by the Evolutionary Linguistics Association), in Cortona (Italy). Fedor, A. & Zachar, I. *Evolution of grammar based on modular replication*.
- 2008.8.30-9.6. Poster and oral presentation at the TECT-INCORE: *Tools of the trade in cooperation research* summer school (Obernai, France). Zachar, I., Szathmáry, E. & Steels, L. *An evolutionary approach on lexicon alignment*.
- 2008.3.11-15. Poster presentation at the 7<sup>th</sup> Evolang (Evolution of Language Conference), Barcelona, Spain. Zachar, I., Szathmáry, E. & Steels, L. *An evolutionary approach on lexicon alignment*.
- 2008.2.4-8. Poster presentation at the Third European PhD Complexity School (Evolution in biological systems: from molecules to life and language), Turin, Italy (Organized by ISI Foundation). Zachar, I., Szathmáry, E. & Steels, L. *An evolutionary approach on the origin of lexicon and grammar*.
- 2007.12.7. Short presentation at ECAgents Evaluation Meeting, Berlin, Germany. Zachar, I. *A replicative model of the origin of lexical and grammatical elements*.
- 2007.7.14–19. Participation at the "International School on Complexity - Course on Statistical Physics of Social Dynamics: Opinions, Semiotic Dynamics, and Language" held in Erice, Sicily. Also participating the "International Summer Atelier: Modeling Language Evolution with Computational Construction Grammar" parallel to the summer school. Organized by Vittorio Loreto ("Sapienza" Università di Roma) and Luc Steels (Sony CSL, Paris).
- 2007.6. Participation at the "Masterclass on Language Evolution: Computer models for empirical data" held in Noordwijk, Netherlands. Organized by Paul Vogt (Tilburg University) and Bart de Boer (University of Groningen).
- 2006.4.12-15. Participation at the 6<sup>th</sup> EVOLANG (Evolution of Language) International Conference, Rome, Italy. Organized by Angelo Cangelosi (University of Plymouth) and others.
2006. Poster presentation at ECAgents Review Meeting, Roma, Italy. Zachar, I., Szathmáry, Z., Ittész, P., Varga, M., Fedor, A., Számadó, Sz. & Szathmáry E. *Measuring the heritability of neural connections in ENGA generated communicating agents*.

- 2003.8. Poster and oral presentation at the VI. Shallow Tethys conference, Budapest. [Zachar, I.](#) *Identifying Tertiary Myliobatoids from Hungary.*
- 2003.7. Poster presentation at the I. EAVP (European Association of Vertebrate Paleontology) conference, Basel. [Zachar, I.](#) *Identifying Tertiary Myliobatoids from Hungary.*

## SCHOLARSHIPS

- 2016.10.1-2017.06.30: Postdoctoral research fellow at the **Institute of Advanced Studies, Kőszeg** ([iASK](#)), Center for Cooperation and Conflict in Evolutionary Systems. Research project: *“Computational modelling of insight problem solution with evolutionary algorithms”*, project leader: Eörs Szathmáry.
- 2012-2015: Postdoctoral scholarship at the **Parmenides Foundation, Munich** (Germany): FP7 ERC advanced grant project EVEEVO (*Evolution of Evolvable Systems*; PI: Eörs Szathmáry; 2012-2017; no. #294332)
- 2007 September–November: Young Researcher scholarship at **ELTE University**, Budapest (Hungary).
- 2007 February–June: Junior Fellow scholarship at **Collegium Budapest, Institute for Advanced Study**, Budapest (Hungary). Research project: *Finding and Analyzing the Replicator of an Artificial Cultural Evolution Simulated in ENGA - Finding the Unit of Memetic Evolution in silico.*

## RESEARCH EXPERIENCE

- 2017-...: Senior research assistant in the [GINOP Evolutionary Systems Research Group](#) (GINOP 2.3.2-15-2016-00057) at the MTA ÖK Centre for Ecological Research, Tihany, Hungary.
- 2017.11.01-2022.06.30: Senior research assistant in the MTA-ELTE Theoretical Biology and Evolutionary Ecology Research Group (ELTE, Budapest, Hungary).
- 2017-...: Research fellow at the [Parmenides Foundation, Centre for the Conceptual Foundation of Science](#), Pullach (Munich), Germany.
- 2016.10.1-2017.06.30: Postdoctoral research fellow at the Institute of Advanced Studies, Kőszeg ([iASK](#)), Center for Cooperation and Conflict in Evolutionary Systems: *“Computational modelling of insight problem solution with evolutionary algorithms”*, project leader: Eörs Szathmáry.
- 2014.9.1-2017.9.30: Postdoctoral research assistant at Eötvös Loránd University (ELTE), Department of Plant Systematics, Ecology and Theoretical Biology. NKFIH #112788: *“The origin of mitochondria”*, project leader: Dr. István Zachar.
- 2013-2015: Member of the Parmenides team in the EU FET-open project [INSIGHT](#) (*Insight: Darwinian Neurodynamics*; PI: Eörs Szathmáry; 2013-2016; agreement no. 308943; total funding 2 219 079 €).
- 2012-2015: Member of the Parmenides team in the FP7 ERC advanced grant project [EVEEVO](#) (*Evolution of Evolvable Systems*; PI: Eörs Szathmáry; 2012-2017; project #294332; total funding 2 616 700 €).
- 2012.10.1–2015.9.30: postdoctoral research fellow at the [Parmenides Foundation, Centre for the Conceptual Foundation of Science](#), Pullach, Germany.
- 2012.1.1-2012.7.1: Postdoctoral research fellow at the [Queen Mary University of London](#) (UK), project leaders: Dr. Chrisantha Fernando and Dr. Alex Mesoudi. Research on human insight learning, modelling cognitive processes using machine learning, conducting experiments on human subjects.

- 2009-2011: Worked in the FP7 EU project [e-Flux](#) (*Evolutionary microfluidix*; PI: Eörs Szathmáry; 2009-2011; project #225167; total funding: 2 300 000 €).
- 2007.12.1.–2011.6.30: Research assistant at the Hungarian Academy of Science (HAS) Theoretical Biology and Ecology Research Group at ELTE Budapest. OTKA #76785 “The Social and Mental Dynamics of Cooperation”, project leader: prof. Eörs Szathmáry. Research on the origin of compositional language, replicator theory and origin of compartmentalized template replication.
- 2008.10: **Artificial Intelligence lab** at Vrije Universitet Brussels as a visiting student. Working jointly with Dr. Joachim de Beule on an analytical model of lexicon alignment and origin of compositionality.
- 2007.9.1-2007.10.1: **SONY CSL lab** at Paris as a visiting student to prof. Luc Steels. Working on an evolutionary (replication-selectional) model of lexicon alignment and grammar origin.
- 2007.2.1-2007.7.1: Junior Fellow scholarship at **Collegium Budapest**. Research title: "*Finding and Analyzing the Replicator of an Artificial Cultural Evolution Simulated in ENGA - Finding the Unit of Memetic Evolution in silico*".
- 2004–2011: **Ph.D. thesis work** at Eötvös Loránd University, Department of Plant Systematics, Ecology and Theoretical Biology: "*Replicator formalism. A general account of replication*". Supervisor: prof. Eörs Szathmáry.
- 2004–2008: Worked in the European FET project **ECAgents** (*Embodied and Communicating Agents*; PI: Eörs Szathmáry; 2004-2008; ID FP6 - IST-2003-1940; total funding 2 616 700 €) at Collegium Budapes. experimenting with newly developed evolutionary neural-network-modelling software framework called ENGA (Evolutionary Neurogenetic Algorithm). Testing core and client-part of the software, running biologically relevant simulations.
- 2002–2004: **Master thesis work** at Eötvös Loránd University, Department of Plant Taxonomy and Ecology: "*Modelling neutral and adaptive evolutionary processes, in case of Weismannian and Lamarckian heredity*". Supervisor: prof. Eörs Szathmáry.
- 1999–2003: **Thesis work** at Eötvös Loránd University, Department of Paleontology: "*Identifying Tertiary Myliobatoids (Rajiformes, Batomorphi, Elasmobranchii) from Hungary*". Supervisor: prof. László Kordos (head of the Geological Institute of Hungary).

## INDUSTRIAL EXPERIENCE

2018-...: Consultant developer at the biotechnological [RIBBON Biolabs GmbH](#). The company specializes in fast, high-throughput, mass-scale synthetization of biosequences (DNA). I develop algorithms and their interfaces to simulate and ease the combinatorial build-up of synthesis, and design methods and *in silico* experiments to benchmark and monitor simulations.

## SUPERVISION

- 2018-2019: Judit Tolnai M.Sc., ELTE: „*Modelling the parasitic origin theory of mitochondria*”
- 2019-2020: István Oszoli B.Sc., ELTE: “*Origin of multicellularity*”
- 2020-2021: István Oszoli M.Sc., ELTE: “*Modelling the origin of aggregative multicellularity*”

## EDUCATION

2004-2007: Ph.D. in Theoretical Biology and Ecology at Eötvös Loránd University (Budapest), Biology Ph.D. School (6 semesters) (2011 12. 8. Budapest, diploma ID: P-3562/2011).



1999-2004: M.Sc. in Biology at Eötvös Loránd University (Budapest) (10 semesters). Additional studies in Paleontology (2004 6. 30. Budapest, diploma ID: PTE 006950).

1995-1999: ELTE Trefort Ágoston High School, Budapest.

## REFEREE SERVICE

Regular refereeing in the following journals:

- *Journal of Theoretical Biology*
- *BioEssays*
- *BioSystems*
- *Briefings in Bioinformatics*
- *ALife*

## DISSEMINATION, MEDIA COVERAGE

2018 March 27. Radio interview in InfoRadio Szigma of the Hungarian Academy of Sciences ([link](#), [link](#)).

2018 March 29. Appearing on the homepage of the Hungarian Academy of Sciences ([link](#)).

2018 March 9. Report on our [PNAS paper](#) (by Hungarian Academy of Sciences): *Sejtjeink kétmilliárd éves ősei lehettek a földi élet legsikeresebb farmerei* 2018 március 9. ([link](#)).

## TEACHING EXPERIENCE

Regular lectures and seminars at ELTE University, Budapest:

- *Programming and modelling* for biologists at ELTE University.
- *Combinatorics, Probability Theory and Statistics* at ELTE University, for senior biology students.
- *Introduction to Programming* at ELTE University, for biologists.
- *Introduction to Biology* at ELTE University, for freshmen.
- Minor classes on theoretical evolutionary biology (esp. on major evolutionary transitions) for senior biologists.

## LANGUAGE KNOWLEDGE

Fluent in English, Hungarian. Latin intermediate level.

## MODELLING SKILLS

Skilled in systems biology, systems chemistry, and general computational biology methods. Amongst others, proficient in:

- differential equations, time evolution, numerical integration, fixpoint analysis, bifurcation exploration;
- stochastic modelling, Gillespie algorithm;
- reaction-diffusion systems, spatially explicit models, cellular automata;
- evolutionary models, adaptive dynamics;
- process algebra;
- individual based ecological models, infection models;

## COMPUTER SKILLS

Operating systems: Windows, OSX, Linux, DOS;

Programming and scripting languages:

- proficient in: C, *Wolfram Mathematica*
- competent in: Bash, Windows shell, Python, Pascal, Delphi, Matlab, BlenX stochastic simulation language, HTML, etc.

Other software: PAUP phylogeny software, Office suite, OpenOffice, Corel Graphics Suite, Adobe Photoshop, Autodesk 3D Studio Max, EndNote, JabRef, etc.

## OTHER ACHIEVEMENTS

2011: Full scale skeletal and cranial reconstructions of extinct dinosaurs *Hungarosaurus tormai* (Nodosauridae), *Mochlodon vörösi* (Rhabdodontidae), a *Mosasauroida* species and cranial reconstruction of *Ajkaceratops kozmai* (Bagaceratopsidae), also with full scale head reconstructions for the "[Lost Worlds](#)" permanent exhibition of the Hungarian Natural History Museum.

2000-... 20+ years of participating in the [Hungarian Dinosaur Expedition](#), involved in field work.

## RESEARCH INTEREST

My scientific interest includes evolutionary topics, mainly prebiotics, replicator theory and dynamics, origin of life, and origin of language. In general, I enjoy investigating models of ecological coexistence and evolutionary dynamics at various levels, from chemical to biological or cultural systems. I have extended the replicator formalism to be able to account for Lamarckian evolution and I have extensively studied the chemoton model of Gánti to investigate the effect of specific template replication methods on the paradox of prebiotics. I am particularly interested in major evolutionary transitions, especially in the origin of eukaryotes, including its date and its many aspects (nucleogenesis, incorporation of endosymbionts and emergence of eukaryotic inventions like the cytoskeleton). I have been also researching the evolutionary origins of human language skills. As a long-running project, I am studying construction grammar and generally the applicability of construction grammar models (like FCG) to syntax/grammar origins and replication-selectional Darwinian dynamics to cultural inheritance. The stunning analogy of Darwinian evolution of biological inheritance systems and the cultural evolution of linguistic inheritance systems fascinates me. I am also working on models explaining insight learning in humans via Darwinian dynamics and neural networks.

I am a long time and avid *Mathematica* user (flagship product of Wolfram Research), and a significant contributor to the [Mathematica.StackExchange](#) Q&A site. Since I enjoy programming, I design and implement my own models (in many languages) to directly find answers to scientific questions.

I am interested in language evolution, from both the biological and the literary aspects (i.e. from Hurford and Bickerton to Eco and Tolkien). Expert in the mythology of Arda. I am also involved in paleontology at a semi-professional level, participating in yearly excavation at the Iharkút and Villány locations in Hungary, digging for Mesozoic vertebrates (dinosaurs, pterosaurs, archosaurs, etc.).

I am doing various sports (cycling, squash, badminton, bouldering).

2022 January, Budapest

A handwritten signature in blue ink, appearing to read 'István Zachar', with a horizontal line extending to the right from the end of the signature.

István Zachar