

Application to:

The RNA Society Outstanding Career Researcher Award 2022

My love affair with the RNA world began 15 years ago, when I began as a graduate student studying the bidirectional communication between mRNA decay and the transcription machinery in the lab of Prof. Motti Choder (Technion, Israel). I found that mRNA decay enzymes (*e.g.* Xrn1, Dcp2) are imported to the nucleus in a mRNA-decay dependent manner, and directly affect transcription (6-7, 21)*. For my post-doctoral studies, I then moved to the lab of Prof. Robert Singer (Albert Einstein College of Medicine, New York), where I discovered that mRNA molecules transfer between mammalian cells through tunneling nanotubes (TNTs). This project I took back with me when I returned to Israel and joined Jeffrey Gerst's lab (Weizmann Institute) to complete my post-doc (9, 16). In addition to these papers, I have authored several review papers related to the RNA world (10-13). The latest, entitled "RNA transfer through tunneling nanotubes" (13) is the first review of this kind on the subject. By the end of 2018, I decided to continue at the Gerst lab as a staff scientist.

My roles as a staff scientist are diverse. First, I have my own research projects. These include two high risk projects focused on the *cis* RNA element "SECRETE", which our lab recently identified (19, Cohen-Zontag *et al.* (2019) PLoS Genetics 15, 7, 1008248). In these projects I am identifying proteins that interact with mammalian and viral SECRETE sequences, as well as determining the relative strength of the numerous variants of the motif in the secretion of proteins from mammalian cells. Second, I have overseen two graduate students (as well as undergrads) who have continued my research on RNA transfer through TNTs, including teaching relevant methods (*e.g.* single molecule FISH & live mRNA imaging), helping them with experimental design, and problem-solving. I also assisted with their thesis and manuscript writing. Importantly, two manuscripts are close to completion and will feature a broad analysis of the RNA transferome, as well as a study into the functionality of transferred mRNA. My role in the lab is not restricted to students who only work on RNA transfer. In contrast, I routinely read and edit manuscripts, reports and theses written by other students and postdocs. Some of my contributions are credited by authorship (17, 20), but not in all cases (*e.g.* Dasgupta & Gerst, 2020; Nair *et al.*, eLife 2021). I also write grant proposals with Prof. Gerst and, in some cases, have written the bulk of the proposal. In other cases, I assist with suggestions, comments, and/or edits. I also initiated three joint-grant collaborations with other labs, specializing in TNT or mRNA imaging. Of the ten grants I have helped to write over the last three years, five were funded. Lastly, I am the lab manager, which maintains the proper running of the lab, including ordering.

In addition, I have a number of extracurricular RNA-related activities. First, I am an associate editor at the journal *Bio-protocol* (<http://www.bio-protocol.org>) for almost 5 years. This is a peer-reviewed journal that publishes detailed protocols with the goal of maintaining reproducibility in biological research. Second, I initiated and developed a course at the Weizmann Institute ("Seminar in mRNA trafficking and localization in development & disease") which I teach with Prof. Gerst already for several years (excluding 2020). Third, I maintain a science blog (*Green fluorescent blog*), in which I write about various aspects of microscopy and other imaging techniques, with a main focus on RNA imaging. Finally, I also write popular science articles (in Hebrew) for Davidson Institute's online magazine (120 articles since 2018). Lastly, I occasionally give popular science lectures to Israeli audience.

To summarize, my research has led to two paradigm shifts in RNA biology (6, 9). I possess a wide view of the RNA world and promote it in my role as a staff scientist and beyond.

* Numbers in parenthesis refer to the list of publications in my CV.

14-Oct-21

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RNA society membership: 1203329

A: Personal details**Position:** Assistant staff scientist**Address:** 234 Herzl st, Belfer bldg. room 416, Rehovot, Israel 7610001

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- 2014-2018 **Postdoctoral fellow** (Senior postdoc since 2017), Dept. Molecular Genetics, Weizmann Institute of Science. **Advisor: Prof. Jeffrey Gerst.**
- 2012-2014 **Postdoctoral fellow**, Dept. Anatomy & Structural Biology, Albert Einstein College of Medicine, Bronx, NY, USA **Advisor: Prof. Robert H. Singer.**
- 2006-2011 **Ph.D.** Faculty of Medicine, Technion, Israel. **Advisor: Prof. Mordechai (Motti) Choder.**
Thesis title: *A novel role for mRNA decay factors in mRNA synthesis.*
- 1999-2004 **M.Sc.** + partial Ph.D. Feinberg Graduate School, Weizmann Institute of Science, Israel. **Advisor: Prof. Atan Gross.** Thesis title: *How does BAX protein regulate apoptosis? The budding yeast as a model organism.*
- 1993-1996 **B.Sc.** Faculty of Biology, Tel-Aviv University, Israel.

C: Employment history

- 2019-present **Assistant Staff Scientist**, Gerst lab, Dept. Molecular Genetics, Weizmann Institute of Science.
- 2018-2019 **Senior Intern**, Gerst lab, Dept. Molecular Genetics, Weizmann Institute of Science.
- 2018-present **Science writer**, Davidson Institute on-line magazine, Israel.
- 2015-2019 **Mentor** at Davidson Institute's summer science camps for high-school students.
- 2010-2011 **Science writer** "Galileo Science and Thought", Israel.
- 2004-2005 **Research assistant** Insight Biopharmaceuticals Inc., Rehovot, Israel.

D: Other appointments**Teaching:**

- 2021 **Guest lecturer** (Bar-Ilan University): *New horizons in molecular biology.*
- 2015-2019, 2021 **Lecturer** (WIS): *Seminar in mRNA trafficking and localization in development & disease.*
- 2009-2012 **Teaching aid** (Technion): *Bacteriology for American medical students* (Lab course).
- 2008-2011 **Teaching aid** (Technion): *Mycology for 2nd year medical students* (Lab course).
- 2007-2011 **Teaching aid** (Technion): *Bacteriology for 2nd year medical students* (Lab course).

Editorial boards:

2016-present **Associate editor** Bio-Protocol (eJournal), Sunnyvale, CA, USA (<http://www.bio-protocol.org>).

E: International recognition

Prizes, awards, competitive scholarships:

2012-2014 Gruss Lipper family postdoctoral fellowship (EGL Charitable Foundation).

Travel awards:

2008 – CSHL meeting travel grant, 2009 - Sidney & Vivian Konigsberg International Scientific Exchange Fund, 2010 – EMBO workshop travel grant, 2014 – ILANIT travel stipend, 2015 – ASCB postdoctoral travel award, 2016 - EMBL Advanced Training Centre Corporate Partnership Program Fellowship, 2017 – EMBO meeting Boehringer Ingelheim Fonds Travel Grant; ASCB-EMBO meeting travel fellowship.

Invited reviewer:

I reviewed papers and grants as follows: 2021 – RNA biology; 2020 – Nature Methods, COVID19-RP Inst. Pasteur grant application; 2019 – Nature Methods (two papers); 2018 – Cell Death Diff., WIREs-RNA; 2017 – Israel Cancer Association grant application; 2015 – Methods; 2014 – RNA.

I also review all protocols which I edit for Bio-protocol (106 protocols since 2016).

Organizing committee, Juries:

2020 **Raised funds**, “Woodstock.bio” conference, Tel-Aviv.

2019 **Co-organizer**, Special Interest Subgroup session “Specialized cellular protrusions, a mechanism for cell-cell communication” at ASCB-EMBO 2019 conference, Washington DC, USA.

2015 **Poster Judge** ASCB 2015: MAC & Ed Comm poster competition, San-Diego, Ca, USA

Invited speaker:

2020 **Woodstock.bio**, Tel-Aviv, Israel

2019 **ASCB-EMBO: special interest subgroup on Tunneling Nanotubes**, Washington DC. USA

2018 **Mini-symposium in honor of Prof. RH Singer**, Hebrew university, Jerusalem, Israel.

2017 **Special Guest seminar**, University of Pennsylvania, Philadelphia, PA, USA.

2017 **ASCB-EMBO: special interest subgroup on Tunneling Nanotubes**, Philadelphia, PA, USA.

2017 **Young Seminar lecture series**, Hebrew university, Jerusalem, Israel.

2014 **Transcription Imaging Consortium meeting**, HHMI Janelia research center, Ashburn, VA, USA.

2013 **mRNA and Protein trafficking in health and disease**, Weizmann Institute, Rehovot, Israel.

2013 **Transcription Imaging Consortium meeting**, HHMI Janelia research center, Ashburn, VA, USA.

2011 **Jacob's Showcase Lecture Series “Plenty New Under the Sun”**, Technion, Haifa, Israel.

Abstracts chosen for oral presentations:

2017 ASCB-EMBO (RNA session); The 42nd FEBS congress; 8th Congress of the Federation of the Israel Societies for Experimental Biology – FISEB; 2016 EMBO-EMBL: The Complex life of mRNA. 2015 ASCB meeting; 2014 Gordon research conference; Gordon research seminar; 7th Congress of the Federation of the Israel Societies for Experimental Biology – FISEB; 2010 EMBO Workshop: RNA control of cell dynamics; 4th RNA stability meeting; 2009 CSHL meeting: "Eukaryotic mRNA processing"; 2007 Fall Workshop of the Israeli Microbiology Society; 2002 Annual meeting of the Israeli Society of Oxygen and Free Radicals.

F: List of Publications

Peer-reviewed research papers:

1. Weiss M., **Haimovich G.** and Pick U. (2001) *Phosphate and Sulfate uptake in the halotolerant alga Dunaliella are driven by Na⁺-symport mechanism.* J. Plant Physiology, 158:1519-1525.
2. Kamer I., Sarig R., Zaltsman Y., Niv H., Oberkovitz G., Regev L., **Haimovich G.**, Lerenthal Y., Marcellus RC. and Gross A. (2005) *Pro-apoptotic BID is an ATM effector in the DNA damage response.* Cell, 122(4):593-603.
3. Lotan R., Goler Bar-On V., Duek L., **Haimovich G.** and Choder M. (2007) *The Rpb7p subunit of yeast RNA polymerase II plays roles in the two major cytoplasmic mRNA decay mechanisms.* J. Cell Biology, 178(7):1133-1143.
4. Goler Bar-On V., Selitrennik M., Barkai O., **Haimovich G.**, Lotan R. and Choder M. (2008) *Transcription in the nucleus and mRNA decay in the cytoplasm are coupled processes.* Genes and Development, 22:2022-2027.
5. Harel-Sharvit L., Eldad N., **Haimovich G.**, Barkai O., Duek L. and Choder M. (2010) *RNA polymerase II subunits link transcription and mRNA decay to translation.* Cell, 143(4):552-563.
6. **Haimovich G.**, Medina D., Causse S., Garber M., Millan-Zambrano G., Barkai O., Chavez S., Perez-Ortin JE., Darzacq X. and Choder M. (2013) *Gene Expression Is Circular: Factors for mRNA Degradation Also Foster mRNA Synthesis.* Cell, 153(5):1000-1011.
7. Somekh J., **Haimovich G.**, Guterman A., Choder M. and Dori D. (2014) *Conceptual Modeling of mRNA decay provokes new hypotheses.* PLoS One, 9(9): e107085.
8. **Haimovich G.**, Zabezhinsky D., Haas B., Slobodin B., Purushothaman P., Lin F., Levin JZ., Nusbaum C. and Gerst JE. (2016) *Use of the MS2 aptamer and coat protein for RNA localization in yeast: A response to “MS2 coat protein bound to yeast mRNAs block 5’ to 3’ degradation and trap mRNA decay products: implications for the localization of mRNAs by MS2-MCP system”.* RNA, 22:660-666.
9. **Haimovich G.**, Ecker CM., Dunagin MC., Eggan E., Raj A., Gerst JE. and Singer RH. (2017) *Intercellular mRNA trafficking via membrane nanotube-like structures in mammalian cells.* PNAS 114(46): E9873–E9882.

Invited Reviews:

10. **Haimovich G.**, Singer RH., Choder M. and Trček T. (2013) *The fate of the messenger is pre-determined: a new model for regulation of gene expression.* Biochem. Biophys. Acta - Gene Regulatory Mechanisms, 1829(6-7):643-653.
11. Buxbaum AR.* , **Haimovich G.*** and Singer RH. (2015) *In the right place at the right time: visualizing and understanding mRNA localization.* Nature Reviews Molecular Cell Biology, 16:95-109. * - **first co-author** (equal contribution).
12. **Haimovich G.**, Cohen-Zontag O. and Gerst JE. (2016) *A role for mRNA trafficking and localized translation in peroxisome biogenesis and function?* Biochem. Biophys. Acta - Molecular Cell Research, 1863(5):911-921.
13. **Haimovich G.** and Gerst JE (2021) *RNA transfer through tunneling nanotubes.* Biochemical Society Transactions 49 (1), 145-160.

Peer-reviewed Book chapters and Protocols:

14. **Haimovich G.** (2018) *Plasmid Extract from Budding Yeast (Saccharomyces cerevisiae)* Bio-protocol Bio101: e2931.
15. **Haimovich G.** and Jeffrey E. Gerst (2018) *Single-molecule Fluorescence in situ Hybridization (smFISH) for RNA Detection in Adherent Animal Cells.* Bio-protocol 8(21): e3070.

16. **Haimovich G.** and Gerst JE. (2019) *Detection of mRNA transfer between mammalian cells in co-culture by single molecule fluorescent in situ hybridization (smFISH)*. Methods in Molecular Biology vol 2038:109-129. Ed. Yaron Shav-Tal.
17. Nair RR., **Haimovich G.** and Gerst JE (2021) *An Aptamer-based mRNA Affinity Purification Procedure (RaPID) for the Identification of Associated RNAs (RaPID-seq) and Proteins (RaPID-MS) in Yeast*. Bio-protocol (revised MS submitted).

Pre-prints:

18. Czarnek M., Mason D., **Haimovich G.**, Puentes VF., Bergese P., Bereta J. and Lévy R. (2018) *Re-Evaluating the Spherical-Nucleic-Acid Technology* chemRxiv #6633980.
19. **Haimovich G.**, Olender T., Baez C. and Gerst JE. (2020) *Identification and enrichment of SECRETE cis-acting RNA elements in the Coronaviridae and other (+) single-strand RNA viruses*. bioRxiv 10.1101/2020.04.20.050088v1.
20. Gelin-Licht R., Conlon PJ., Singh R., Nair RR., **Haimovich G.**, Baez C., Gal L., Schuldiner M., Levchenko A. and Gerst JE. *Translational control as a novel regulator of gradient sensing and chemotropism in yeast*. BioRxiv 2020.12.13.422562v2.
21. Chattopadhyay S., Garcia-Martinez J., **Haimovich G.**, Khwaja A., Barkai O., Ghosh A., Chuarzman SG., Schuldiner M., Elran R., Rosenberg M., Bohnsack K., Bohnsack M., Perez-Ortin JE. and Choder M. *RNA-controlled nucleocytoplasmic shuttling of mRNA decay factors regulates mRNA synthesis and initiates a novel mRNA decay pathway*. BioRxiv 2021.04.01.437949v1

F: Patents

1. **Haimovich G.** and Gerst JE. *Improving the translation and protein secretion efficiency of mRNA vaccines* (filling in preparation).

G: Other Science-related publications and activities

1. **Scientist and parent** – life story; an eLife series on work-family balance (2018).
2. **Guest post** at Sharp Thinking blog (2015) Peer-review: Past, Present and Future (Hebrew).
3. **Guest post** at Addgene blog (2014): Which Fluorescent Protein Should I Use?
4. **Popular science lectures** given (mostly) at Israeli Science Fiction conventions, on topics such as the genomic revolution, epigenetics, gene editing, microbiome, synthetic biology, and, this year, on RNA vaccines and “The Future is RNA”.