

# **NOVEL TECHNOLOGIES FOR THE DIAGNOSIS AND TREATMENT OF POSTTRAUMATIC STRESS DISORDER**

A Dissertation  
Presented to  
The Academic Faculty

by

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To my mothers, Zerrin and Nesrin, and my grandmother, Saimoş, for their love that will  
last forever.

## ACKNOWLEDGEMENTS

One day, after a somewhat impulsive decision, I told my family that I was heading to Seattle for an exchange program, to help me decide if the United States was worth it for grad school (and to check out the land of grunge). I did not ask for their permission, I only let them know, just like with every other thing I do. For instance, I traveled Europe with friends many times when I was a teenager, only informing my family that I was leaving next week to this or that country. Though they worried, my family largely accepted my independent nature.

Then, though, I consciously selected a difficult male-dominated career path: engineering. I was at my family's limit at that point. To them, it would be more reasonable for me to go to medical school, which would mean a "better" future for me given Turkey's circumstances and I would not be "wasting" my university preparation struggle. My father, an engineer himself, warned me, in one of the most serious conversations I have had with him, that I would have to work harder than my male colleagues to fit in as an engineer. He worried that I would end up damaged, tired, stressed, demoralized. My uncle, a professor of pathology, shared his reason to study veterinary medicine rather than medicine - his pigeon that died in his hands when he was a young boy. He told me that he understood me and my passion, but his own impulse to study veterinary medicine had not been worth it: every animal has a different physiology, he would have better excelled at treating humans rather than different animals, and medicine would have been a better career path in Turkey. My mother, who always wanted to become a pediatrician but ended up as an English Literature major, begged me to go to medical school. Because she is undeniably smarter than me, she also tried psychological manipulation through my friends, especially Hande Kucukunsal, and the subtle tactic of us later we ended up watching Pathology. Elegant try, canım annem.

I refused to be dissuaded. I pulled off on my own. I started a summer job at a call center right after the university entrance exam, with night shifts, so as to not confront my mother during day hours. I had *always* wanted to be an engineer. Nothing and no one could change that simply because I did well at a ridiculous university entrance exam that haunts Turkish youth with lifelong traumas.

I am forever grateful to my family for loving me while letting me live my independence, and also for raising me without any kind of tribalist conditioning. Growing up in Istanbul, which is bigger and more populous than any city in the United States, particularly having been raised in a historically Armenian minority district, where you can hear both the church bells and mosque's call to prayer, certainly helped to prepare me to spread my wings in different cultures (also, potentially, my alleged Greek/Russian heritage, according to some internal family musings).

Many thanks to my family and friends for tolerating me while I struggled for years working on my PhD. I apologize to my family for being inaccessible, especially during these pandemic days when I have been writing my dissertation and finishing up my PhD work. Them and their health were on my mind everyday.

During my studies in the United States, I have had many happy times, dodged a few bullets, and made many mistakes, including but not limited to traffic accidents. My family and friends know only a few, aside from the automotive accidents. I do not have terrible regrets. I am truly grateful for the memories, experiences, and the people I met from all walks of my life. I am neither good at nor a big fan of inspirational messages, so hopefully this will not turn into one.

I owe a great deal to my advisor, Omer Inan. I was an undergraduate student at Bogazici Electrical and Electronics Engineering when we first met in 2014, sometime after my first PhD application to Georgia Tech. I always felt that my interview with him went well, but I was not selected. A

bizarre cascade of events, though, later led me to Georgia Tech after my first PhD attempt (and after finally getting accepted in 2016), and I have been truly blessed to work with him. I am not a “meant to be” person, but I cannot deny that working with Omer was truly meant to be for me. My coming to Georgia Tech was followed by me requesting to change my PhD research from heart disease to PTSD. Omer did not hesitate to accept, although he knew it would mean a ton of work, deadlines, DARPA reports, and teleconferences.

Just like my family, Omer gave me independence. He always had a positive and supportive attitude to every e-mail I sent, no matter how crazy it could sound. I was free to make collaborations and work on additional publications that were not entirely relevant to my PhD work with him. Before PhD, I did not imagine that independence would be a requirement for me in my career path. Independence is now a requirement for me, partly because Omer and others supported it when helping me to flourish. Omer was also the first person to know about the hiring freezes after each of my interviews took place and helped me through my pessimism during COVID-19 times.

My time in Atlanta was substantially enriched by meeting my Emory collaborators: Doug Bremner, Viola Vaccarino, Amit Shah, Matt Wittbrodt, Brad Pearce, Emily Driggers, Stacy Ladd, Raj Dedhia, Jeanie Park, Shawn Hochman, Heidi Kloefkorn, and many others. As a film buff and activist, I could never have imagined having a PI who is also a film director as well as an activist, one who also happened to be the expert witness for a lawsuit regarding a pharmaceutical I used in my high school years. Filled with Doug’s creative personality, Viola’s vision, Amit’s support for my first paper rejections, Matt’s rigorous critiques, Brad’s immunology guidance, Shawn and Heidi’s physiology and stress expertise, and the rest of the Emory team’s help in clinical research, our work together was an enjoyable feast for me. In no particular order, I would like to thank Steven Rhodes, Nancy Murrah, Margie Jones, Lucy Shallenberger, Emily Driggers, Jamil Alkhalf,



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My research could not have been done without the support and encouragement of Georgia Tech and Emory University faculty, and the interdisciplinary ecosystem these two top notch institutions provided. I am grateful to Magnus Egerstedt, Azadeh Ensari, Pamela Bhatti, Daniela Staiculescu, Alenka Zajic, Chris Rozell, Gregory Abowd, Rosa Arriaga, Rozga Agata, Jackie Nemeth, Ashlee Gardner, Leyla Conrad, UbiComp Group researchers Vedant Das Swain, Mehrab Morshed, and current and past Georgia Tech friends Sinan Hersek, Asim Gazi, Beren Semiz, Maziyar Baran Pouyan, Dotun Ode, Mobashir Shandhi, Hewon Jung, Mohsen Safaei, Nordine Sebkhi, Samer Mabrouk, Hyeon Ki Jeong, Venu Ganti, Jacob Kimball, Jon Zia, Brandi Nevius, Sevda Gharehbaghi, Kristy Scott, Goktug Cihan Ozmen, Hazar Ashouri, Jordan Conant, Abdul Qadir Javaid, Andrew Carek, Caitlin Teague, Lara Orlandic, Yaoyao Jia, Nazli Goller, Nick Bolus,

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Besides my Maryland family, I also have a Seattle family. Many thanks to Brenda Donner and Bruce Brewer for welcoming me in my first days in Seattle in 2012. I met them during a two week period designed as a warm introduction to “American life” by the University of Washington’s International Students Office when I was an undergraduate exchange student. We have never disconnected. Brenda always has remembered me whenever there is a political turbulence in Turkey (indeed, it is hard to find a time frame there is *\*not\** any sort of turbulence in Turkey, so we have communicated quite frequently). Her considerate messages made me aware how empathetic she was toward a student she barely saw a few days; I hope to model her caring.

I also have an Atlanta family, who have been a blessing to me. One of the most pleasant surprises from my time at Georgia Tech has been having the pleasure to meet and bond with the Milor family. Vedat Milor, who is a food & wine critic I admired for years, happened to live in Atlanta with his wife Linda, a professor in my department, and his daughter Ceylan. Interestingly enough,

I shared two other schools with them: Vedat was a Bogazici graduate and Linda worked at the University of Maryland College Park many years ago. Vedat's admirable search for beauty in everything, Linda's concise and effective career advice, and Ceylan's curious eyes that brighten to every strange thing she encounters, including salep and New York cheesecake, made my time in Atlanta much more memorable. I especially thank my youngest friend Ceylan for improving my *Turkish*, reminding me of my Turkish song playlists on Spotify which I had long neglected, making me discover the existence of Bluetooth AUX receivers as an electrical engineer, and looking amazed at every Turkish food recipe I tried (they were just primitive imitations of my mother's recipes).

Last but not least, I would like to thank my friends who always adjust their already busy schedules to make time for me whenever I go back to Istanbul: Hande Kucukunsal, Sezen Sari, Begum Konuralp, Sevgi Gokce Ceran, Seda Bakan, Arzu Takil, Gizem Karakadi, Ozlem Pinar Akin, Ilhan Yildirim, Dilan Ecem Karakaya, Bilge Ozata, Sinan Can Okutan, and others. Sorting by geographical location, I thank my friends in the United States (Burak Nehbit, Nilsu Goren, Besim Halit Yasar, Anshuman Sinha, Maya Kabkab, Berk Gurakan, Kleoniki Vlachou, Bige Deniz Unluturk, Suna Pelin French, Brett Murphy, Seyma Gurkan, Ayse Selin Cakmak, Fatma Karagoz, Sezen Yucel, Can Sever, Idil Arsik, Selcuk Karakas, Lina Castano), in Europe (Ece Gulay, Asya Cubuk, Samy Halaji), and friends/family who could be anywhere in the world anytime (Gozde Tutuncuoglu, Gamze Akarsu, Aysun Unal, Ecem Unal, Eren Unal, Ercument Unal, Esen Moya). I owe so much to my dear friend Brett Murphy, for his tireless reading of my many drafts (including this one), and his many useful suggestions. I am lucky to have this incredible social support network.

There are a few events I wish I had not missed, for example, Ece's Zagreb Wedding, and Gizem's and Gokce's Istanbul Wedding. After my PhD, I will try to not miss these happy moments of my friends, no matter where in the world they happen. I am looking forward to traveling for them more often.

Where you live becomes your boundary. I am fortunate to have lived in many places and had my boundaries expanded across the oceans. Many thanks to all my friends, family, mentors, mentees, collaborators, reviewers, colleagues for my training and development as a human being and a researcher.

People in need in Turkey and the United States are not terribly different. Here under the umbrella of racism and poverty, there under domestic abuse, lack of freedom, and poverty. It is not hard to map the problems of one place onto another; the reality is the people need help. You can volunteer, you can work for them for free. You will not be able to cause a significant change unless you educate the most vulnerable ones, re-defining reality in their eyes, and inspire them to stand up for themselves and others.