

BIOGRAPHICAL SKETCH

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NAME: Zegers Delgado, Juan Andres

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POSITION TITLE: Postdoctoral Scholar (University of Maryland)

EDUCATION/TRAINING (*Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.*)

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Pontificia Universidad Católica de Chile, Santiago, Chile	BS (Bachelor)	08/2017	Biochemistry
Pontificia Universidad Católica de Chile, Santiago, Chile	Professional Title	09/2018	Biochemistry
Pontificia Universidad Católica de Chile, Santiago, Chile	MSc	09/2020	Biological Sciences
Pontificia Universidad Católica de Chile, Santiago, Chile	PhD	04/2023	Biological Sciences (Cellular and Molecular Biology)

A. Personal Statement

I am a postdoctoral scholar at the University of Maryland, working under the mentorship of Dr. Ricardo Araneda. My research focuses on the mechanisms of neuronal computation, neuromodulation, and network dynamics, combining experimental and computational approaches to understand how neuronal circuits process information and adapt through plasticity. I am also interested in studying the regulation of the olfactory bulb by top-down inputs and the modulation of local inhibition by neurotransmitters and peptides.

My doctoral training at Pontificia Universidad Católica de Chile in the laboratory of Dr. Katia Gysling and Dr. Maria Estela Andres provided me with extensive expertise in neuropharmacology and molecular mechanisms of dopamine and corticotropin-releasing factor (CRF) receptor interactions in stress and addiction. During this period, I published multiple peer-reviewed articles addressing neurotransmitter modulation, receptor signaling, and the impact of stress on dopaminergic circuits. In parallel, I also engaged in mentoring, co-advising theses in my doctoral laboratory and later guiding honors students in their research projects at UMD.

At Maryland, my work focuses on computational neuroscience and systems-level questions, particularly within the framework of an NSF-funded project ("URoL: Learning the Rules of Neuronal Learning"). I am experienced in high-density microelectrode array (HD-MEA) technology, neuronal cultures, and quantitative analysis of neuronal activity, which will allow me to contribute to multidisciplinary projects integrating experimental neurobiology, computational models, and bioengineering.

My postdoctoral training has provided me with advanced expertise in preparing and maintaining primary neuronal cultures, performing MEA recordings, and applying optical-electrical stimulation paradigms. In parallel, I have developed and implemented custom analysis pipelines to extract information from complex datasets. This integration of experimental and computational neuroscience will allow me to study the development of in vitro

cortical networks and investigate the emergence of high frequency synchronized events, known as network bursts or avalanches. These events have been proposed as a mechanistic basis for epilepsy in preclinical models.

B. Positions, Scientific Appointments, and Honors

Positions and Scientific Appointments

2023-Present	Postdoctoral scholar, University of Maryland, College Park, MD
2023-2025	Teaching assistant, Marine Biology Laboratory (MBL, University of Chicago), Woods Hole, MA
2021-2022	Graduate instructor, "Molecular Pharmacology (Bio272c)," Pontificia Universidad Católica de Chile
2018-2023	Research assistant, Laboratory of Dr. Katia Gysling, Pontificia Universidad Católica de Chile
2017-2018	Teaching assistant, "Molecular Pharmacology (Bio272c)," Pontificia Universidad Católica de Chile

Honors

2019-2023	National PhD fellowship (beca de doctorado nacional), ANID, Chile
2017	First class honors (matrícula de honor, 2016 academic year), Pontificia Universidad Católica de Chile

C. Contributions to Science

1. Computational neuroscience and neuronal learning.

Neuronal networks encode, process, and adapt to information through complex patterns of connectivity and plasticity. Understanding how neurons integrate signals and adapt is essential for linking cellular mechanisms with network computation. As a postdoctoral scholar, I am involved in the NSF-funded project "URoL: Learning the Rules of Neuronal Learning," where I investigate neuronal connectivity and computational primitives in cultured networks using HD-MEAs. This project integrates experimental and computational approaches to uncover the fundamental rules of neuronal learning, including the computational primitives of synaptic integration. Our work aims to define how neuronal networks learn and adapt, providing insights relevant to both basic neuroscience and biologically inspired artificial intelligence. We are currently working on a comparative analysis of spike detection methods that will provide the field with validated and precise tools for studying spontaneous network activity, advancing both basic research and clinical applications of MEA technology.

Zegers-Delgado J, Renegar N., Pathirage K., Horiuchi T., Abshire P., Araneda RC. Assessment of spike detection methods in spontaneous network bursts. [Publication in preparation]

2. Social isolation effects odor discrimination.

Olfaction plays a central role in guiding social interactions in animals, including recognition, communication, and behavioral adaptation. Chronic stress can impair social behavior, but its effects on olfactory processing remain poorly understood. During my postdoctoral training, I am investigating how social deprivation at different developmental stages influences olfactory processing in the olfactory bulb. Using a model of social isolation, we examine how sensory inputs and inhibitory circuits are altered, and how these changes affect the discrimination of social versus non-social odors. This work aims to uncover the mechanisms by which social deprivation shapes sensory processing, with implications for understanding social behavior deficits observed in neuropsychiatric disorders. These studies integrate behavioral assays with electrophysiological and computational analyses, providing a bridge between sensory coding and social behavior.

Zegers-Delgado J, Irvine L., Matheny D., Sartag I., Araneda RC. Sexual dimorphism dictates resilient responses in stress induced smell discrimination impairments. [Publication in preparation]

3. Developmental aspects of CRF receptor function and Transcriptional regulation of CRF receptors.

The corticotropin-releasing factor (CRF) system is a key component of the brain stress response. However, its receptors have shown complex and sometimes ambiguous effects when pharmacologically or genetically targeted in treatments for stress-related disorders. My PhD research focused on the CRF-R1 metabotropic receptor, examining its age-dependent role in neurotransmitter regulation within the nucleus accumbens. I identified critical developmental differences in stress and reward processing. In addition, I collaborated on characterizing the signaling pathways and transcriptional regulation of CRF receptor expression and localization in the CNS, summarized in a comprehensive review. These findings provide a framework for understanding age-dependent outcomes of pharmacological interventions targeting CRF receptors, which is critical for developing treatments for stress-related psychiatric disorders. We are currently working on characterizing sex-specific stress mechanisms that will inform therapeutic approaches for social behavior deficits in psychiatric disorders.

Zegers-Delgado J, Aguilera-Soza A, Calderón F, Davidson H, Verbel-Vergara D, Yarur HE, Novoa J, Blanlot C, Bastias CP, Andrés ME, Gysling K. Type 1 corticotropin-releasing factor receptor differentially modulates neurotransmitter levels in the nucleus accumbens of juvenile versus adult rats. *Int J Mol Sci.* 2022. doi:10.3390/ijms231810800. PubMed.

Amado P, **Zegers J**, Yarur HE, Gysling K. Transcriptional regulation, signaling pathways, and subcellular localization of corticotropin-releasing factor receptors in the central nervous system. *Mol Pharmacol.* 2022. doi:10.1124/molpharm.121.000476. PubMed.

4. Dopamine and CRF receptor interactions in stress and addiction.

Stress and addictive behaviors share overlapping neurobiological pathways, many of which involve dopaminergic signaling and the corticotropin-releasing factor (CRF) system. Dysregulation of these systems contributes to vulnerability to relapse and stress-related psychiatric disorders. We studied the functional interplay between dopaminergic and CRF-R2 receptors in the prefrontal cortex and amygdala. We demonstrated that receptor heteromers modulate neurotransmitter release through receptor–receptor interactions. In addition, we used a social isolation model to examine neurochemical changes of dopamine signaling in the nucleus accumbens of juvenile rats. We found that isolation induces anxiety-like behaviors and enhances dopamine release evoked by chemical stimulation in the nucleus accumbens. We also identified a decrease in CRF-R1 receptor function in isolated animals, suggesting a link between this receptor and the behavioral-neurochemical changes induced by social isolation. Together, these findings reveal a molecular mechanism by which stress alters dopaminergic signaling, advancing our understanding of stress–addiction comorbidity.

Yarur HE, **Zegers J**, Vega-Quiroga I, Novoa J, Ciruela F, Andres ME, Gysling K. Functional interplay of type-2 corticotrophin releasing factor and dopamine receptors in the basolateral amygdala-medial prefrontal cortex circuitry. *Int J Neuropsychopharmacol.* 2020. doi:10.1093/ijnp/pyaa079. PubMed.

Novoa J, Yarur HE, Rivero C, Perez-Cardona E, Freire J, **Zegers J**, González-Pérez JL, Segarra AC, Gysling K. K+-induced dopamine release in the nucleus accumbens: role of CRF-R1. *Eur J Neurosci.* 2021. doi:10.1111/ejn.15345. PubMed.

5. Role of oxidative stress in amphetamine-induced behavior.

Oxidative stress has emerged as an important factor in neuropsychiatric conditions, including those related to drug abuse. Psychostimulants such as amphetamine increase dopamine release, which in turn promotes the generation of reactive oxygen species (ROS). However, the role of ROS in shaping behavioral and neurochemical responses to psychostimulants has remained unclear. As an undergraduate, I investigated how reactive oxygen species (ROS) modulate locomotor activity and dopamine release induced by psychostimulants. This work formed the basis of my honors thesis and resulted in a research article in which my findings contributed to the understanding of redox modulation of dopaminergic neurotransmission.

Zegers-Delgado J, Yarur HE, Novoa J, Vega-Quiroga I, Bastias CP, Calderón F, Blanlot C, Gysling K. Reactive oxygen species modulate locomotor activity and dopamine extracellular levels induced by amphetamine in rats. Behav Brain Res. 2022. doi:10.1016/j.bbr.2022.113857. PubMed.

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