My scientific research is focused on understanding how prenatal exposures to substance use shape brain developmental trajectories and behaviors. During my PhD, with Dr. Patricia Gaspar at the Institut du Fer à Moulin, a research unit of the Sorbonne Université in Paris dedicated to the study of the development and plasticity of the nervous system, I learned pharmacological, and neuroanatomical viral manipulations to probe the brain stress-coping and reward-related circuits of adolescent mice exposed to early life stressors and substance use.

To further understand the molecular mechanisms and neuroadaptations occurring in brain reward-related areas resulting from exposures to developmental substance use, for my postdoctoral training, I joined Dr. Mary Kay Lobo's lab at the University of Maryland in Baltimore. At this time, her lab had recently shown that perinatal exposure to the synthetic opioid - fentanyl increases the risk of anxiety-like and motivational behaviors in adolescent mice. I led the examination of the brain transcriptional landscape in these mice by investigating gene substrates within reward-related brain regions dysregulated by perinatal fentanyl exposure during the adolescent period. I used a multivariate transcriptome analysis in a sex-wise manner, to show that reward areas like the nucleus accumbens and ventral tegmental area had opposing differentially expressed genes. Further, I observed a sex-wise expression of gene clusters involved in extracellular matrix remodeling, synaptic signaling, and mitochondrial respiration.

Additionally, I am collaborating with Dr. Courtney Townsel in the Department of Pediatrics to aid in generating and interpreting gene ontology signatures occurring in the placenta from mothers of babies with neonatal opioid withdrawal syndrome. I am excited to lead future collaborations with Dr. Townsel to compare transcriptomic signatures in the placenta of our perinatal fentanyl mouse model to clinical samples.

Concurrently, I am leading a project investigating how the compound effects of maternal stress and cannabis impact brain development. This is based on increasing reports of pregnant mothers ingesting cannabis to reduce different forms of chronic stress. With the recent legalization of cannabis for recreational purposes in some states in the US and Maryland, the incidences of cannabis use among women of child-bearing ages is predicted to increase further raising concerns about the vulnerability of exposed offspring to lasting behavioral deficits. In the lab, we have begun probing behavioral deficits in mice exposed to prenatal THC and chronic maternal stress. My preliminary results show some sex-specific interaction effects of prenatal THC and stress in anxiety-like behaviors, particularly in adolescent males. I am currently probing gene substrates within the reward-brain areas driving observed behavioral deficits using gene multiplexing approaches. This experiment will generate transcriptional targets that can be manipulated using gene editing approaches with the hope of restoring normal brain functioning. Overall, the goal of these combinatorial approaches will be to identify cellular and molecular mechanisms that can be pharmacologically targeted and subsequently translated to clinical trials to possibly reduce or prevent lasting behavioral deficits in offspring exposed to prenatal cannabis, maternal stress, or a combination of both.

My long-term goal is to pursue questions relating to neuroadaptations from genetic and epigenetic modifications within reward-related brain areas following developmental substance use exposures. I hope to become an independent investigator and establish a competitive multidisciplinary laboratory at a top research institution where I would also continue to mentor younger colleagues and engage in outreach

programs aimed at combating substance use disorders. I believe scientific outreach programs aimed at empowering first responders and drug rehabilitation, intervention therapies, and harm reduction practices in disproportionately affected communities have gone a long way in reducing the addiction burden. Additionally, I hope that advances in basic research into mitigating the addiction cycle through the identification of gene biomarkers and pharmacological agents are achieved.

I believe the Matthew Osborne Fellowship will bridge the basic and clinical collaborations I need within the addiction field. This fellowship will also allow me to share my scientific research with leading addiction research groups within the UMSOM and broaden my knowledge beyond the bench to encompass bedside and communities as a well-rounded addiction scientist.