Substance addictions, together with rapidly growing behavioral addictions (e.g., gaming), generate many problems for addicted individuals and the social environment, and the Covid-19 pandemic only increased their prevalence. Addictive substances and behaviors act upon dopaminergic neurons to transiently increase extracellular concentrations of dopamine affecting motor activation, reward expectancy, and processing, as well as prediction error (PE) learning. PE – a mismatch between our expectations and the outcome of our actions increases phasic dopamine response, enhancing learning and allowing us to better predict future events and behavior. Unfortunately, it is still unclear how PE learning looks like in addiction as conducted studies revealed conflicting results, which have been interpreted in the context of two contradictory theories. One theory assumes that general reactivity to cues and reward is lower for individuals with addictions, possibly due to coexisting anhedonia. The other theory assumes that reactivity to cues which are related to specific addiction may be much higher for the addicted person than the healthy person due to sensitization.

In this proposal, we would like to focus on two things: (1) to investigate whether reactivity of the brain differs between addiction-specific and addiction-nonspecific cues (2) to investigate what is the role of anhedonia in possible lower brain activity. Based on recent findings and our preliminary data, we propose an integrative model of additive effects resulting in lower reactivity caused by anhedonia and at the same time, higher reactivity for cues specific for certain addiction.

We designed a series of 6 studies (4 cross-sectional and 2 longitudinal with over 800 participants in Poland and China) using electroencephalography (EEG) for assessment of feedback-related negativity (FRN), a brain activity component signaling PE. In the series of these 6 studies with people diagnosed with alcohol, methamphetamine, gaming, and compulsive sexual behavior disorders, we will compare FRN components in the addiction-specific and non-specific contexts among different types of addictions (substance vs. behavioral). Doing this across two different cultures (Poland and China), we will be able to evaluate the universal character of our potential findings.

If obtained results successfully replicate across different populations, labs, and cultures, this project will provide robust scientific evidence contributing to the field of addiction research with a theoretical framework integrating seemingly contradictory findings of previous studies, showing that both current theories may be complementary and related to the different aspects of addiction.