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Using Raman Spectroscopy for the Detection of Opioid Use Disorders

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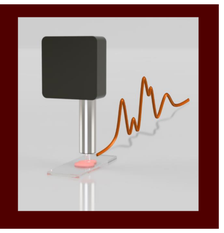

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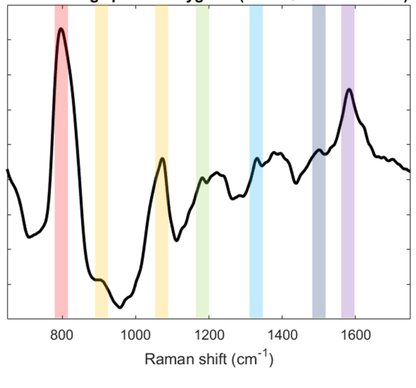
Introduction

Opioid use disorder (OUD) is a serious and relapsing mental health disease. In contrast to other chronic disorders, there are no objective diagnostic tools for early detection or to monitor disease progression. Raman spectroscopy is employed in biomedical fields for both research and as a diagnostic tool, but is underutilized for the study of OUD.

In humans, both personality and social environment influence the development of OUD. Previously, we have demonstrated that both social environment and sociability levels influence the response to opioids in rodent models. Mice can be tested and divided, based on their sociability levels, into Socially Avoiding (SA) and Socially Exploring (SE). We demonstrated that SE mice are more sensitive to the sensitizing effects of opioids suggesting that the positive reward system is likely mediating abuse escalation in SE individuals. In contrast, SA mice are more sensitive to opioids' effects on stress and pain. This suggests that negative reinforcement is likely mediating abuse escalation in SA individuals.

In this project, we have demonstrated that by using Raman spectroscopy, we can detect baseline differences between SA and SE mice, as well as in their responses to morphine. SA and SE mice were treated with saline (Sal SA and Sal SE) or morphine (Mor SA and Mor SE). Different brain areas were examined, including the amygdala, nucleus accumbens, ventral tegmental area, prefrontal cortex, and hippocampus. For space considerations, only the results from the amygdala and nucleus accumbens are shown.

PC1 loadings plot of amygdala (L23&Q24 vs V24&V25)



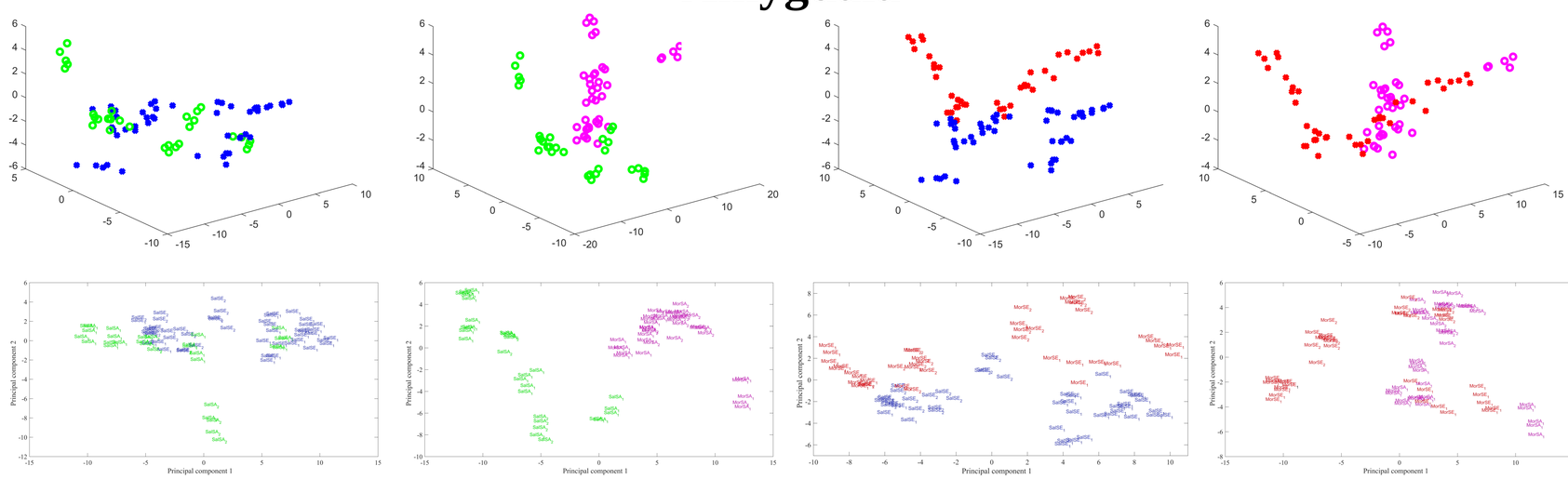
Tentative assignments

- phosphodiester bands
- skeletal mode of polysaccharides, C-C stretch of proline, glucose, lactic acid
- Lipids/collagen, C-C stretch of protein
- Carotenoids, L-Tryptophan
- Nucleic acids (Try, Ala)/proteins (Amide III), lipid, phospholipid =C–H bend,
- Carotenoids, C=C stretch
- Amide II, aromatic amino acids within proteins, nucleic acids

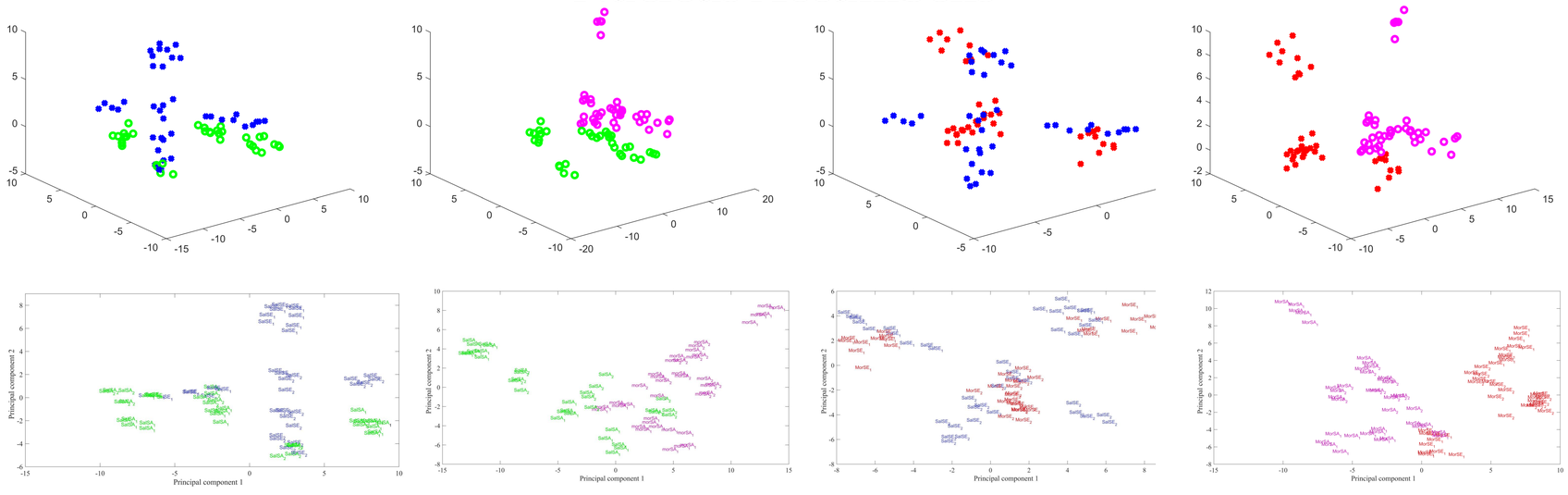
Ref: 10.1039/c4an01876a, 10.18632/oncotarget.19668, 10.3390/bios6040057

Sal SA vs. Sal SE | **Sal SA vs. Mor SA** | **Sal SE vs. Mor SE** | **Mor SA vs. Mor SE**

Amygdala



Nucleus Accumbens



Conclusions:

- **There is separation in PC1 between Sal SA & Sal SE in both the amygdala and the nucleus accumbens.**
- **There is separation in PC1 between Sal SA & Mor SA in both the amygdala and the nucleus accumbens.**
- **There is separation in PC2 between Sal SE & Mor SE in the amygdala (and not the nucleus accumbens).**
- **There is separation in PC1 between Mor SA & Mor SE only in the nucleus accumbens (and not in the amygdala).**
- **The PC1 spectra analyses suggest alteration in certain elements across the different experimental groups, such as phosphodiester bands, lipids/collagen, and amide II.**
- **These methodologies are expected to provide insights into potential need to individualize the care of OUD patients, as well as markers to be used for objective diagnosis of the development of trajectory of OUD in humans.**