Characterizing dopaminergic signaling in the nucleus accumbens core across different sign-tracking responses using fiber photometry

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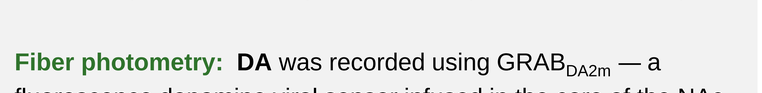
Introduction

- **Sign-tracking (ST)** ia physical manifestation of **motivation** in which animals attribute **incentive salience**—or motivational value—to a reward predictive cue (1).
- When this physical manifestation is too amplified, maladaptive behaviors like **addiction** arise (1).
- **Phasic dopamine (DA)** signaling in the **nucleus accumbens core (NAc)** is thought to **encode incentive salience** in ST (2), in addition to **reward prediction errors** when reward values change (3,4).
- It is unknown whether phasic DA may modulate the **vigor** and **persistence** of different sign-tracking responses observed across individual differences.

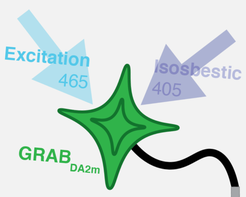
Methods

Subjects: 9 Long Evans rats, PN 70-90 male (n=4) and female (n=5)

Timeline:

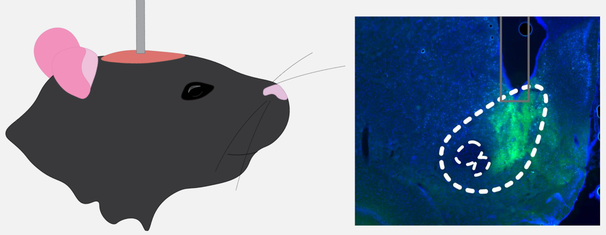


Fiber photometry: **DA** was recorded using $GRAB_{DA2m}$ — a fluorescence dopamine viral sensor infused in the core of the NAc

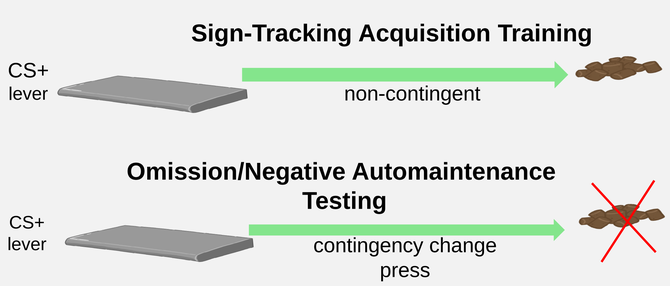


$GRAB_{DA2m}$ was excited by a **465 nm** LED light through an implanted **fiber optic cable.**

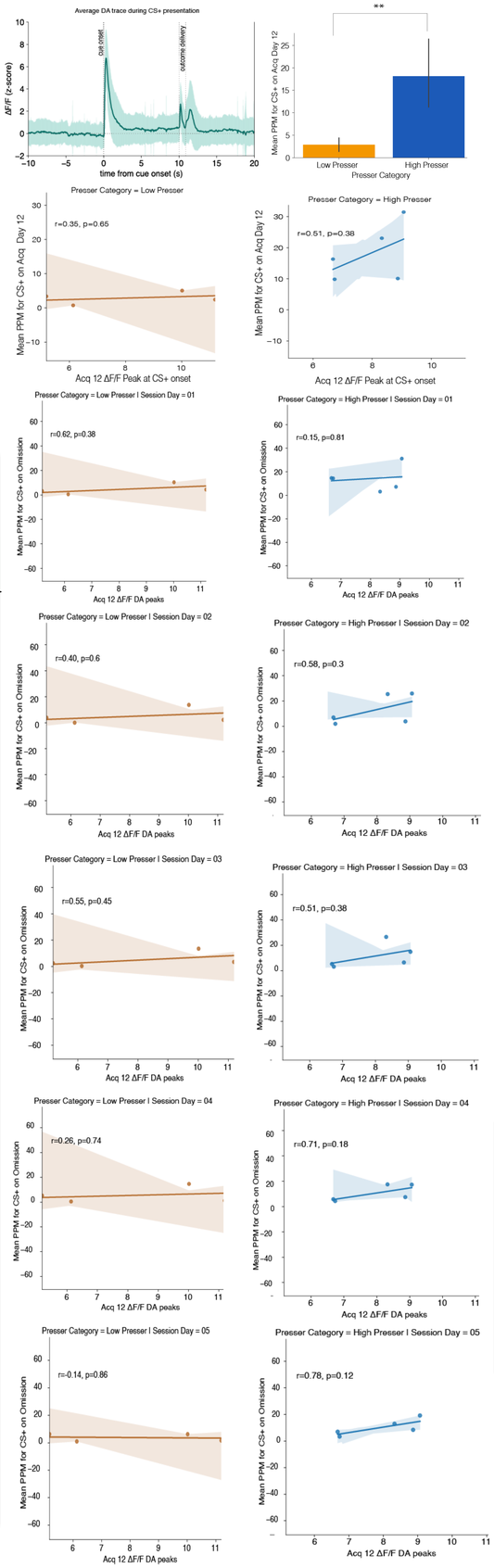
An isosbestic **405nm** LED wavelength served as control.



Behavioral task:



Sign-tracking press phenotypes and DA transmission through the task



Dynamics between behavioral microstructure and DA transmission through the task

Conclusions and Future directions

- **Phasic DA in the Nac** in ST animals may underlie dissociable **incentive salience** and **prediction errors.**
- The **magnitude** of Phasic DA signal may also explain the **vigor** and **persistence** of sign-tracking.
- **ST** animals with **higher DA release** at cue onset were more likely to engage in **vigorous** behavior during **acquisition training** and **omission.**
- **Behavioral microstructure** better characterizes the range of sign-tracking responses than pressing rates.

Future Directions:

- Using DA release during omission to predict behaviors during omitted or rewarded trials.
- Characterize cholinergic-dopaminergic dynamics in NAc across sign-tracking responses.

Funding: NSF IOS 1557987 (KSS); NIH 1R01DA044199 (KSS)

Acknowledgements: E.E Just Program Fellowship, UGAR Program, Presidential Scholar Program.

Special thanks to my advisors: Dr. Kyle Smith, Dr. Katherine Nautiyal and Erica Townsend

References

1. **Berridge (2004)**, *Physiol. Behav.*
2. **Flagel et al. (2011).** *Nature*
3. **Schultz (1998).** *J Neurophysiol.*
4. **Townsend et al. (2023).** *Sci Rep*