Exploring the use of surface electroencephalography and the identification of lameness in mature horses

By: Sabrina A. Valdés Ramos

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ABOUT ME

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2019-2024
B.S. ANIMAL SCIENCE & PRE-VETERINARY MEDICINE

APRIL 2023
VET CHAMPS ADMISSIONS BOOT CAMP

SUMMER 2023
VET UP! COLLEGE SUMMER PROGRAM

SUMMER 2024
USDA REEU RESEARCH SUMMER PROGRAM

AUGUST 2024
1ST YEAR DVM CANDIDATE

REEU SUMMER RESEARCH INTERSHIP

LOCATION

TEXAS, USA

UNIVERSITY

TARLETON STATE UNIVERSITY

MENTOR

DR. JESSICA LEATHERWOOD

PERSONAL CHANGES

Confidence

Adaptability

Awareness

Collaborator

PROFESSIONAL CHANGES

- *Interdisciplinary Collaboration*
- *Research Methods Knowledge*
- *Statistics Importance*
- *Literature Review*

Exploring the use of surface electroencephalography and the identification of lameness in mature horses

Sabrina Valdés, Jessica Leatherwood, Jesús Cortés, Cecilia Gualandri, Lauren Pavel, Nichol Civitello, Lauren Hanna, Neil Petroff, and Amber Bozer

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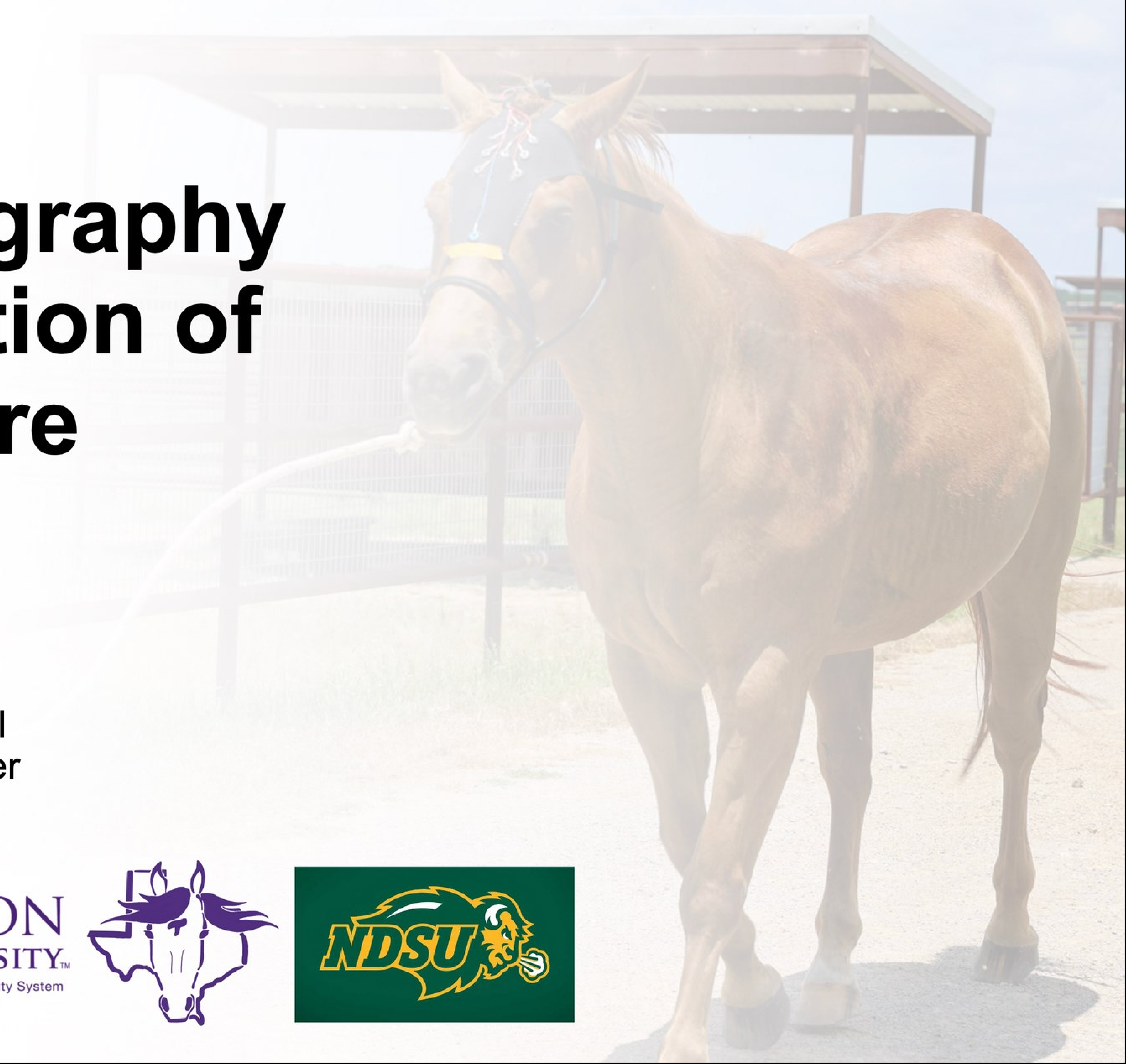


Background

- Lameness (LS):
  - Clinical sign
  - May affect all horses (Kane et al., 2000)
  - Abnormal gait
    - **Often caused by pain** (Adams, 2023)

- Detection - Gold standard:
  - AAEP lameness scale (Crecan et al., 2022)
  - Lameness Locator

- Need early detection - Welfare:
  - Avoid chronic cases
  - Avoid subjectiveness (Kegan et al., 2010)

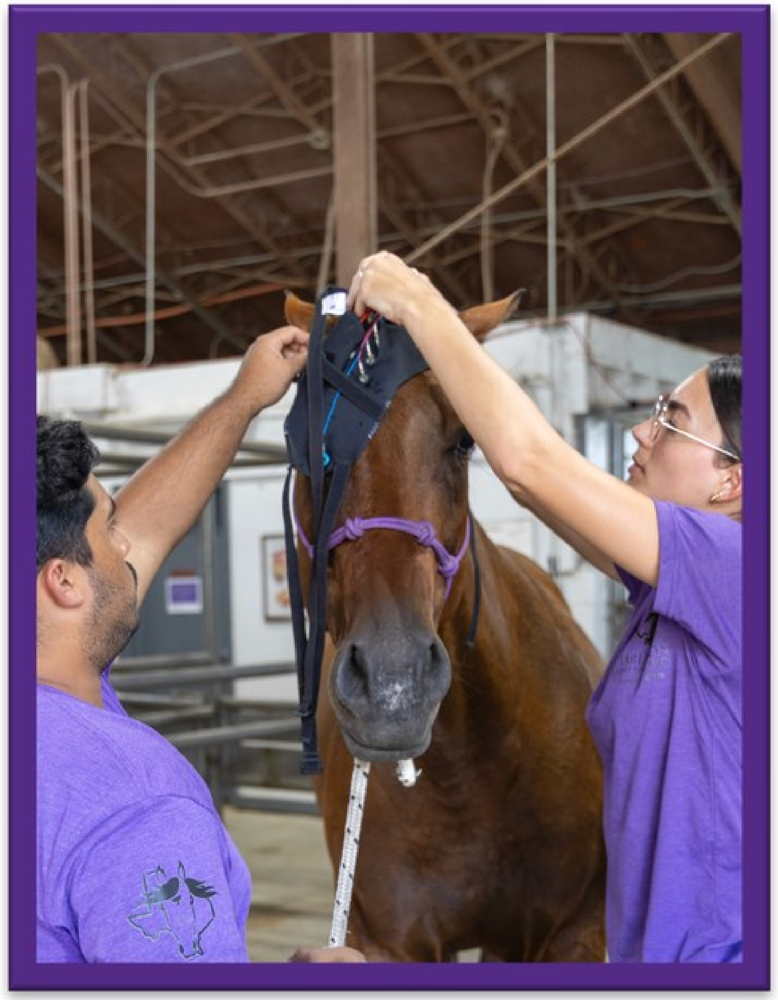
Background

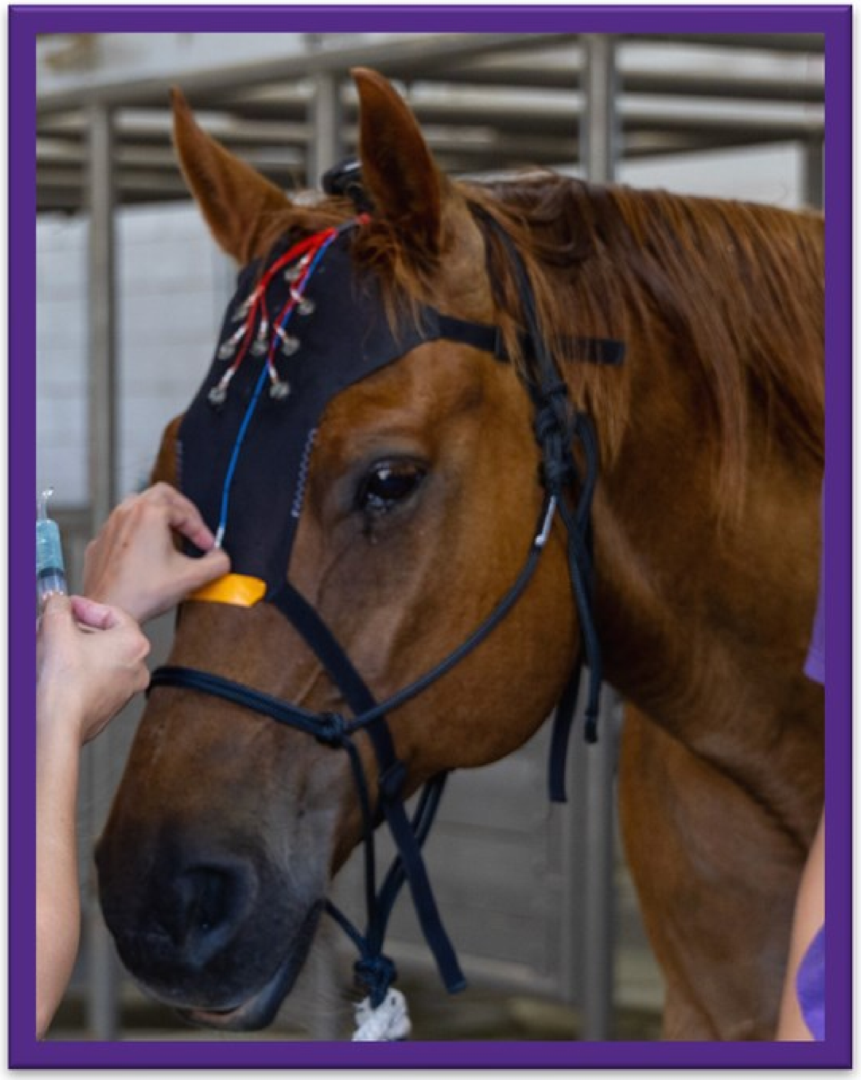
- Novel Detection - Surface electroencephalography (sEEG):
  - Summed electrical potentials from pyramidal cells (Berger et al., 1929)
  - Oscillations
    - Cortical networks on the surface of the scalp (Kida et al., 2016; Nora et al., 2020)
    - A shift may indicate pain
  - Pain in sheep (Harris et al., 2021)
- Blood biomarker:
  - Substance P (SubP) - neuropeptide
    - Systemic biomarker of pain

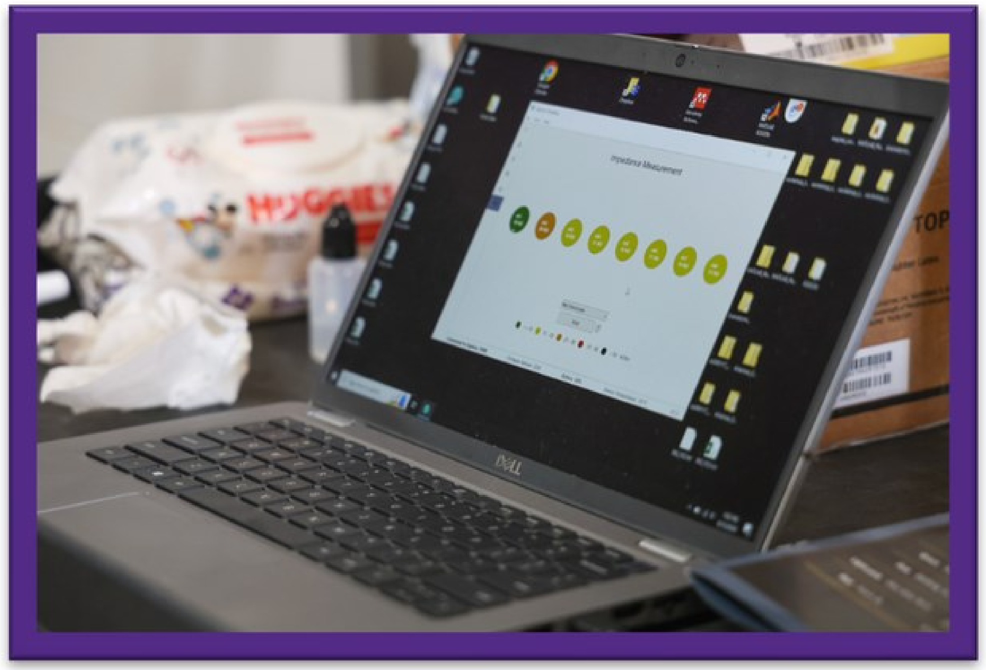
Objectives:

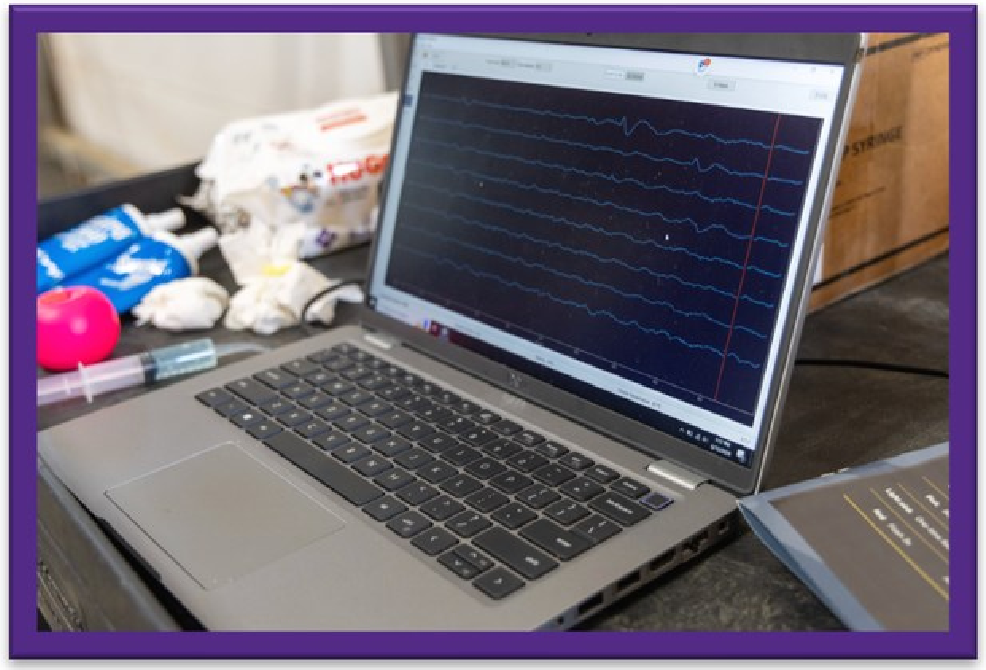
The objective of this study was to determine the effect of conducting a lameness evaluation on a systemic biomarker of pain (substance P; SubP) and sEEG recordings in mature horses.

sEEG cap placement

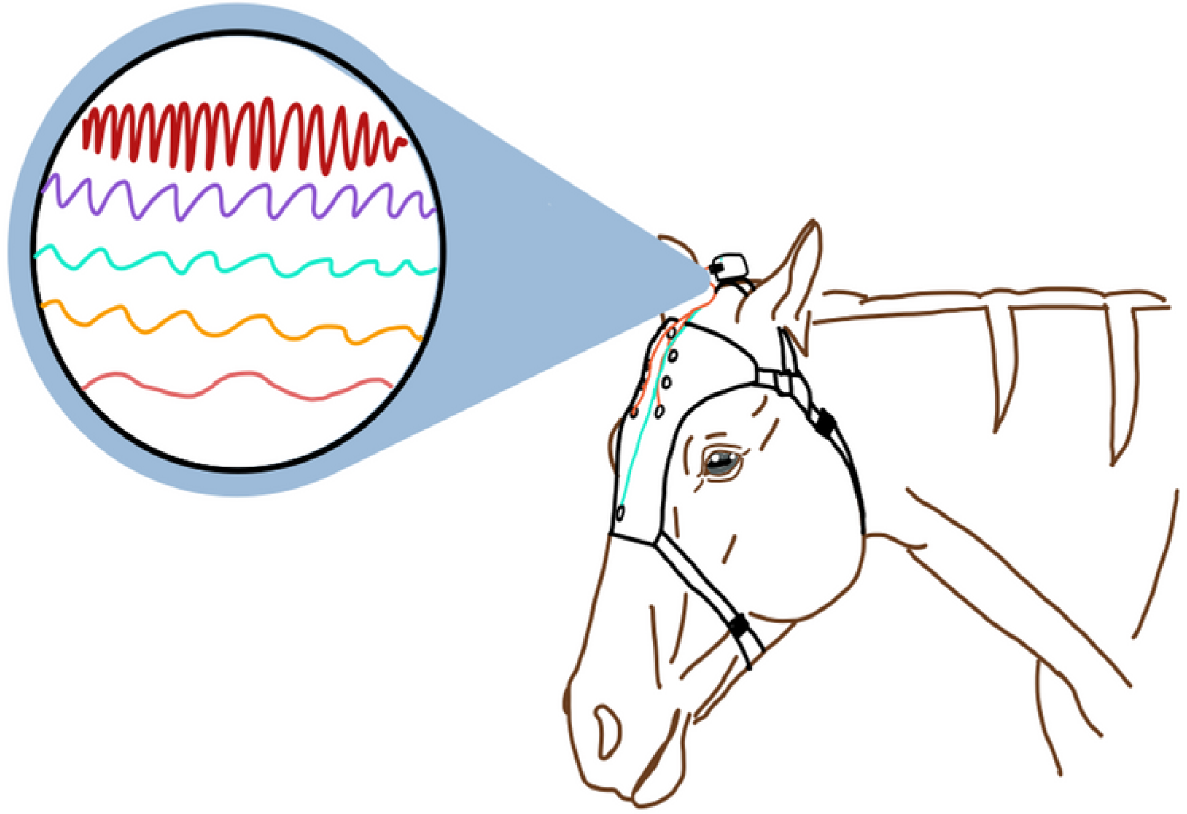








sEEG recording:



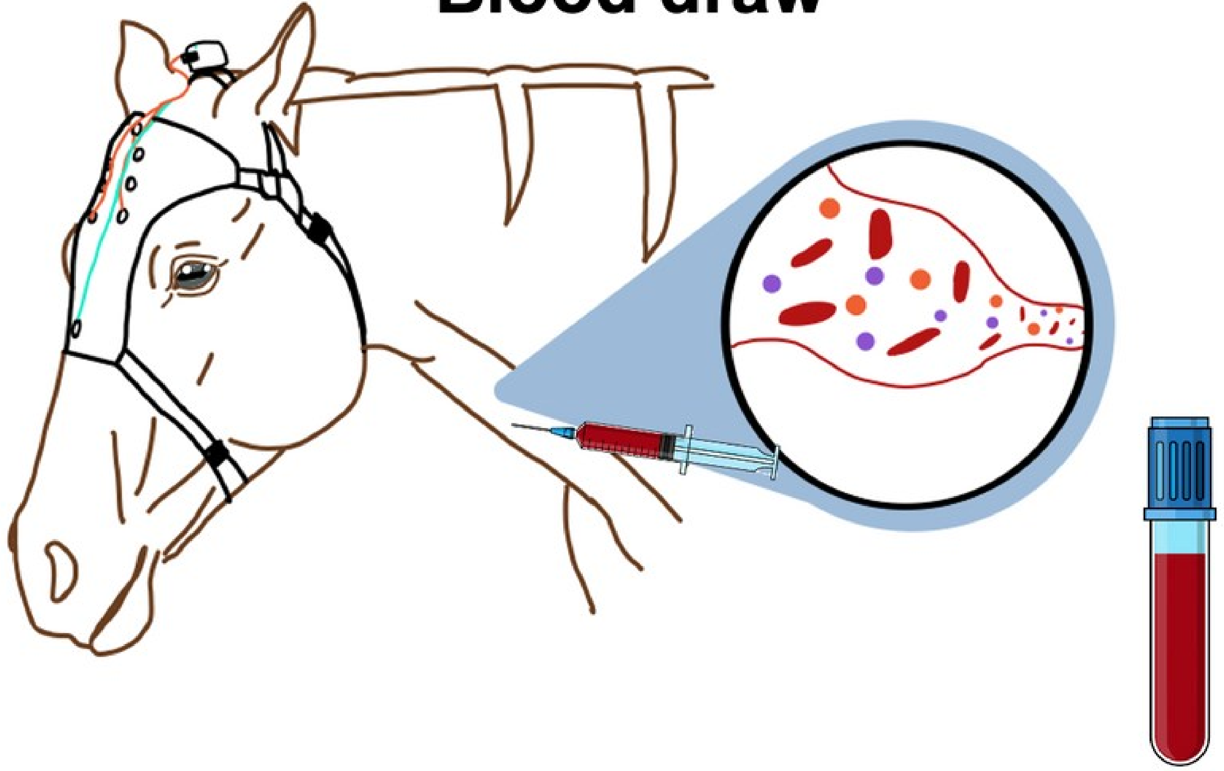
Pre and Post lameness evaluation for 5 min

Processed: MatLab
Filtered, Reject, Fast Fourier Transform: Notepad++, Carpool software

- **Gamma** (31-50 Hz)
- **Beta** (13-30 Hz)
- **Alpha** (8-12 Hz)
- **Theta** (4-7 Hz)
- **Delta** (0-3 Hz)

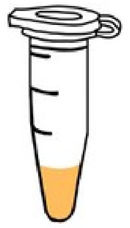
SubP collection and analyses:

Blood draw



Pre and Post lameness evaluation
for 5 min

Blood allowed to **clot &**
Serum Harvested



Stored at -80°C
for later analyses

Substance P ELISA kit

Concentrations analyzed
with BioTek CYTATIONS|5
Imaging Reader

Lameness evaluation:

KEY FINDINGS

No effect of time (pre and post lameness evaluations) **on SubP** (P = 0.07) **or any** frequency **sEEG bands** (P ≤ 0.5).

Age and SubP had a **negative relationship** (r = -0.55, P = 0.03).

Age and LS, moderate to strong **relationship** (r = 0.56, P = 0.02).

SubP and LS, no relationship (r = 0.02, P = 0.94).

No time effect on the sEEG frequency bands (0.84 ≤ P ≤ 0.98).

ELEMENTS FOR FUTURE CAREER

1. Networking skills and community
2. Data analysis and statistical reasoning
3. Efficient literature review
4. Equine science and hands-on exposure
   a. Horsemanship skills
5. Animal welfare and ethical considerations

Acknowledgements

- Special thanks to:
  - Dr. Jessica Leatherwood
  - Jesús Cortés
  - Cecilia Gualandri
  - Lauren Pavel
  - Nichol Civitello
  - Dr. Lauren Hanna
  - Dr. Neil Petroff
  - Dr. Amber Bozer
  - Dr. Leatherwood’s graduate and undergraduate students.
  - Tarleton Equine Center and Texan Therapeutic Riding
- Bridging The Gap Project that was supported by USDA-NIFA-AFRI-009041; **Award Number 2023-68018-40320**.

References

Barbariga, M., Rabiolo, A., Fonteyne, P., Bignami, F., Rama, P., & Ferrari, G. (2018). The effect of aging on nerve morphology and substance P expression in mouse and human corneas. *Investigative Ophthalmology & Visual Science*, *59*(13), 5329-5335.

Caron, J. P., Bowker, R. M., Abhold, R. H., Toppin, D. S., Sonea, I. M., & Vex, K. B. (1992). Substance P in the synovial membrane and fluid of the equine middle carpal joint. *Equine Veterinary Journal*, *24*(5), 364-366.

Crecan, C. M., Morar, I. A., Lupsan, A. F., Repciuc, C. C., Rus, M. A., & Pestean, C. P. (2022). Development of a Novel Approach for Detection of Equine Lameness Based on Inertial Sensors: A Preliminary Study. *Sensors*, *22*(18), 7082.

De Camp, N. V., Ladwig-Wiegard, M., Geitner, C. I., Bergeler, J., & Thöne-Reineke, C. (2020). EEG based assessment of stress in horses: a pilot study. *PeerJ*, *8*, e8629.

Kane, A. J., Traub-Dargatz, J., Losinger, W. C., & Garber, L. P. (2000, November). The occurrence and causes of lameness and laminitis in the US horse population. In *AAEP Proceedings* (Vol. 46, pp. 277-280).

Kaneene, J. B., Ross, W. A., & Miller, R. (1997). The Michigan equine monitoring system. II. Frequencies and impact of selected health problems. *Preventive veterinary medicine*, *29*(4), 277-292.

References

Murray, R. C., Walters, J. M., Snart, H., Dyson, S. J., & Parkin, T. D. (2010). Identification of risk factors for lameness in dressage horses. *The Veterinary Journal*, *184*(1), 27-36.

Stomp, M., d'Ingeo, S., Henry, S., Lesimple, C., Cousillas, H., & Hausberger, M. (2020). EEG individual power profiles correlate with tension along spine in horses. *Plos one*, *15*(12), e0243970.

Swor, T. M., Dabareiner, R. M., Honnas, C. M., Cohen, N. D., & Black, J. B. (2019). Musculoskeletal problems associated with lameness and poor performance in cutting horses: 200 cases (2007–2015). *Journal of the American Veterinary Medical Association*, *254*(5), 619-625.

Williams, D. C., Aleman, M., Holliday, T. A., Fletcher, D. J., Tharp, B., Kass, P. H., ... & LeCouteur, R. A. (2008). Qualitative and quantitative characteristics of the electroencephalogram in normal horses during spontaneous drowsiness and sleep. *Journal of veterinary internal medicine*, *22*(3), 630-638.

Thank you!
Any questions?