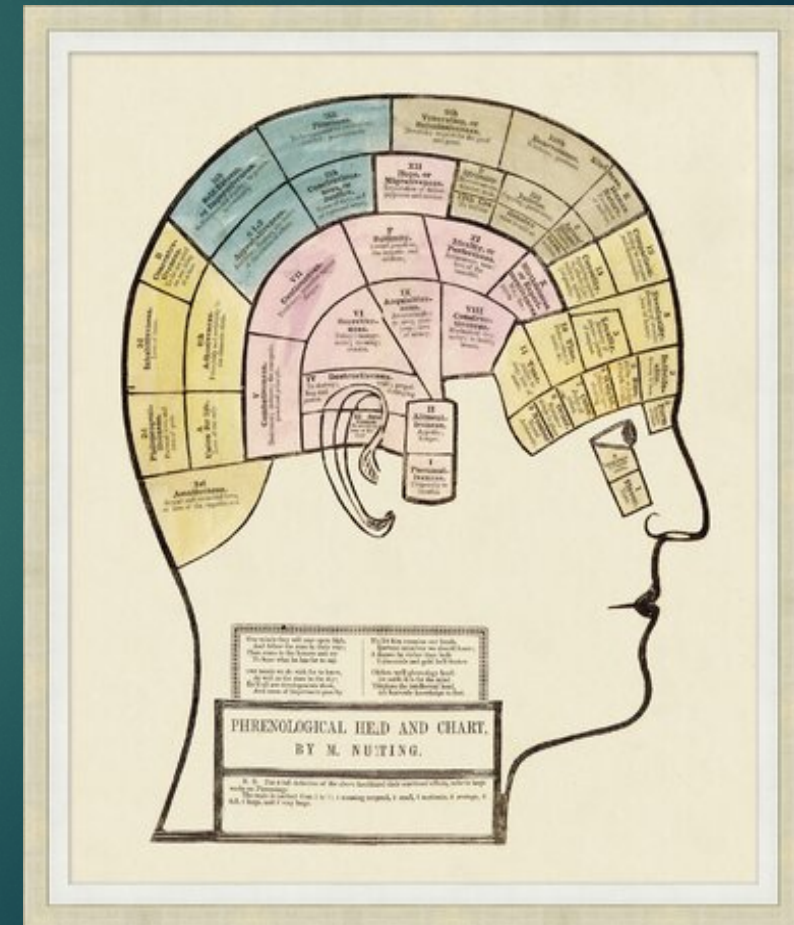


Human/Equine Psycho physiology/ Brain Activity During Interactions

PROFESSOR ANN HEMINGWAY 2024



`I feel therefore I am`

Aiming for a neuro-scientific understanding of the embodied self, a self-grounded in our bodies may help us to understand primary process emotional learning experiences between and across species.



Emotions arise in the sub-cortical structures in the ancient medial mid-line and ventral brain areas connected to the higher brain (including the amygdala), it is not essential to have a fully functional brain cortex or the ability to speak to experience emotions.

Primary Innate Mammalian Emotions

Seeking, the brain reward (umbrella) system – anticipation and desire the quest for everything. Described as excited euphoric anticipation, an `eagerness`. If this system is damaged it can cause depression and death.

Rage – provides the desire to strike, and feelings of outrage.

Fear – this is the heritage of our evolutionary memory as mammals an unpleasant emotion caused by the belief that someone or something is dangerous, likely to cause pain, or a threat.

Lust – from romance to reproduction.....

Care (nurture, love) – mammals would not exist without maternal caring, our preferred life course consists of seeking opportunities to feel these emotions.

Panic (grief, separation) – Many mammals only survive through the maintenance of social bonds.

Play (social joy, delight) – deep transformative play, laughter, building skills and connections. Wild naughty rambunctious play is the right of every living creature (author).

(Panksepp et al., 2012)



► Emotional events are remembered more clearly, accurately and for longer periods of time than neutral events, while also enabling enhanced memory consolidation (Damasio 1994).

► All cognitive activity is motivated by basic emotional and homeostatic needs that explore environmental events for survival while facilitating processes of learning and memory (Carter et al., 2004). However chronic stress or immediate intense stress or pressure may prevent detailed learning while enabling learning which focuses only on the negative experience (Hemingway 2019).

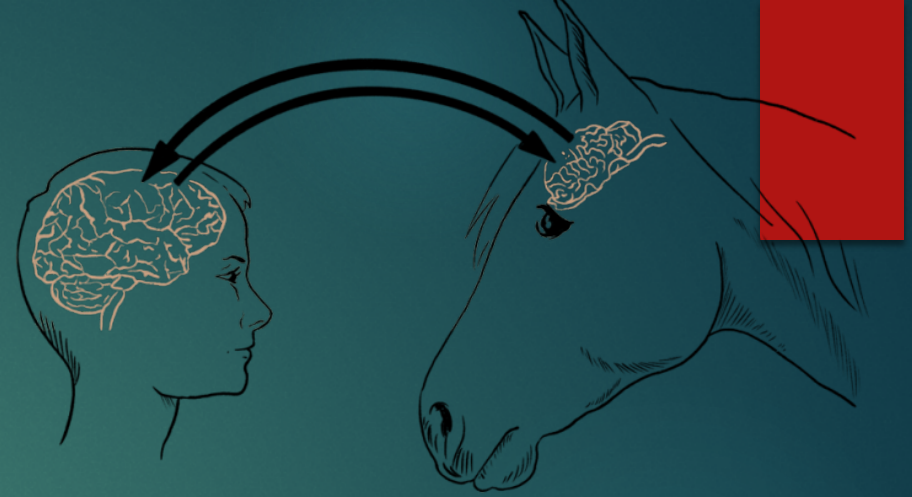
Damasio A.R. *Descartes Error: Emotion, Reason and the Human Brain*. Grosset/Putman; New York, NY, USA: 1994.

Carter S., Smith Pasqualini M.C. Stronger Autonomic Response Accompanies Better Learning: A Test of Damasio's Somatic Marker Hypothesis. *Cognit. Emot.* 2004;18:901–911. doi: 10.1080/02699930341000338.

Differences between horses and human brains....

B.H. Riisberg

<https://magazine.malgretoutmedia.com/malgre-tout-media-9/the-horse-s-brain-how-the-horse-s-and-the-human-brain-differ-from-each-other>

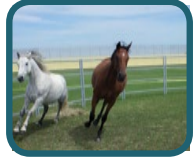


An adult human brain weighs between 1.2 and 1.4 kg. The adult horse brain weighs between 600 and 800 g. The horse's brain is on average smaller than ours.

Our brain has expanded for refined motor skills, such as typing and using tools. In addition, our brain contains a large area dedicated to our complex language, both verbal and body language.

We also have an area that specializes in complex thoughts; our frontal lobe. This differs from the horse where this area largely does not exist.

The horse has a larger cerebellum than us, which means that the horse is considerably better at overall movement and balance over long distances. **In addition, and crucially for horse and human learning together, the horse's brain specializes in receiving sensory input and acting on it without complex mental or emotional interference.**



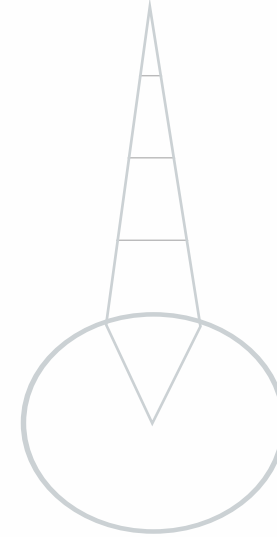
TheHorseCourse



NB. the participant pictured was not part of the study cohort

The Impact of an Equine Assisted Intervention

The Intervention Outcomes



A 4-minute video is also available at (non
verbals) www.thehorsecourse.org

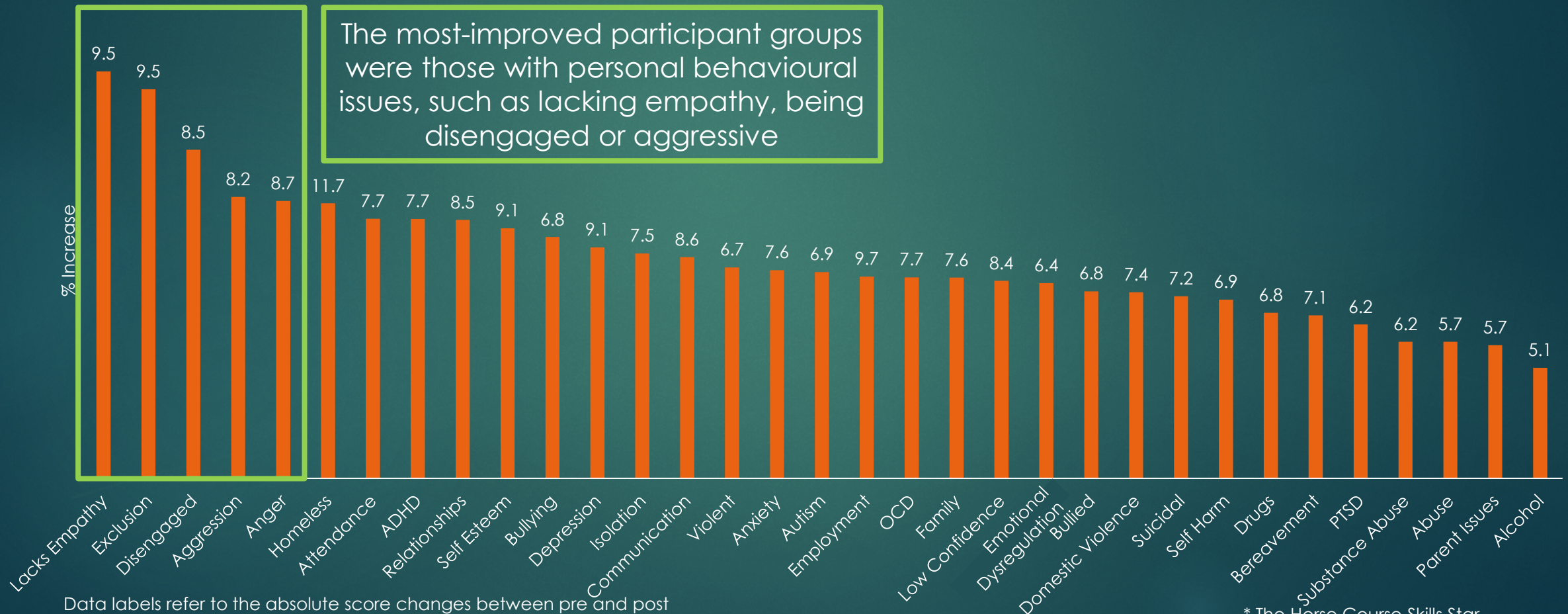


TheHorseCourse

NB. the participants pictured were not part of the study cohort

Every group showed statistically significant improvement on the Horse Course Skills Star when analysed using a simple T-Test

% Increase in Star Chart* Scores Across Groups

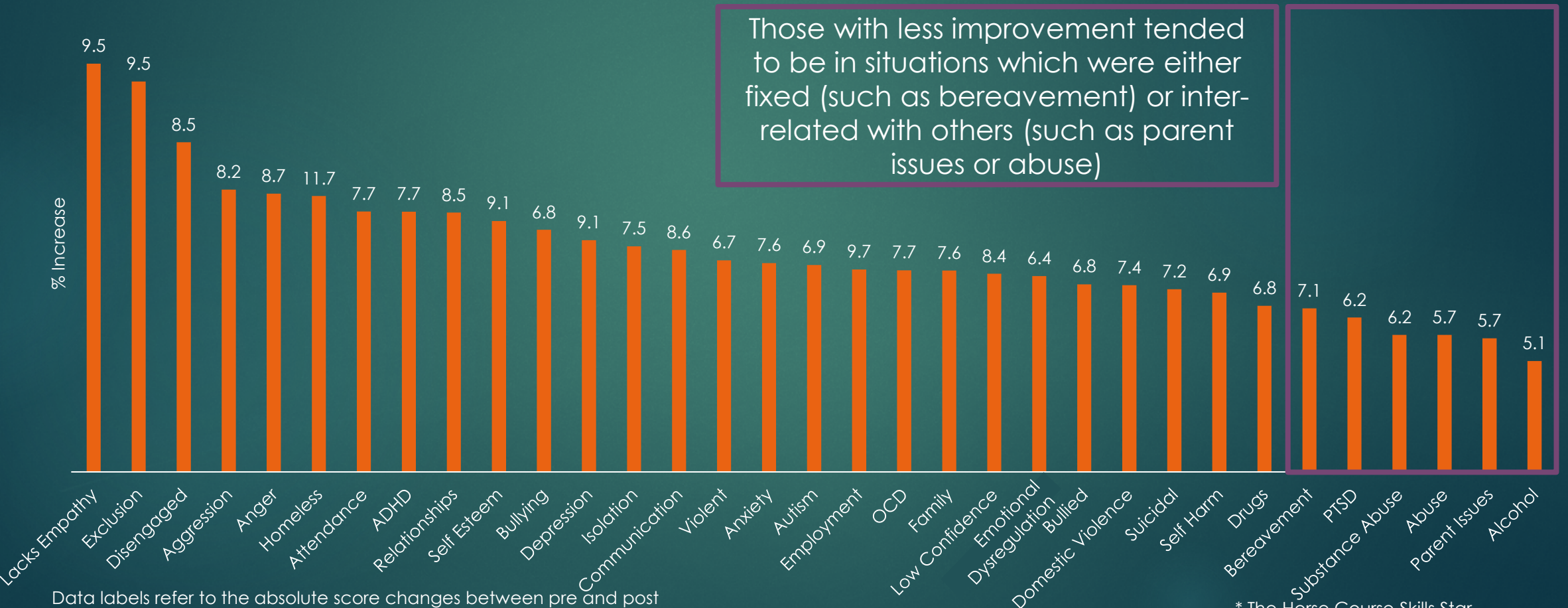


Data labels refer to the absolute score changes between pre and post intervention

* The Horse Course Skills Star

Every group showed significant improvement on the Horse Course Skills Star when analysed using a T-Test

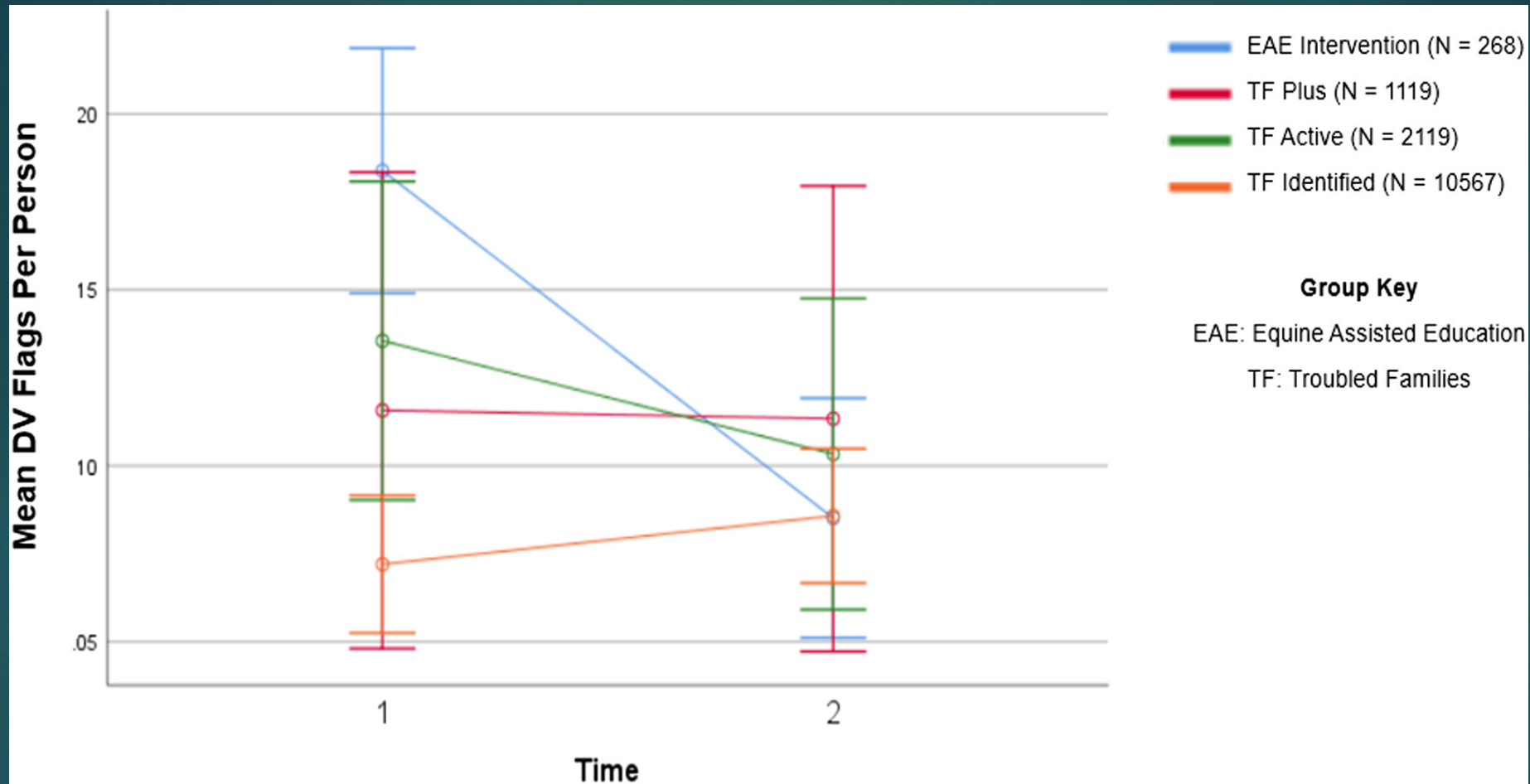
% Increase in Star Chart* Scores Across Groups



Data labels refer to the absolute score changes between pre and post intervention

* The Horse Course Skills Star

REDUCING DOMESTIC VIOLENCE



Hemingway A. & Sullivan K 2022 Reducing the Incidence of Domestic Violence: An Observational Study of an Equine Assisted Intervention, Family Process, First published: 30 March DOI: 10.1111/famp.12768 <https://onlinelibrary.wiley.com/doi/full/10.1111/famp.12768>

Testing Damasio`s theory during the horse human interaction

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616398/>

Hemingway et al., 2019 An Exploration of the Mechanism of Action of an Equine-Assisted Intervention Animals (Basel). 2019 Jun; 9(6): 303. Published online 2019 May 31. doi: [10.3390/ani9060303](https://doi.org/10.3390/ani9060303)

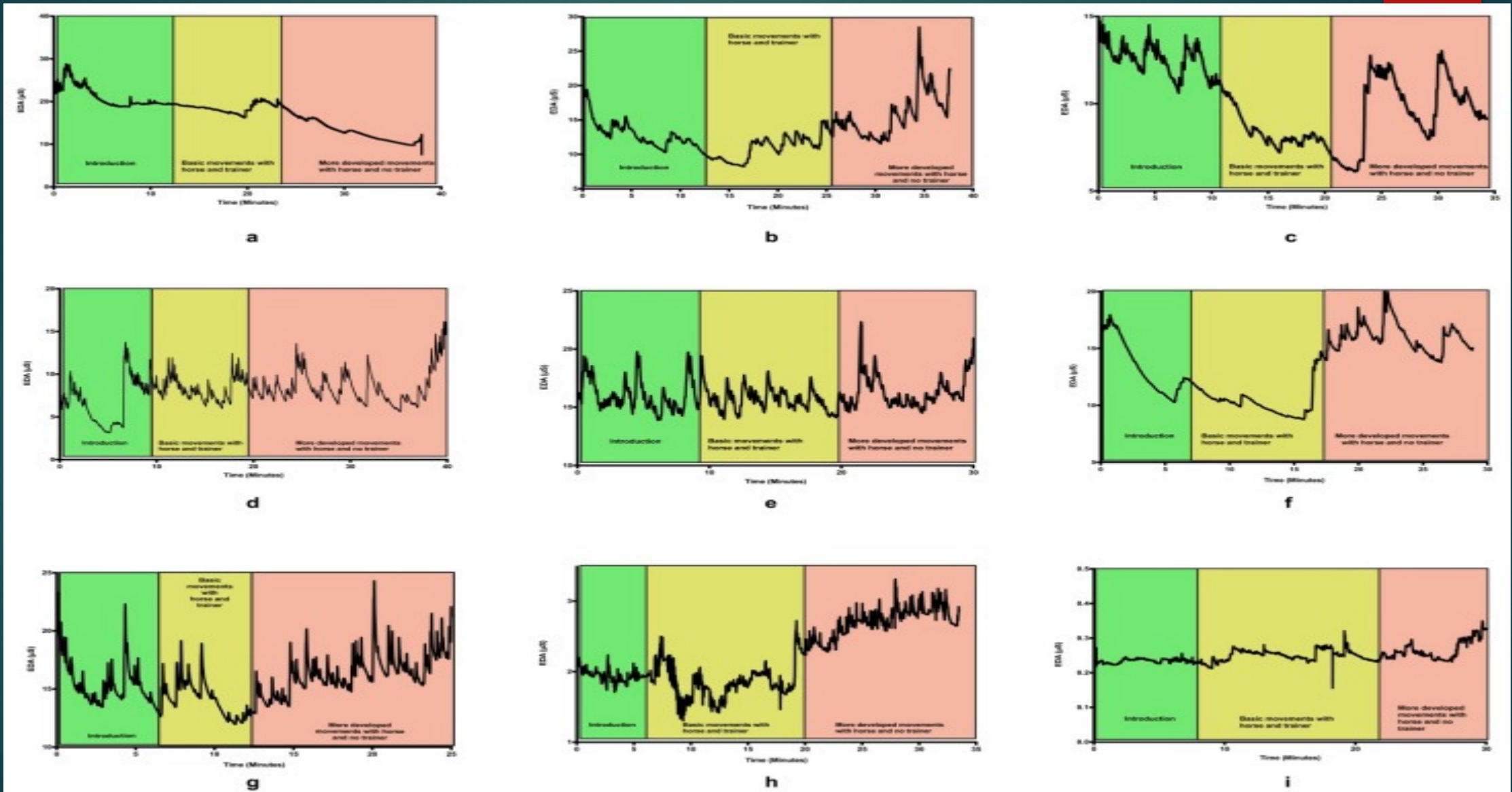


“By the end, I felt noticeably different, I had a real sense of achievement and I felt much more relaxed than usual across my body, my back, and shoulders.”

“I felt like proud and happy...no words, I need like a synonym...”

“It really feels amazing.”

Skin Conductivity Response (Hemingway et al., 2019)

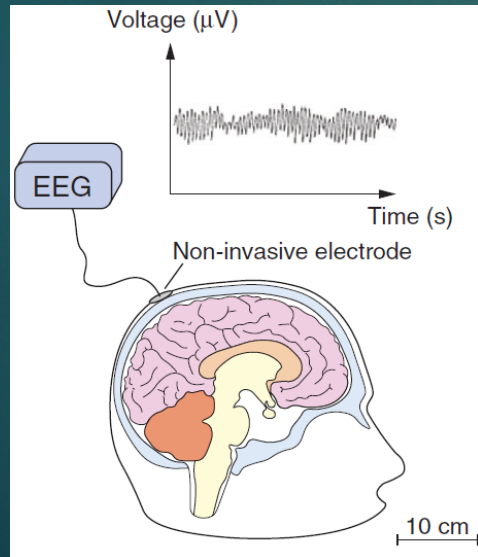
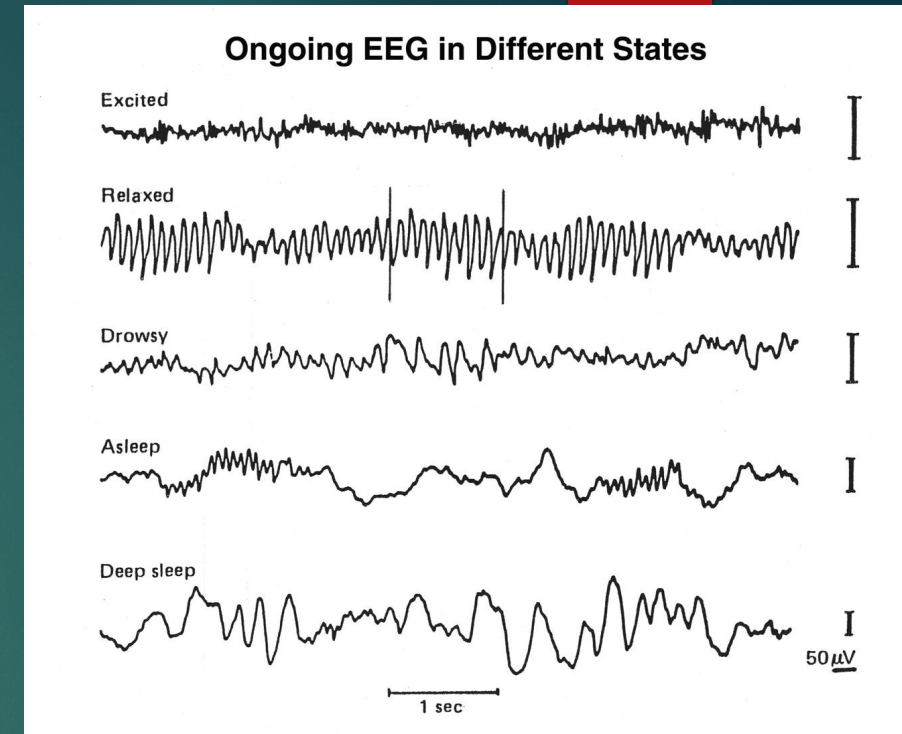


EEG – Dr Xun He

EEG (electroencephalography) is the method of recording of electrical activities from scalp surface

EEG recording = electrical changes in groups of neurons similarly oriented and behaving in time

EEG is sensitive to mental states



Behaviour ratings

Inter-rater reliability scoring video of participants (5 beginners, 5 facilitators) interacting with horse`s - neutral, ask and focus rating 0-10

Cohen's kappa to indicate reliability of ratings:

≤ 0 no agreement

0.01 – 0.20 none to slight

0.21 – 0.40 fair


0.41 – 0.60 moderate

0.61 – 0.80 substantial

0.81 – 1.00 almost perfect agreement

Results across conditions (tasks during the experiment)

- Neutral: 0.809
- Ask: 0.840
- Focus: 0.908



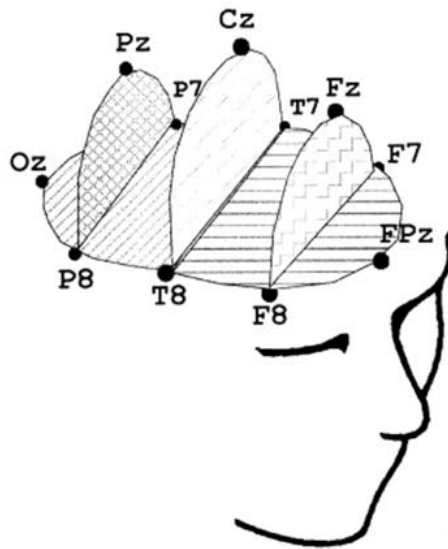
Our research found activity in the temporal gamma part of the brain in humans during interaction with a horse...

Gamma oscillations specifically control the integration between different brain regions, which is crucial for perception, movement, memory, and emotions and gamma activity has been associated in some studies with meditation

About gamma band of EEG

Gamma is the fastest-changing EEG activity

- Over 30 Hz (i.e., above 30 cycles per second)
- Quantified 40-80 Hz at P8 in the current study



Comparison of EEG Bands



Gamma: 30-100+ Hz



Beta: 12-30 Hz



Alpha: 8-12 Hz



Theta: 4-7 Hz

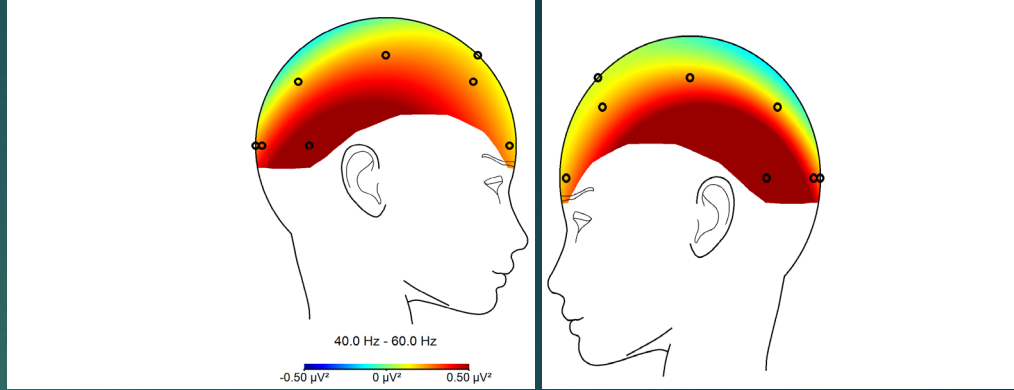


Delta: 0-4 Hz

Temporal gamma

Black = facilitators
Red = beginners

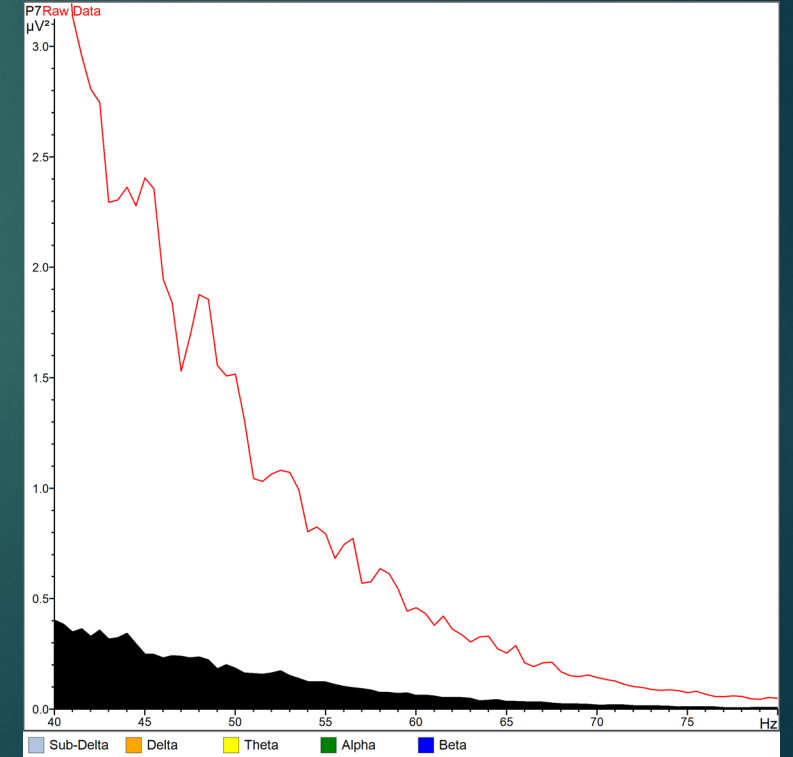
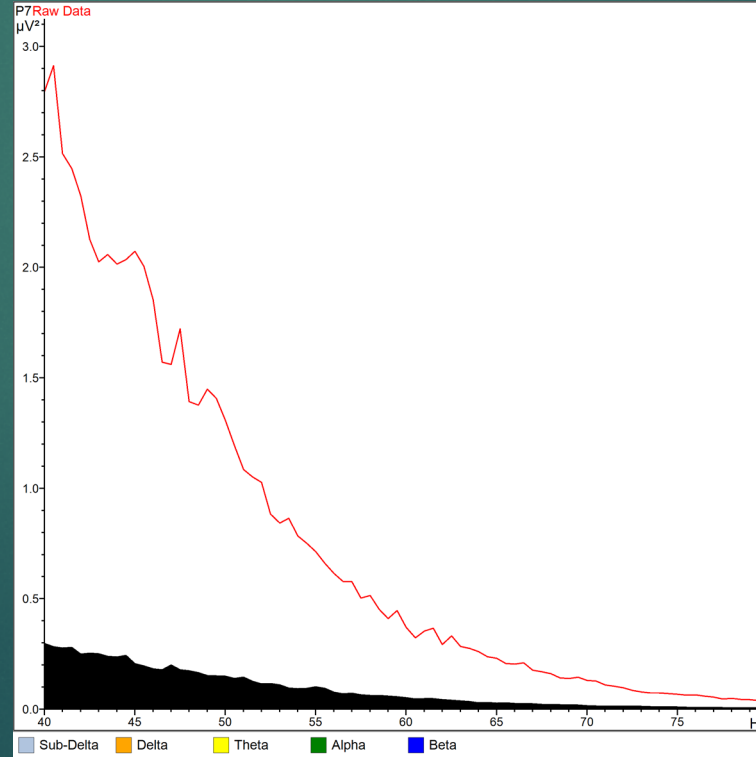
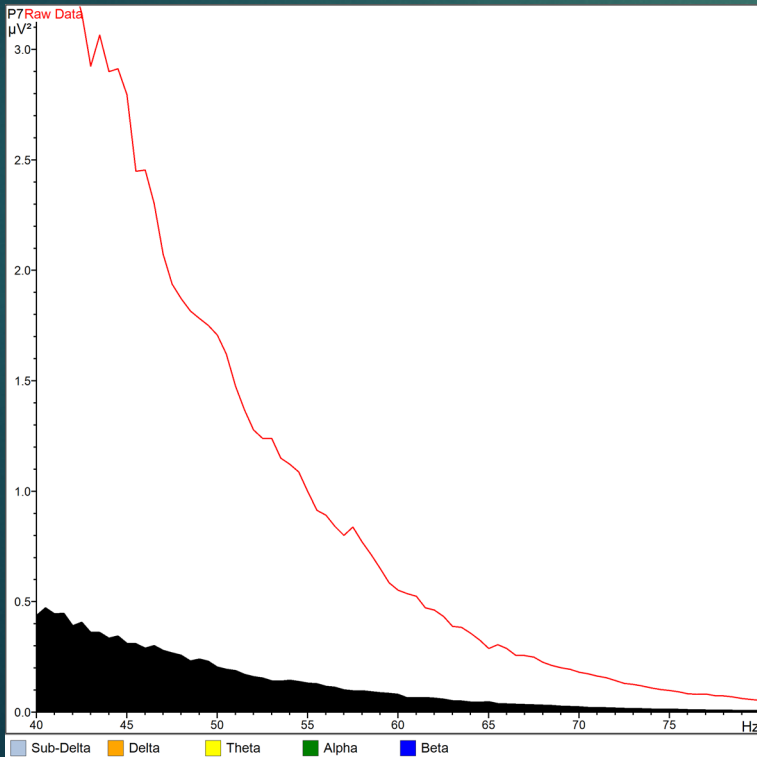
Beginners showed much stronger gamma than facilitators – may be due to general effort/emotion (multiple information integration) in beginners



Neutral

Ask

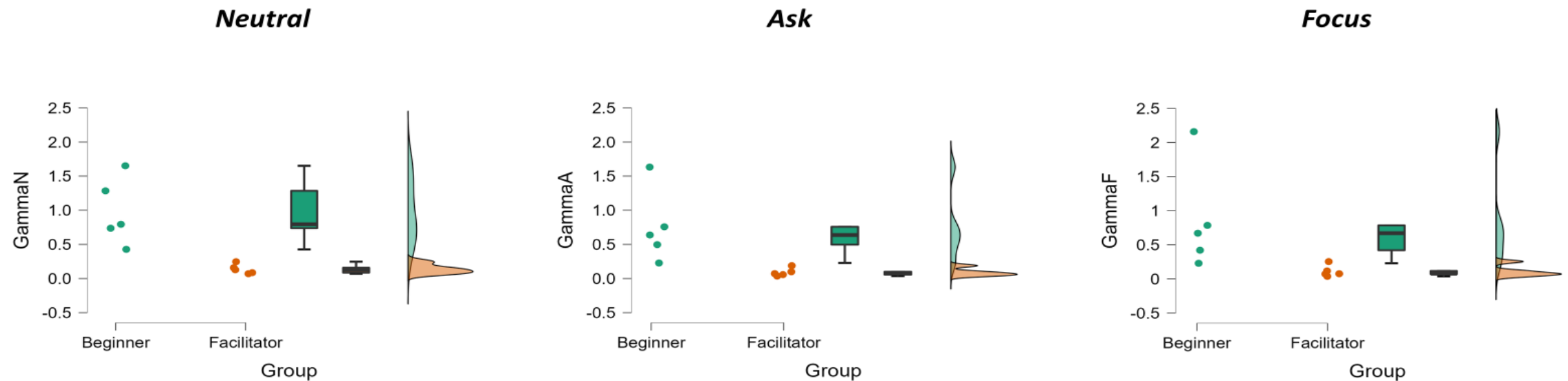
Focus



Temporal gamma

Between-group comparisons

Lower gamma voltage in facilitators than in beginners in all conditions
Note the convergence in facilitators (close to zero, “near perfection”)



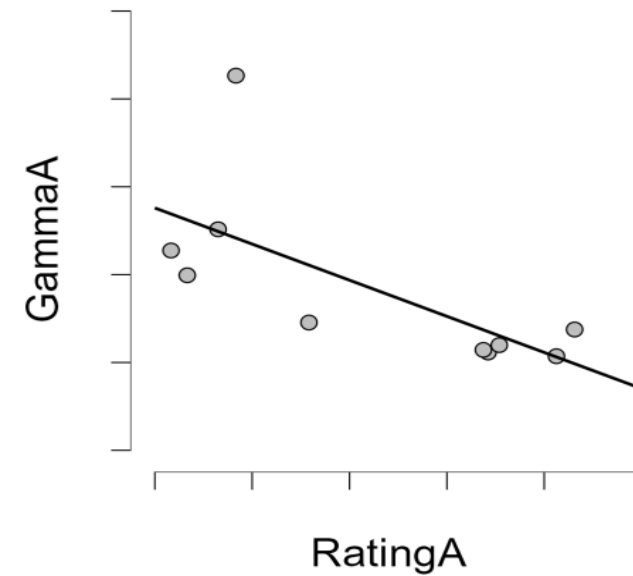
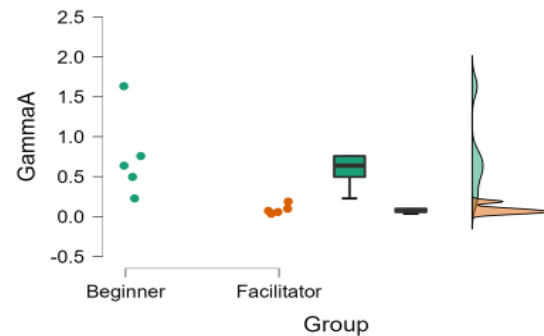
Behaviour-gamma relationship

Gamma voltage vs. Behavioural rating correlation

As the beginners learnt the gamma voltage decreased which is consistent with the between-group differences (lower gamma voltage in the facilitators demonstrating less effort in information integration)

Correlation in Ask (between-group pattern below)

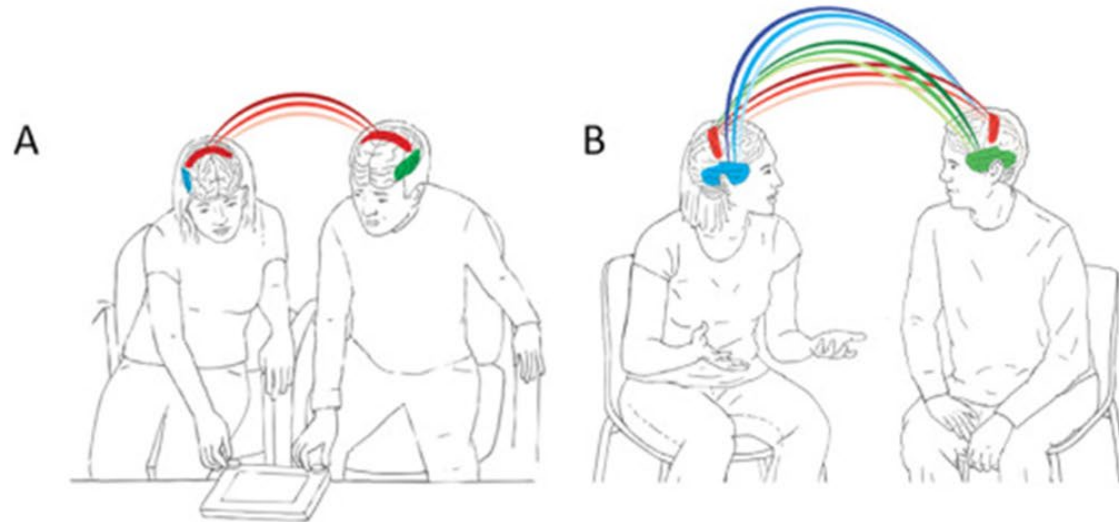
(similar trends in the other two conditions neutral and focus)



Next Steps.....

<https://eprints.bournemouth.ac.uk/39702/1/Ann%20Hemingway%20research%20outreach%20EAS%20DV.pdf>

Inter-brain synchrony in EEG





The New York Declaration on Animal Consciousness

April 2024

[https://sites.google.com/nyu.
edu/nydeclaration/declarati
on](https://sites.google.com/nyu.edu/nydeclaration/declaration)



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COCO AND TOM X