

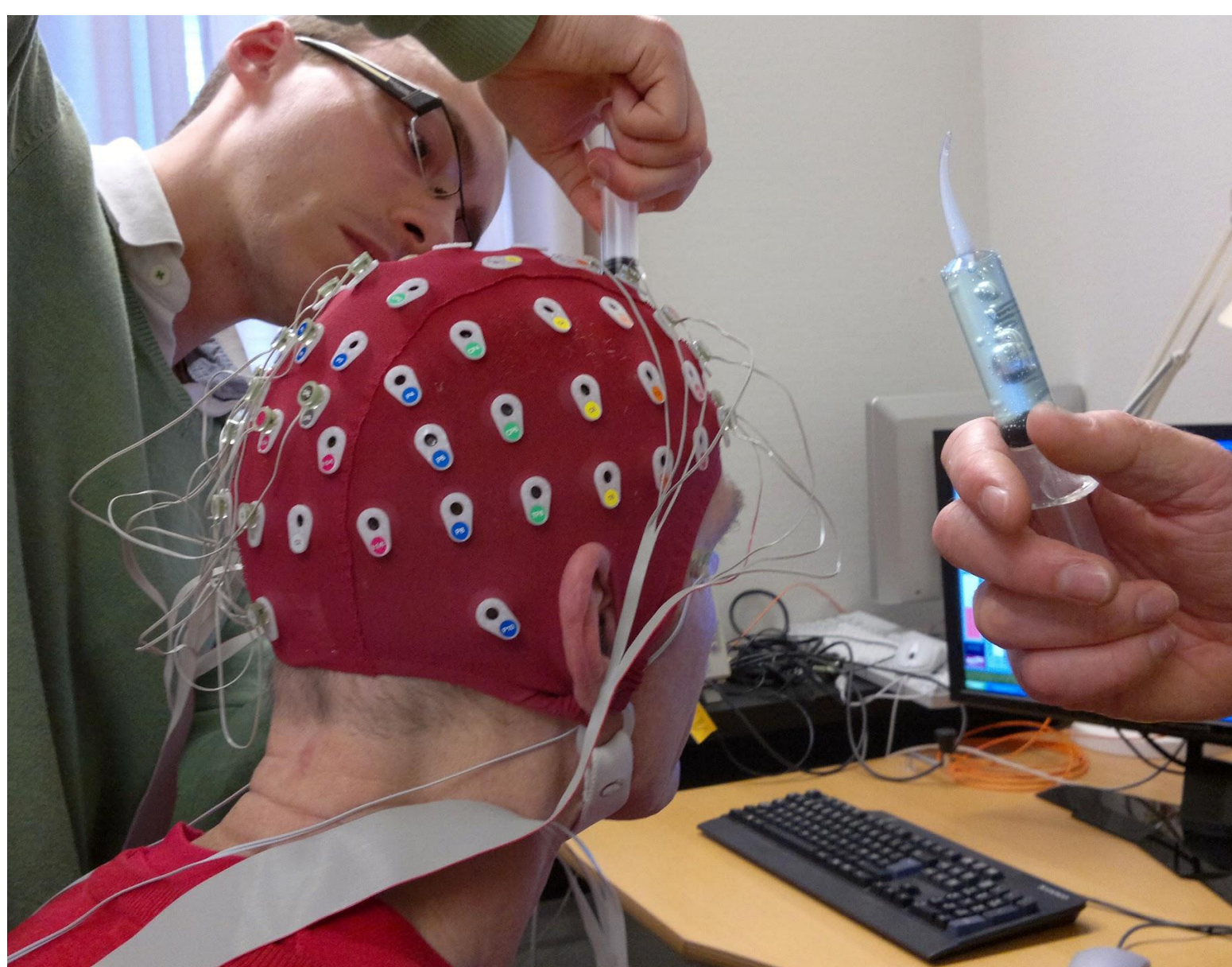
An Exploration of a Simplified EEG System in Studying Sex by Hemisphere Differences

Emily Young and Dr. Larry Cahill

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Background



Traditional EEG systems can take a long time to set up and can be uncomfortable for the participant.



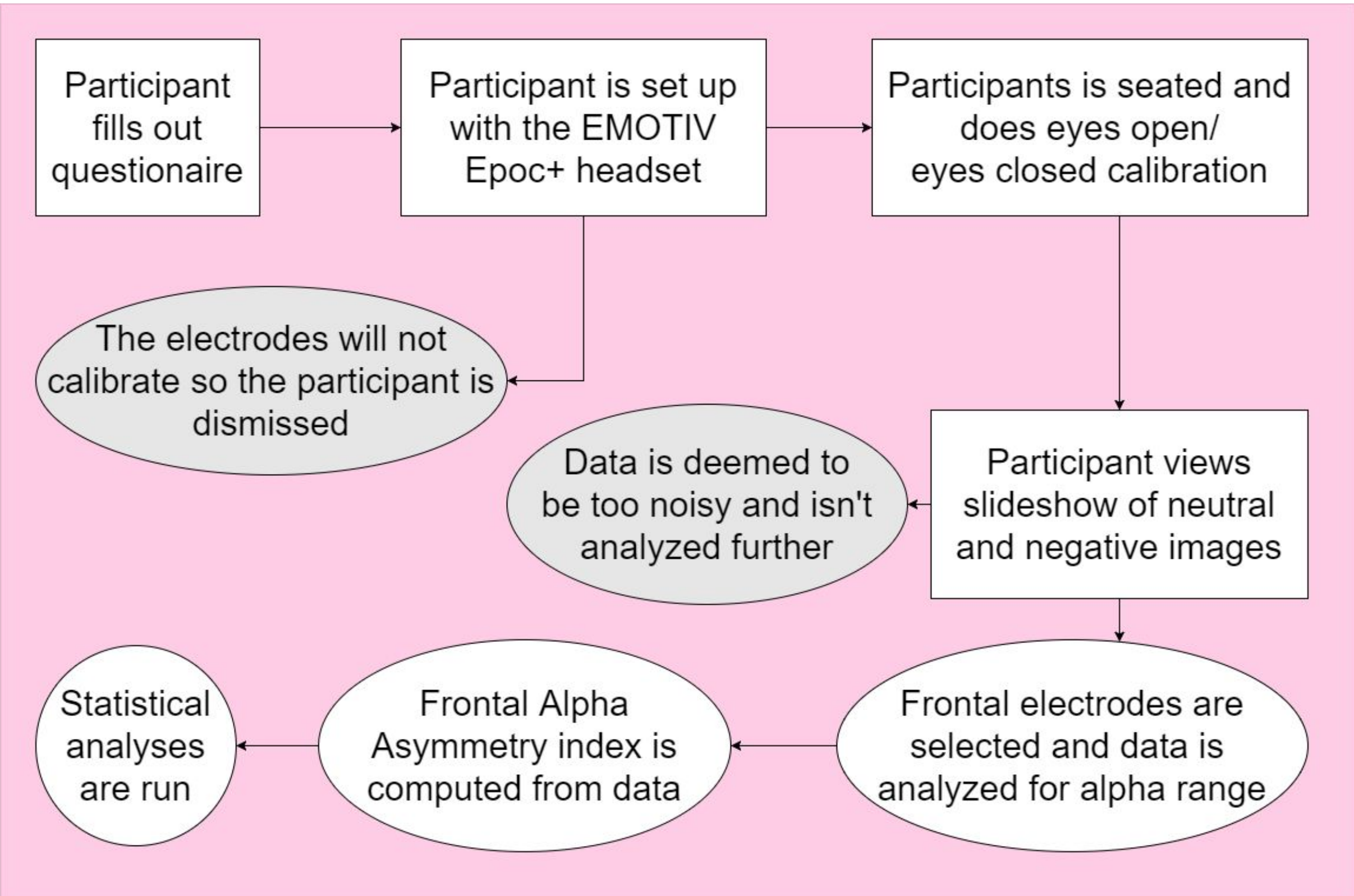
The EMOTIV Epoc+ with the frontal electrodes (AF3, F3, F7) highlighted.

- Traditional EEG systems can be very expensive and difficult to keep up-to-date. Many new systems are being developed and aimed at consumers. Can any of them be used for research?
- A more practical EEG system could allow for quickly gathering data from more people, including understudied populations.
- According to Cahill, the variables of sex and cerebral hemisphere interact in emotional experience and memory.
- Additionally, Davidson and others consistently find that depression or negative emotional reactions result in decreased alpha power (increased brain activity) in the right (relative to the left) frontal lobe in women. The opposite has been observed in men.
- The goal of this project is to explore the utility of the EMOTIV Epoc+ system. We attempt to replicate the well-established findings of sex differences in the hemisphere of increased frontal brain activity associated with negative emotional arousal.

References

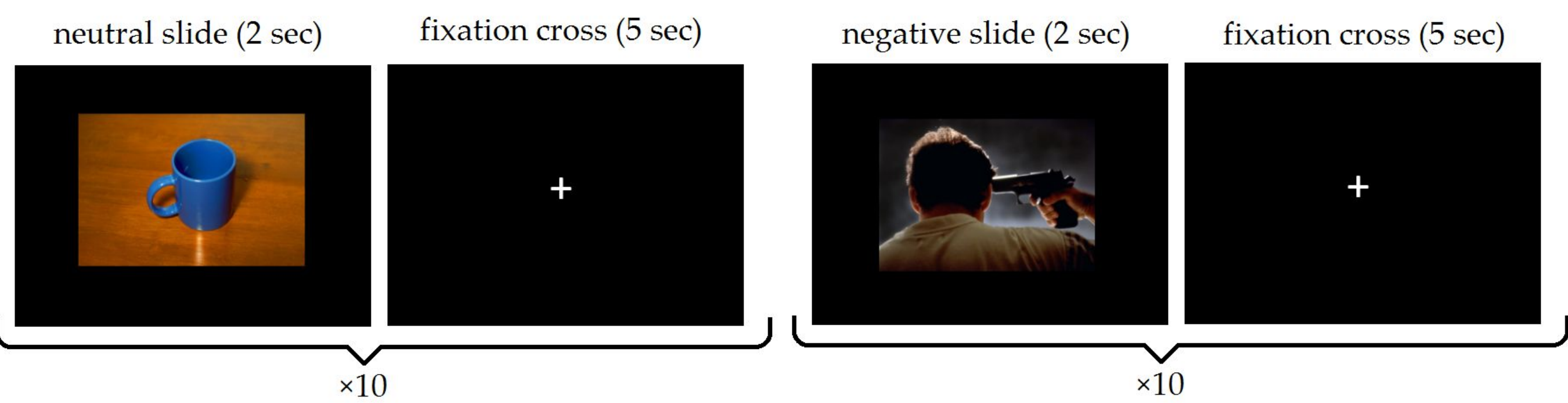
Davidson, R. J. et al. Approach-withdrawal and cerebral asymmetry: Emotional expression and brain physiology. *Journal of Personality and Social Psychology*. (1990) 58: 330-341.
 Cahill, L., et al. Sex-Related Hemispheric Lateralization of Amygdala Function in Emotionally-Influenced Memory: An fMRI Investigation. *Learning and Memory*. (2004) 11: 261-266.

Methods



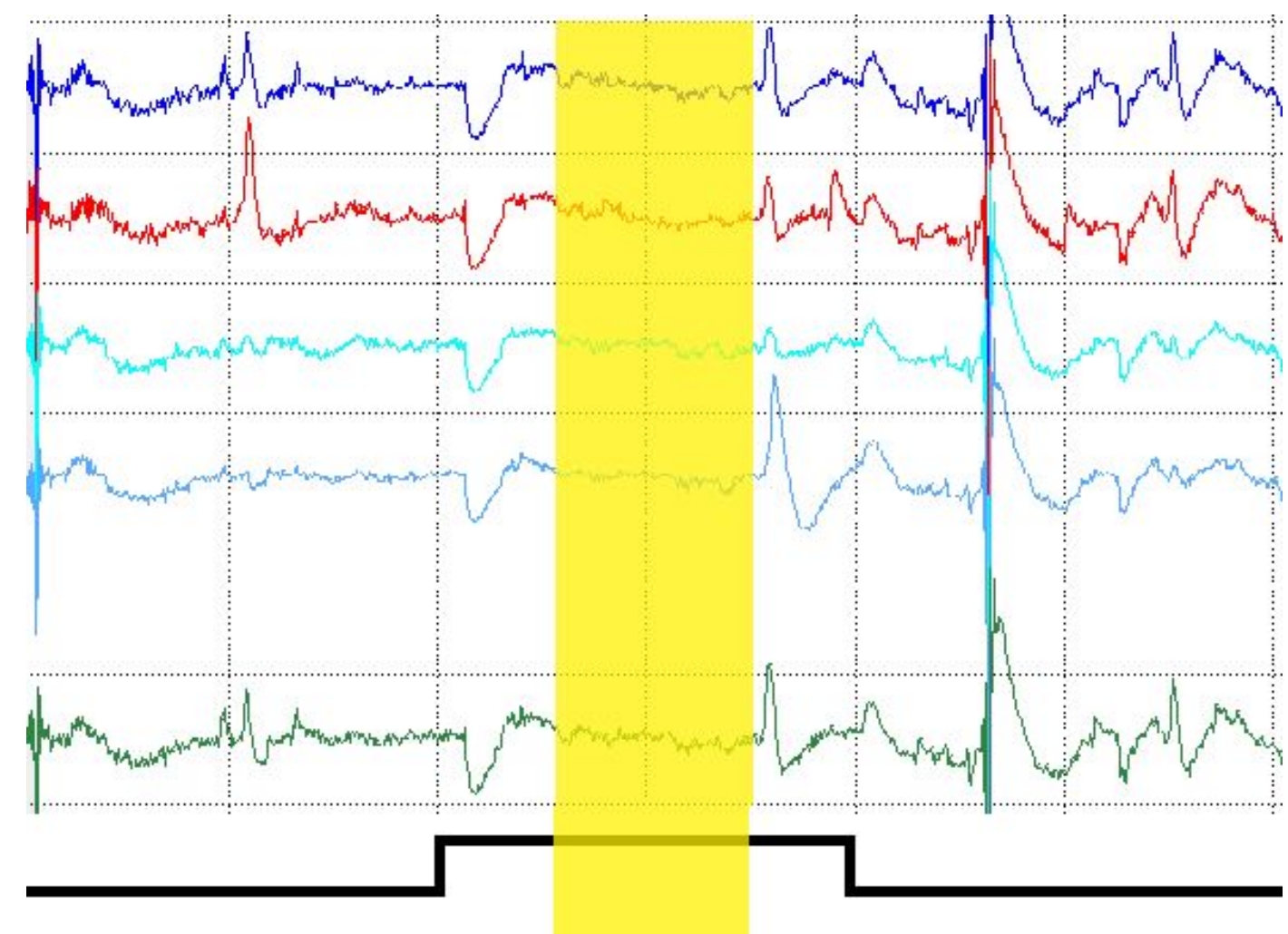
Procedure to gather and analyze data

- Usable data was collected from 19 participants: 14 female and 5 male. Some participants could not be used due to calibration issues or too much noise.
- Slides were neutral and negative images from the International Affective Picture System (IAPS), shown for 2 seconds each with a 5 second fixation cross between images. 10 neutral slides were shown followed by 10 negative slides.



Slideshow shown to participants

- EEGLab was used to analyze the middle one second of EEG data from the 2 seconds collected per image. A toolbox was used to get the Frontal Alpha Asymmetry (FAA) index for the AF3-AF4, F3-F4, and F7-F8 electrodes for each slide for each subject.
- A difference score for each subject was determined by subtracting the average of their FAAs in response to negative slides from the average of their FAAs in response to neutral slides.



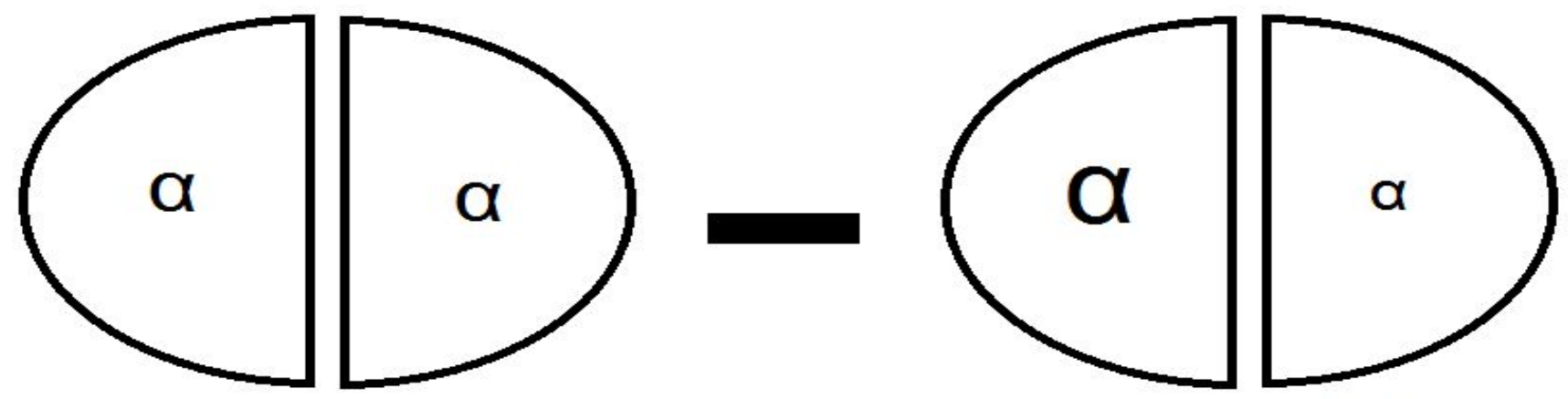
The line indicates stimulus duration (2 seconds) and yellow indicates the middle second of data analyzed.

	mean	std. dev.
females	0.0077	0.3193
males	-0.3305	0.4566

Average difference between FAA for neutral slides and FAA for negative slides (negative denotes greater left activation)

Results

- A paired t-test comparing the average FAA of neutral and negative slides revealed no significant difference in activation when considering all subjects ($p=.36$), and also no difference when considering only females or only males.
- A 2 sample t-test comparing the difference scores of males and females had a $p=.086$ despite the very low statistical power (14 females and 5 males).



Average alpha asymmetry of neutral slides minus average alpha asymmetry of negative slides. The result is the difference between the neutral and negative conditions.

Conclusions

- We need more participants (especially males) to increase our statistical power, but even with 19 people we were able to observe $p = .086$.
- Further investigation into the details of these possible sex differences and their significance is needed.
- The EMOTIV system is simpler to use than traditional EEG in many ways, but it has a high learning curve due to poor documentation of the system.