A Appendix

This appendix contains the following sections:

In appendix A.1, we provide additional information on the subjects used in the fMRI data collection.

In appendix A.2, we visualize the effect of the accuracy threshold on the number of voxels we can brain-tune on.

In appendix A.3, we display the changes in brain alignment for all subjects.

In appendix A.4, we expand on the CMU MOSEI evaluation results across all emotions.

In appendix A.5, we show the STS region mask.

In appendix A.6, we discuss the potential broader impacts of our work.

In appendix A.7, we provide information on how to access our code and relevant data.

In appendix A.8, we include all licensing information.

A.1 Participants

Six healthy participants (aged 31 to 47 years at the time of recruitment in 2018), three women (sub-03, sub-04, and sub-06) and three men (sub-01, sub-02, and sub-05) were recruited to participate in the Courtois Neuromod Project for at least 5 years. All subjects provided informed consent to participate in this study, which was approved by the ethics review board of the "CIUSS du centre-sud- de- l'île-de- Montréal" (under number CER VN 18-19-22). Three of the participants reported being native franco- phone speakers (sub- 01, sub-02, and sub-04), one as being a native anglophone (sub-06), and two as bilingual native speakers (sub-03 and sub-05). All participants reported the right hand as being their dominant hand and reported being in good general health. Exclusion criteria included visual or auditory impairments that would prevent participants from seeing and/or hearing stimuli in the scanner and major psychiatric or neurological problems. Standard exclusion criteria for MRI and MEG were also applied. Lastly, given that all stimuli and instructions are presented in English, all participants had to report having an advanced comprehension of the English language for inclusion. The above boilerplate text is taken from the cNeuroMod documentation [7], with the express intention that users should copy and paste this text into their manuscripts unchanged. It was released by the Courtois NeuroMod team under the CC0 license. For more details regarding fMRI acquisition, stimuli presentation

A.2 Cross Subject Prediction Accuracy Calculation

We follow recent studies [31], [14] in adapting [34]'s method to estimate cross-subject prediction accuracy for each voxel. For each subject, we generate all possible subsets of the remaining 5 subjects, and for each subset we use a voxel-wise encoding model (see Sec. 5) to predict one participant's response from the others. As in previous studies [14, 31], the final value is calculated as an average at the group level. These cross-subject encoding models are trained using nine episodes (7700 TRs) from the first season of Friends, and tested on three other episodes from the same season (2872 TRs). In fig. 4, we display the number of viable voxels based on the cross subject prediction accuracy threshold. We observe that Subject-05 has no remaining voxels above 0.25, and thus deem this as our cut-off.

A.3 Differences in Normalized Brain Alignment For all Subjects

In fig. 5, we display the differences in normalized brain alignment for all subjects. Most subject models show improved alignment in and around the STS, but these improvements do not consistently extend to other regions.

A.4 CSU MOSEI Complete Emotion

In fig. 6, we breakdown the performance of the model across each emotion aggregated in the CMU MOSEI evaluation (See fig. 3, rightmost chart). Notably, sadness is the only emotion with significantly improved F1 score - however, we also observe decreased accuracy (A2). Although sadness occurs in

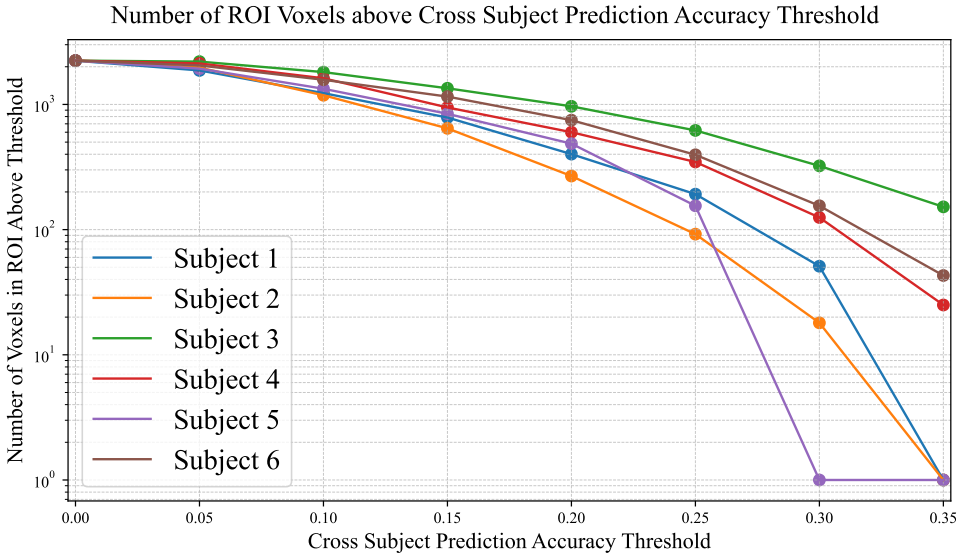

Figure 4: A subject (Subject 5) has no voxels in the STS above a cross subject prediction accuracy threshold of 0.25, and thus we cannot perform brain-tuning.

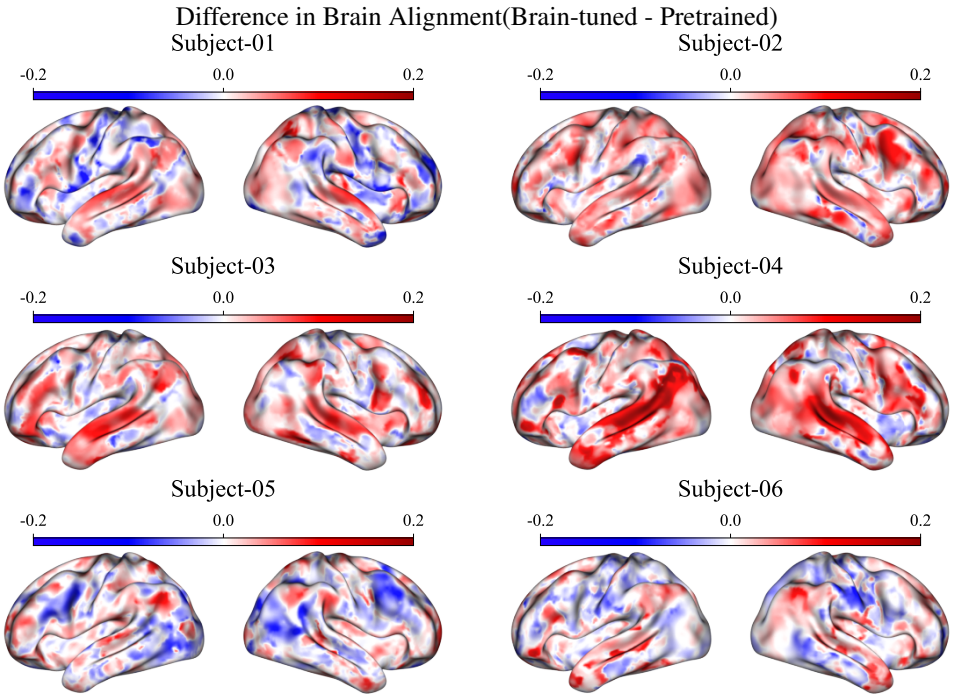

Figure 5: Differences in Normalized Brain Alignment before and after brain-tuning.

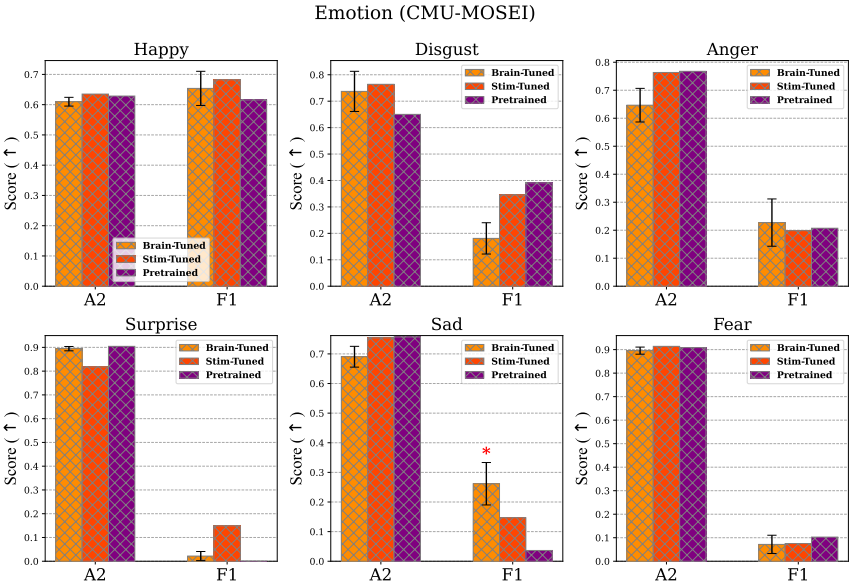

Figure 6: A breakdown of the performance of the model across each emotion aggregated in the CSU MOSEI evaluation (See fig. 3, rightmost chart).

Friends, it is it not the dominant emotion in the show [33]. In future work, we hope to investigate this finding further for an explanation.

A.5 Visualization STS Region

We display the voxel mask of the STS region which we tune our model to in fig. 7.

A.6 Broader Impacts

Our work can be an initial step towards creating AI models with better understanding of human social cognition using brain activity as a tuning target. This could have positive impacts, such as improving AI-human communication or potential uses in AI-assisted therapy. Further, an AI model which can replicate human social cognition may be a useful in-silico model helping us understand social cognition in humans. On the other hand, this could enhance the abilities of AI for human manipulation. We urge future researchers to consider these pros and cons as they continue investigating this topic.

A.7 Data and Code Availability

The fMRI data used to perform the brain tuning are openly available through registered access at link `https://www.cneuromod.ca/access/access/`.

To get our code, and for exact instructions on how to replicate or results, please visit `https://huggingface.co/AnonymousSubmission43/mmbt`, download and unzip all files, and follow the instructions on the README.md in mmbt-anon.

Due to privacy concerns, we do not release model weights or cross subject prediction accuracies, as these are derived from subjects' brain data.

A.8 Licenses

Method Diagram: Our method diagram in fig. 1 includes an audio sound wave, licensed under the public domain. You can find the url here: `https://www.pngfind.com/maxpin/bwRwR/`

Models:

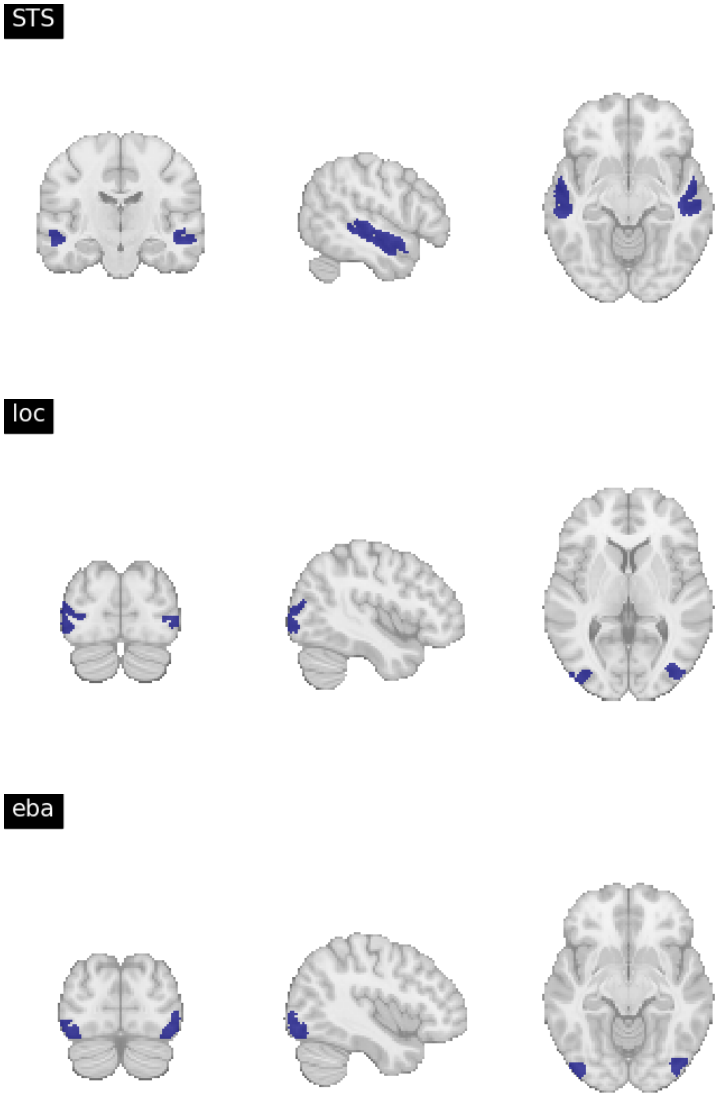

Figure 7: The STS, LOC, and EBA regions from coronal (left), lateral (middle), and horizontal (right) views.

- TVLT: MIT https://github.com/zinengtang/TVLT/blob/main/LICENSE

Packages:

- nilearn: BSD https://github.com/nilearn/nilearn/blob/main/LICENSE
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Datasets:

- CMU-MOSEI: MIT https://github.com/CMU-MultiComp-Lab/CMU-MultimodalSDK?tab=MIT-1-ov-file
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Justification: The study did not itself collect any data from human subjects, but uses the cneuromod 2022-alpha release of the Friends dataset. All subjects provided informed consent to participate in the cneuromod data release, which was approved by the ethics review board of the "CIUSS du centre-sud-de-l'île-de-Montréal" (under number CER VN 18-19-22). For more details, see the cneuromod documentation: `https://docs.cneuromod.ca/en/latest/DATASETS.html#friends`

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