Long Short-Term Memory Network Predicting Negative Affect using Bilateral Amygdala Activation during Naturalistic Viewing

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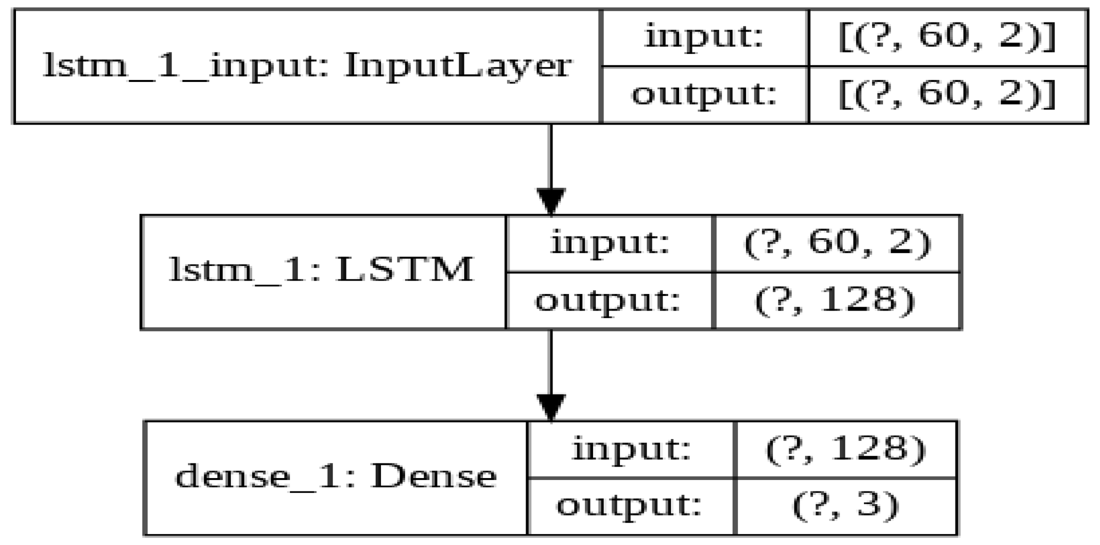
LSAN

INTRODUCTION

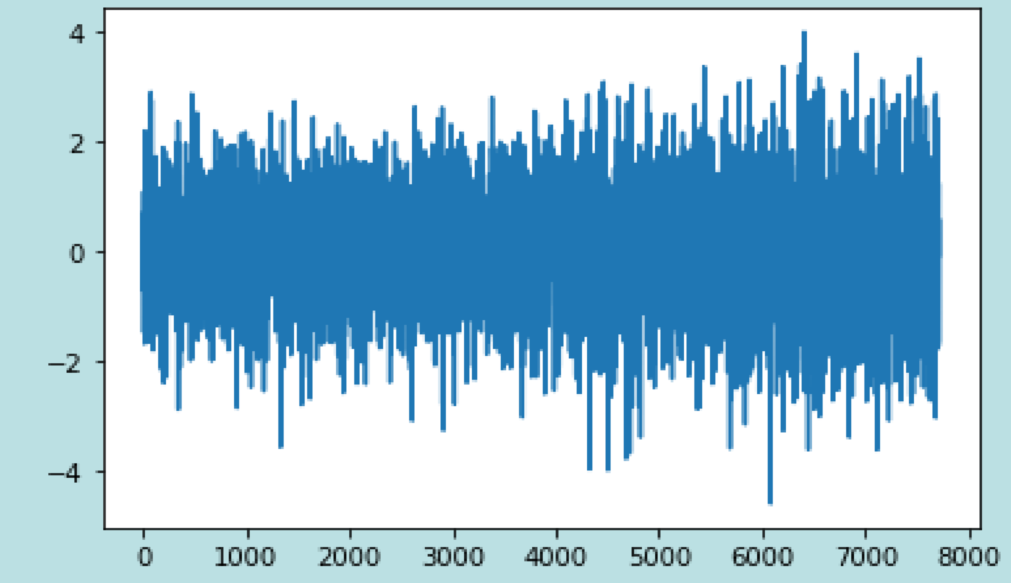
- The Amygdala is brain region important for emotion perception. [1]
- Prior research on emotion perception:
  - Often uses static pictures of actors displaying different emotions [1]
  - Has begun to use naturalistic viewing or movie watching to better capture how people perceive emotion in their every day lives [2]
  - However, this data is often then analyzed as individual moments in time rather than as a timeseries [1]
- We used a LSTM network to investigate emotion perception during naturalistic viewing.
  1. The LSTM network will be able to predict participants' level of negative affect

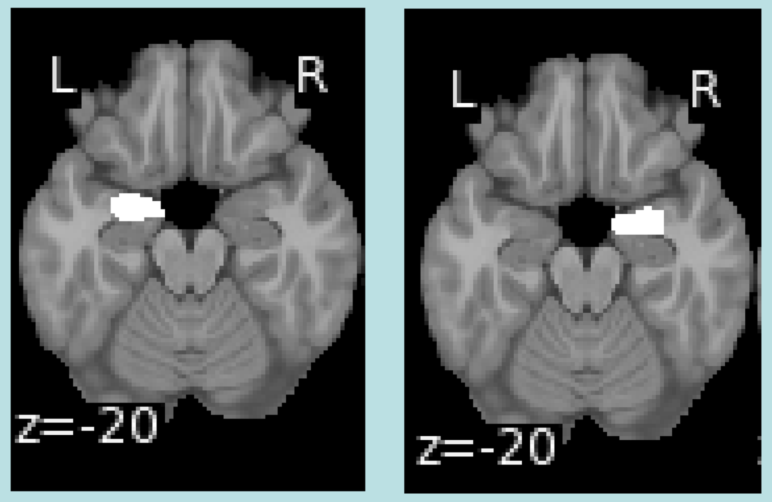
METHODS

- Participants (n=86; 44 males) watched one of 10 full length movies.
- Amygdala response was captured via functional magnetic resonance imaging (fMRI).
- Participants also completed the negative affect rating scale which measured sensitivity to anger, fear, and sadness.



Timeseries Amygdala Activation

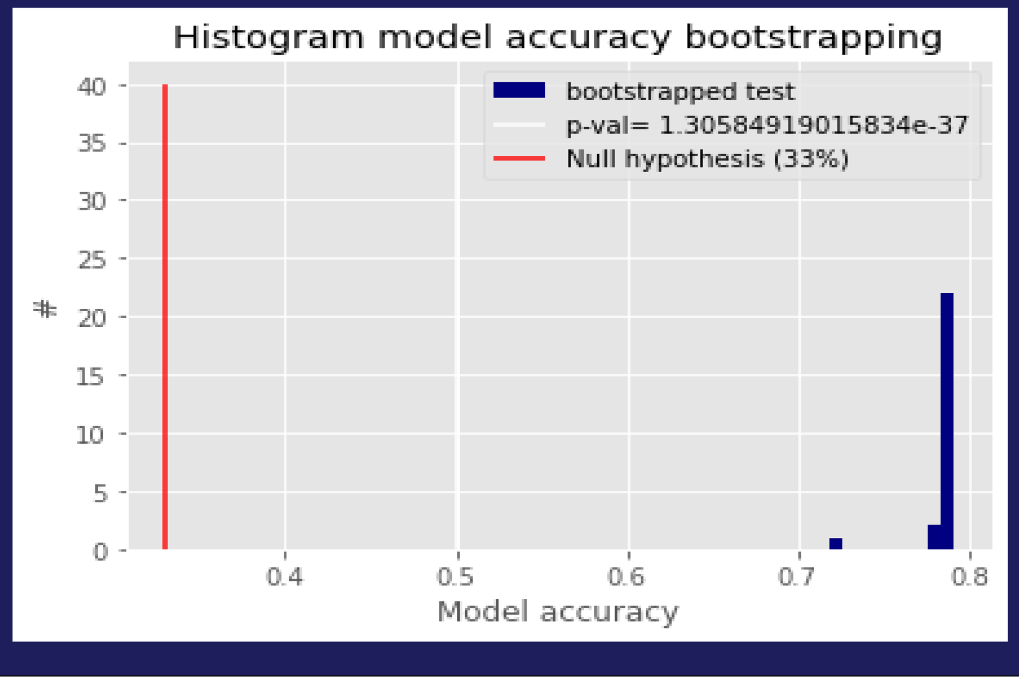




- Mean left and right amygdala activation was calculated for every second of the timeseries (movie). Final values were normalized.
- There were 7826 total timeseries, each timeseries 60 seconds in length, with 2 values, one for left, and one for right amygdala response.

LSTM Network

- The LSTM network took an input of size 7826 * 60 * 2. To prevent overfitting and retain only the most predictive features a dropout rate of .2 was used on the inputs. [3]
- The LSTM had an output space of 128 units. An additional recurrent dropout rate of .15 was applied to the outputs of the LSTM network. [3]
- A dense layer was used to capture the output from the LSTM
- Predictions were made for each timeseries resulting in an output of size 7826 * 3. These ratings quantified the probability that a timeseries belonged to each of the three negative affect groups (low, medium, high).



RESULTS

- Results from a bootstrapped resampling of testing and training data that calculated model accuracy with 25 replications suggested that the model performed above chance.

CONCLUSIONS

- We were able to predict participants' sensitivity to negative affect based on 60 seconds of bilateral amygdala activation during a movie.
- These results support prior research that the amygdala is a key region in emotion perception and varies in its sensitivity to negative affect (fear, anger, sadness) across individuals
- We also highlight the importance of the LSTM network and its ability to leverage the dynamic nature of fMRI naturalistic viewing data.
- Future research should include other brain regions as inputs to the model and investigate the impact of different actors in a movie displaying the same emotion

REFERENCES

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[2] Aliko, S., Huang, J., Gheorghiu, F., Meliss, S., & Skipper, J. I. (2020). A naturalistic neuroimaging database for understanding the brain using ecological stimuli. Scientific Data, 7(1), 347.

[3] Gal, Y., & Ghahramani, Z. (2016). A theoretically grounded application of dropout in recurrent neural networks. Advances in neural information processing systems, 29, 1019-1027.