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Real-time decoding of mood from human large-scale ECoG activity

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I. Motivation

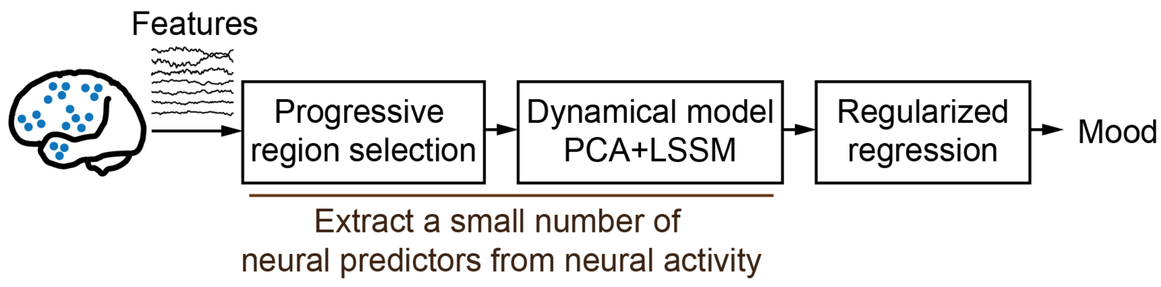
- Decoding mood from neural activity:
  - Can enable personalized treatment of mood disorders such as depression and anxiety
  - Can help us understand the neural processes underlying mood regulation
- Decoding an individual's mood from neural activity has not been demonstrated.
- Prior studies:
  - Have used fMRI which would not be practical for closed-loop stimulation therapy
  - Have only found brain regions related to mood across human populations, but have not decoded an individual's mood over time
- Our goal:
  - Identify mood-predictive networks in individuals
  - Decode mood variations over time in individuals

II. Methods

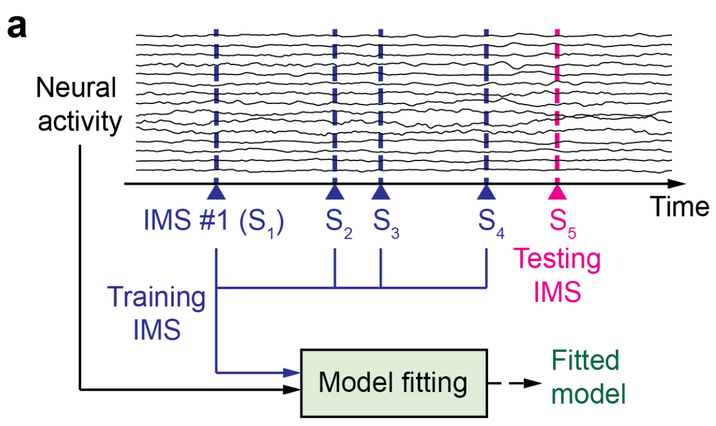
1. Datasets

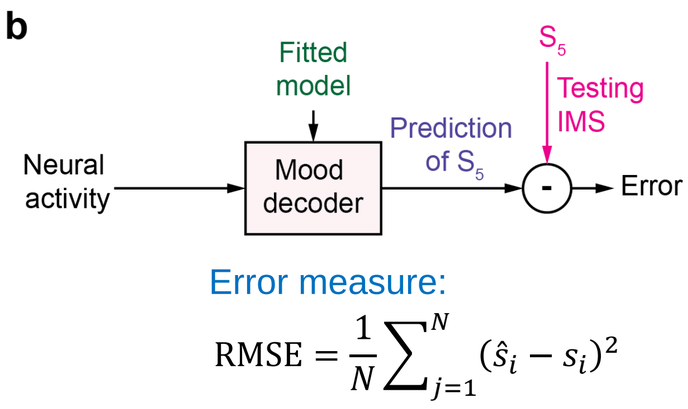
- Multi-day intracranial recordings from 6 epilepsy patients (Chang Lab at UCSF).
- Self-reports of mood via Immediate Mood Scaler (IMS) questionnaire

2. Modelling framework



- Evaluate with leave-one-out cross-validation





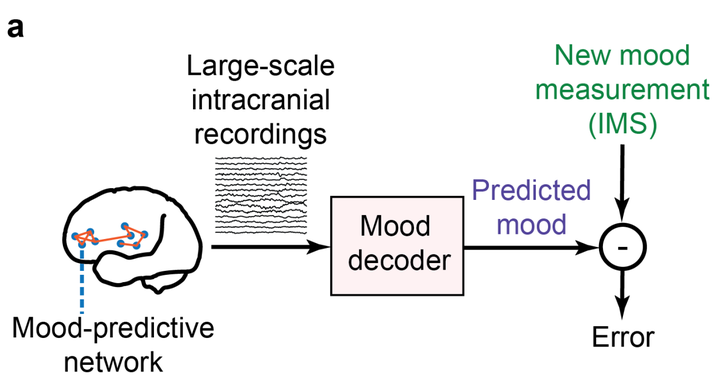
Error measure:

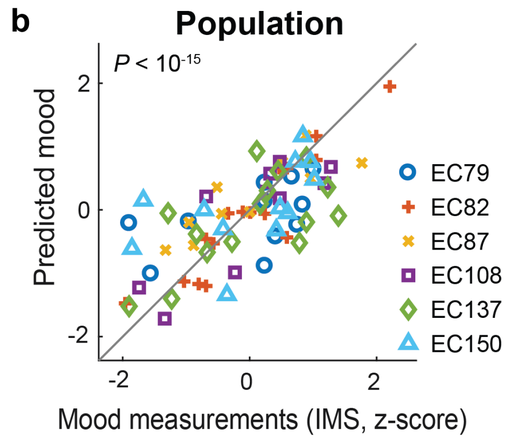
$$\mathrm{RMSE} = \frac{1}{N}\sum_{j=1}^{N}(\hat{s}_i - s_i)^2$$

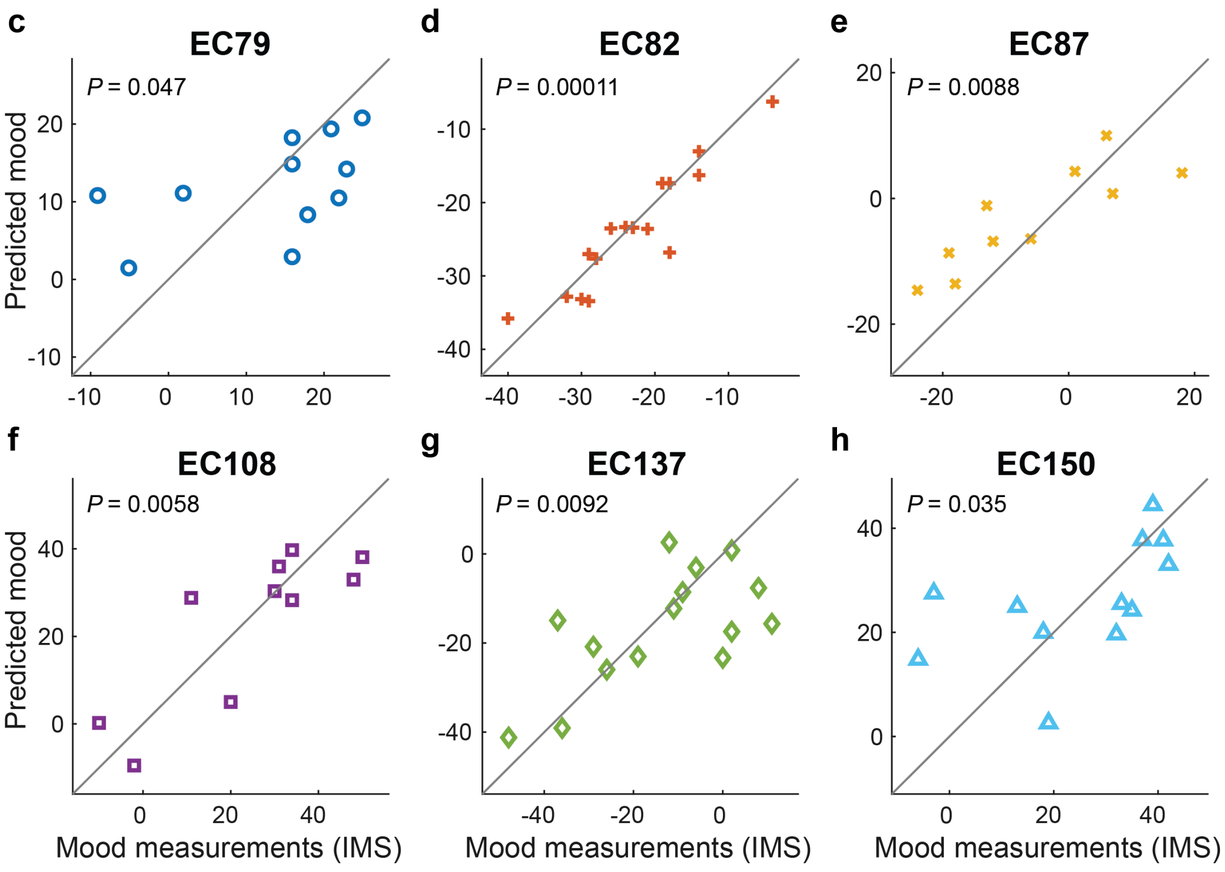
- Repeat same modeling for randomly generated mood to assess significance

III. Results

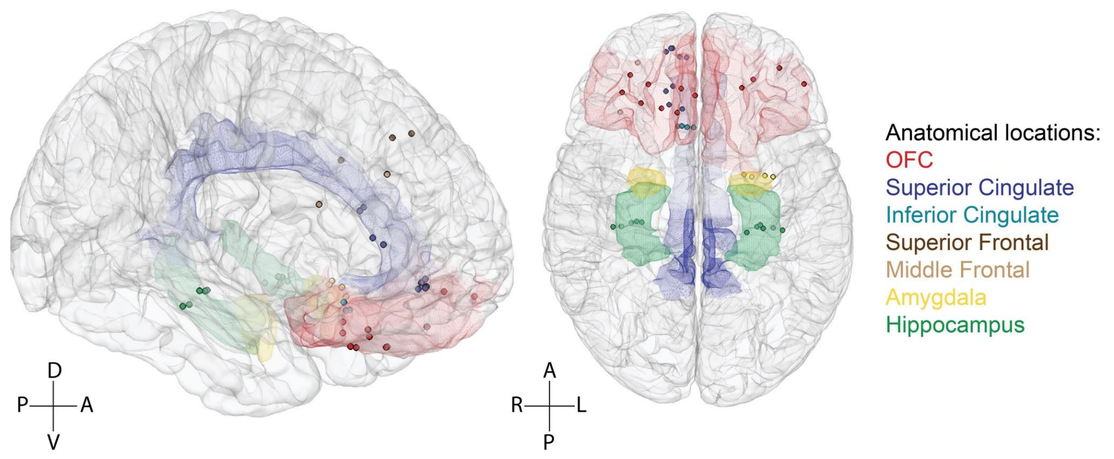
1. Mood could be decoded in all individuals



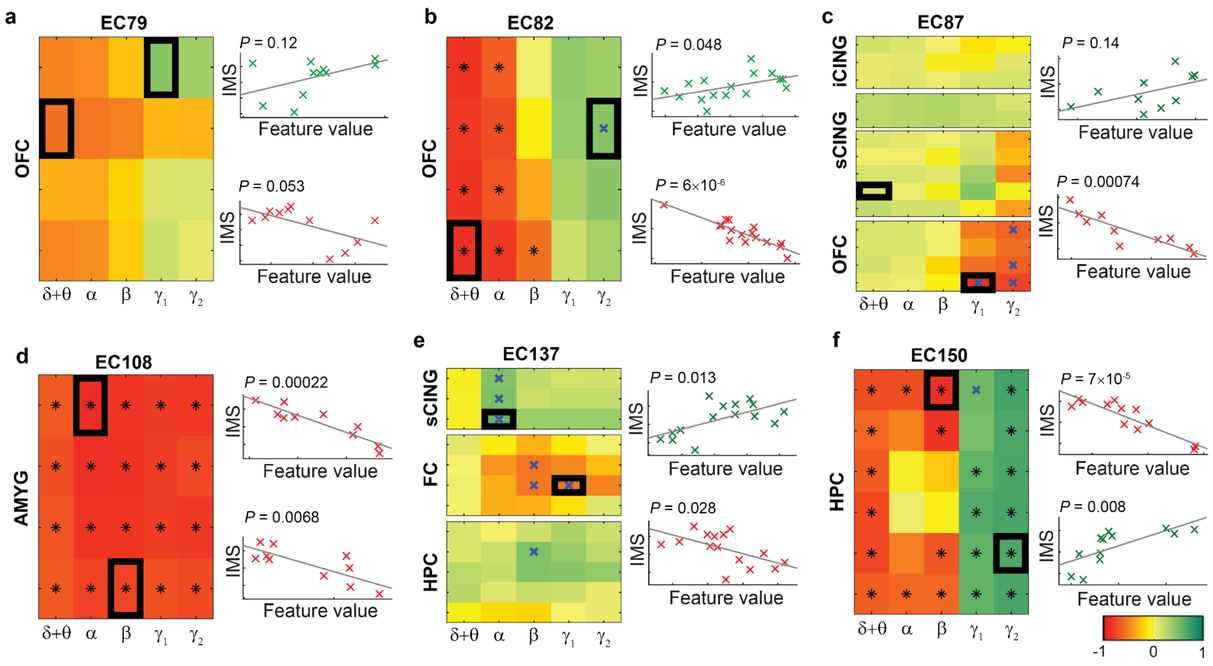




2. Identified mood-predictive networks were largely in the limbic system



3. Spectro-spatial neural features were tuned to mood variations over time



IV. Conclusions

- Demonstrated for the first time that mood variations can be decoded from human intracranial neural recordings
- Identified mood-predictive neural features were distributed largely in the limbic system
- Spectro-spatial features in identified networks were tuned to mood variations
- These results demonstrate the feasibility of real-time, chronic mood decoding

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