Ambulatory Physiological State Dynamics Predict Proximal Behavioral Markers of Depression in Everyday Life

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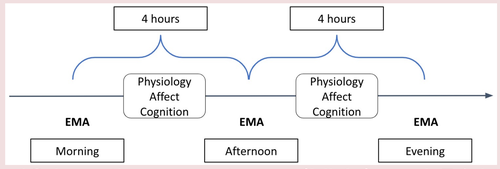
BACKGROUND

- Major depressive disorder (MDD) is prevalent yet treatment is sometimes ineffective.
- Affect and affect regulation are central to MDD etiology, and physiological markers of affect dysregulation have been proposed, such as diminished complexity of cardiac signals.
- However, conventional cross-sectional measures cannot capture the dynamics of affective, cognitive and physiological processes.
- Active and passive ambulatory measurements offer unique opportunities to examine affect and affect regulation *in situ*, *in vivo*, and *across contexts*.
- Multivariate patterns of physiological indicators (i.e., physiological states) could be predictive of affect dysregulation and thus inform just-in-time adaptive interventions.

METHODS



- **Participants**: 42 healthy volunteers (HVs) and 51 individuals with remitted MDD (rMDD). Mean age = 25.4 years.
- **Measures**: 7-day ecological momentary assessments and ambulatory recording of heart rate, respiration and activity.
- **Idiographic state extraction**: Hidden Markov Models applied to physiological time-series person by person.
- **Theory-based state alignment**: Matched states to templates specified based on prior literature.
- **Quantifying dynamics**: *frequency*, *dwell time*, and *transitions.*
- **Multilevel prediction**: generalized linear mixed-effects models + hurdle models (adaptive strategies).

Heart rate
HR variability
HR unpredictability
HR self-similarity

Breathing rate
Tidal volume

3-axis displacement

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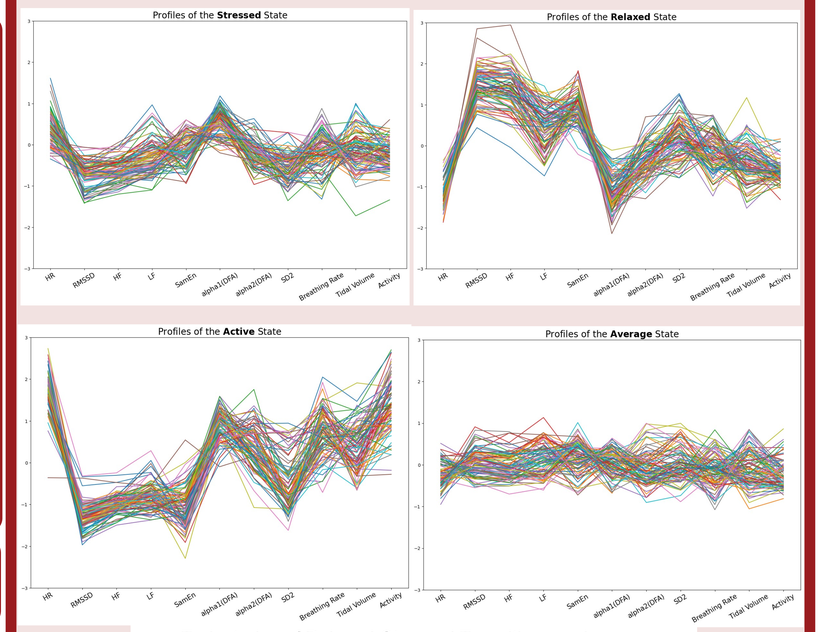
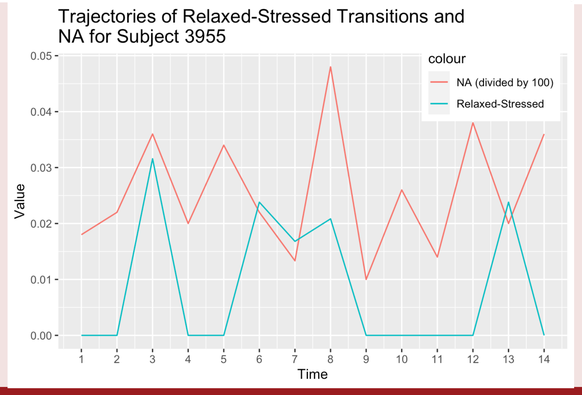
Negative affect
Positive affect

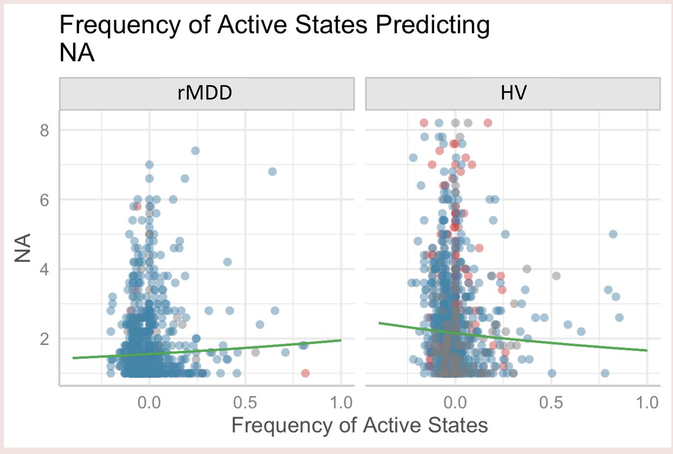
Brooding
Mind-wandering
Reappraisal
Acceptance
Distraction
Regulation success

Impulsivity

FIGURES







RESULTS

- Four physiological states: stressed, relaxed, active, and average.
- **Negative affect (NA)**
  - Relaxed-to-stressed transitions predicted elevated NA.
- **Brooding & Mind-wandering**
  - Entering active states predicted lower brooding, while leaving active states predicted increased brooding.
  - Leaving stressed states predicted lower brooding.
  - Entering stressed states predicted lower mind-wandering.
- **Impulsivity**: Effects observed among HVs only.
- **Depression history moderated affect-physiology associations.**
  - Active: mostly favorable among HVs, less consistent effects among individuals with rMDD.

CONCLUSION

- Discretizing physiological recordings into multivariate states revealed higher-dimensional associations with psychological outcomes.
- Temporal dynamics of ambulatory physiological states tracked natural fluctuations in affect, affect regulation and impulsivity.
- Stress physiology and activity may have different psychological implications for individuals with and without depression history.
- Findings may inform the input (*what*), timing (*when*), and modality (*how*) of just-in-time adaptive interventions.

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