

NEUROANATOMICAL MARKERS OF SENSITIVITY TO SOCIAL ISOLATION: AMYGDALA SUBSTRUCTURE IN ADOLESCENTS

Do individual differences in amygdala subregion volumes predict psychological responses to acute social isolation in adolescent humans?

AUTHORS

Emily Towner^{1,2}, Livia Tomova³, Kirsten Thomas¹, Linn Norbom⁴, Christian Tamnes⁴, Sarah-Jayne Blakemore¹

AFFILIATIONS

- 1 – University of Cambridge
2 – California Institute of Technology
3 – Cardiff University
4 – University of Oslo

01 BACKGROUND

Social Connection & Loneliness

- Social connection is an evolutionarily conserved 'innate need' (Matthews & Tye, 2019)
- Loneliness is an adaptive drive to maintain social contact and avoid aversive consequences of social isolation
- Amygdala key in social deficit neural circuits

Evidence

- Rodents:** isolation = cellular changes in amygdala (Lavenda-Grosberg et al., 2022; Zhang et al., 2022)
- Humans:** ↑ loneliness → ↓ amygdala activation & ↓ grey matter (Lieberz et al., 2021; Duzel et al., 2019)

Amygdala Subregions

- Amygdala not unitary – discrete subnuclei (Wilensky et al., 2006)
- Distinct functions: aversive processing (Michely et al., 2020), social stress connectivity (Chang & Yu, 2018), adolescent restructuring (Campbell et al., 2021)

PARTICIPANTS

- N = 35 adolescents with complete data (from 42 recruited)
- Age: 16–19 years
- Recruitment: schools & local advertisements (Cambridge, UK)
- Exclusion criteria: neurological conditions, mental health disorders, high chronic loneliness

02 METHODS

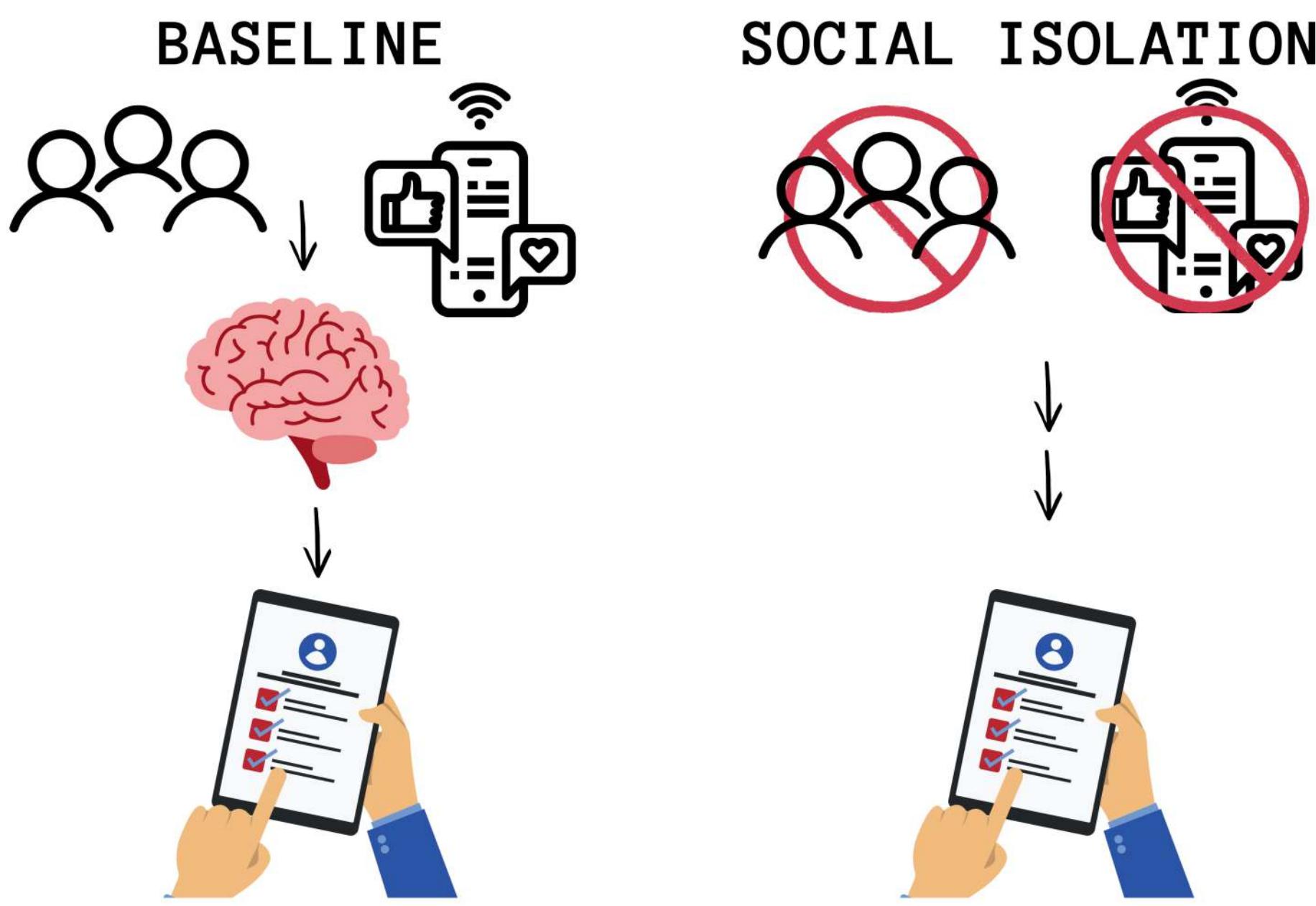
PROCEDURE

Study Design

- 3 sessions: baseline + 2 counterbalanced isolation sessions
- Baseline: brain scan, questionnaires, behavioural tasks
- Isolation sessions: 3.5–4 hours controlled lab isolation
 - One session: digital social interaction access (data not included here)

Psychological Measures

- Collected: at baseline & post-isolation
- Measured: state anxiety (STAI), loneliness, social craving, boredom, positive/negative mood (PANAS)



MAGNETIC RESONANCE IMAGING

MRI Acquisition

- 7-Tesla Siemens Terra scanner (Wolfson Brain Imaging Centre, Cambridge, UK)
- T1-weighted MP2RAGE sequence: 224 sagittal slices, 0.7mm isotropic voxels, FOV: 224mm

Amygdala Segmentation

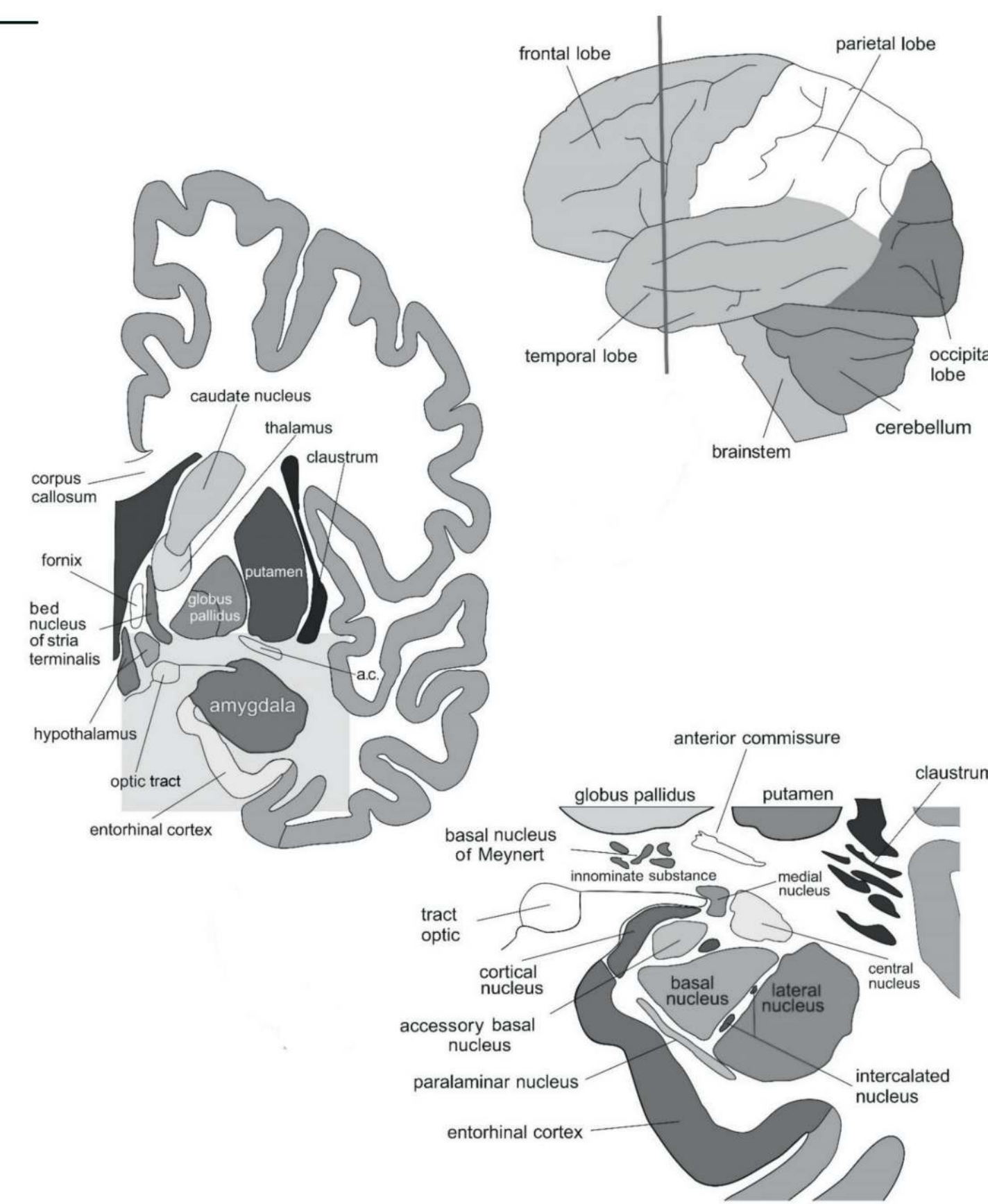
- FreeSurfer 7.3: 9 nuclei per hemisphere
- Nuclei: lateral, basal, accessory basal, anterior amygdaloid area, central, medial, cortical, corticoamygdaloid transition, paralaminar
- Extracted: subregion volumes + eTIV (control variable)

ANALYSES

- LASSO regression with 10-fold cross-validation
- Predictors: 18 amygdala subregion volumes (9/hemisphere) + eTIV (all standardised)
- Outcomes: differences in psychological state (baseline → post-isolation)
- Lambda: optimized via cross-validation to minimize prediction error

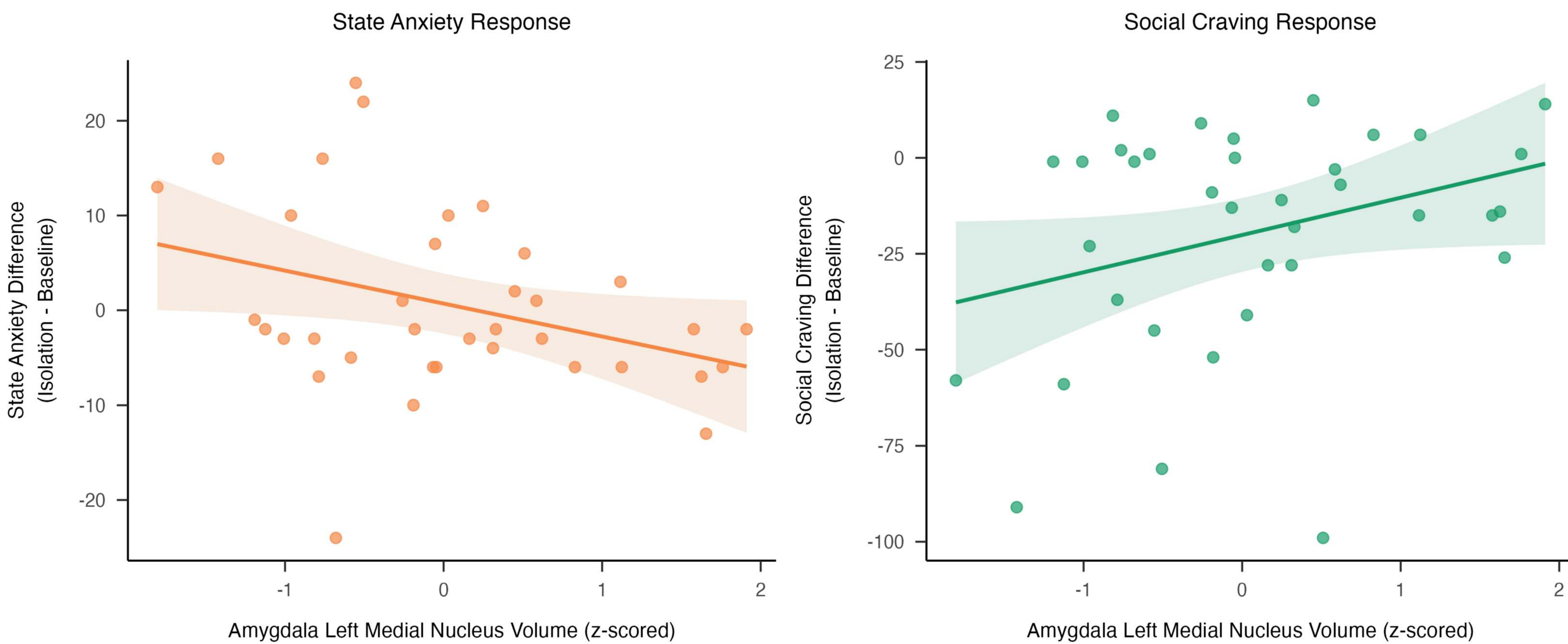
Validation

- Stability analysis: 1000 bootstrap iterations
- Inclusion criteria: regions selected in initial LASSO AND >70% bootstrap samples



03 RESULTS

- Left medial nucleus predicted psychological responses to isolation
 - State anxiety: negative prediction ($\beta = -2.01$, $R^2 = 0.14$, 72.8% stability)
 - Social craving: positive prediction ($\beta = 6.09$, $R^2 = 0.25$, 74.4% stability)
- No stable predictors for loneliness, boredom, positive/negative mood
- Effects lateralized to left hemisphere only
- eTIV not selected for any outcome



04 DISCUSSION

- Left medial nucleus = neuroanatomical predictor of isolation sensitivity
 - Structural dissociation: ↑ volumes → ↓ state anxiety AND ↑ social craving post-isolation

Prior research has documented both **threat hypervigilance** (Towner et al., 2024) and **heightened social motivation** (Tomova et al., 2020) as group-level responses to social isolation. However, the **balance** between **social approach** and **threat avoidance** after isolation might be related to individual differences in amygdala morphometry.

These preliminary findings have implications for understanding individual differences in vulnerability to isolation-related psychopathology.

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LET'S CONNECT!

@emilyanntowner

www.emilytowner.com

