Anticipation of Peer Evaluation in Anxious and Non-Anxious Adolescents: Divergent Patterns of Neural Maturation

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METAlab
Motivation & Executive Function in Trauma & Anxiety

Why Adolescence?

- Rapid development in neural circuits involved in motivation, emotion, & social interaction[1]
- Peak onset time for many anxiety disorders[2]

[1]Dahl (2004); Steinberg & Morris (2001); [2]Kessler et al. (2005)

Social Concerns in Adolescence

- Social concerns common during adolescence
  - Clinical anxiety can be debilitating[1]
- Adolescent anxiety predictive of chronic long-term mental illness[2]
- Understand how neuromaturational trajectories diverge in anxious adolescents

[1]Rapee et al. (2009); [2]Pine et al. (1998)

Exploring Neural Instantiation

- Simulated social interactions paradigms[1]
- Anxiety- and mood-related processing differences[2]
  - Amygdala
  - Striatum
  - Ventromedial prefrontal cortex (vmPFC)
  - Ascribe salience, generate predictions, & create flexible patterns of behavior within a motivated social context[3]

[1]Jarcho et al. (2013)
[2]Davey et al., (2011); Gunther Moor et al. (2010); Guyer et al. (2008, 2013); Jarcho et al. (in press); Lau et al. (2012); Masten et al. (2011); Silk et al. (in press)
[3]Haber (2009); Pessoa & Adolphs (2010); Phelps et al. (2004); Schiller et al. (2008)

Social Paradigms

- Complex cognitive & motivational processes
  - Mentalizing, self-reflection
  - Differences related to development/anxiety often challenging to interpret

- Parse into smaller components
  - Evaluation/selection[1]
  - Anticipation of interaction
  - Receipt of feedback[2]
  - Learning from outcomes[3]

[1]Guyer et al. (2009); Somerville et al. (2013); [2]Guyer et al. (2012); Somerville et al. (2013); [3]Jarcho et al. (prep)

Anticipation

- Anticipation of an unknown, salient outcome is key component of anxiety
  - Grupe & Nitschke (2013): Many features of anxiety most likely to manifest during anticipation
- After a decision to socially engage but prior to knowing consequences
  - E.g., preparing to make a speech, waiting to ask someone for a date

Anticipation

- Regions implicated in anxiety & social tasks thought to play important role in experience of anxiety during anticipation[1]

- Social anticipation particularly provocative for adolescents
  - Adolescent peak in reactivity to motivational stimuli[2], particularly peer-related stimuli[3]

[1]Grupe & Nitschke (2013); [2]Crone & Dahl (2012); Galvan (2010); [3]Nelson et al. (2005); Morris et al. (2001)

Why Amplified in Adolescence?

- Subcortical structures particularly responsive to social stimuli during this time[1]
- Connections with vmPFC underdeveloped[2]
- Divergent patterns of maturation may predispose toward development of anxiety in adolescence

[1]Guyer et al. (2008); Casey et al. (2008); Galvan (2010); [2]Ernst et al. (2006)

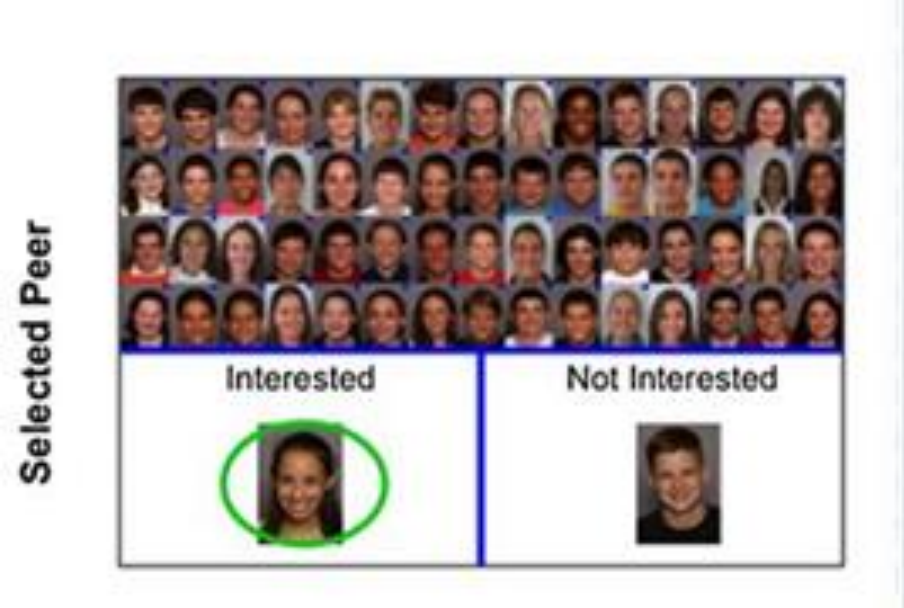
Present Study

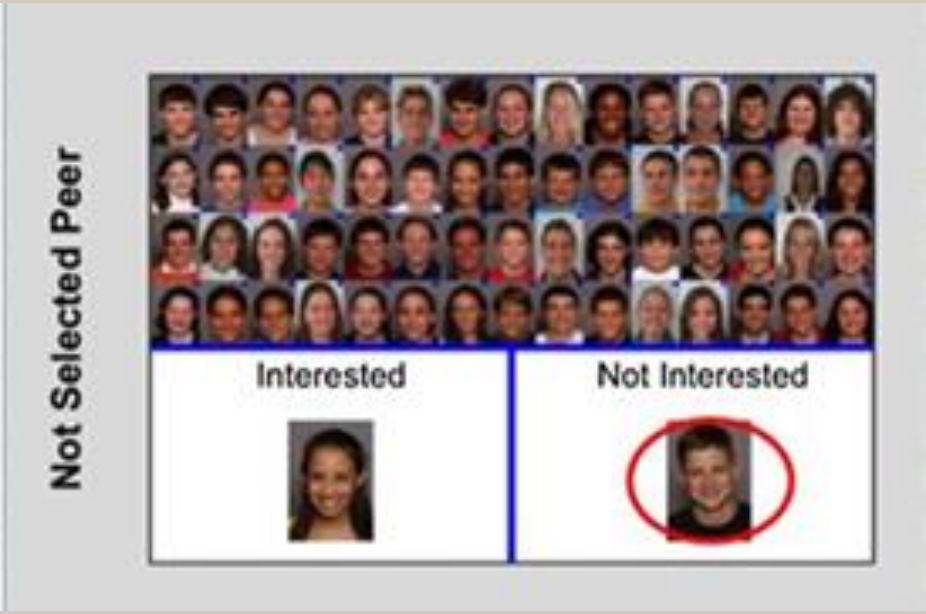
- Examined developmental trajectories
- Anxious & non-anxious youth
- Anticipated social feedback in established peer neuroimaging paradigm

Chatroom Task

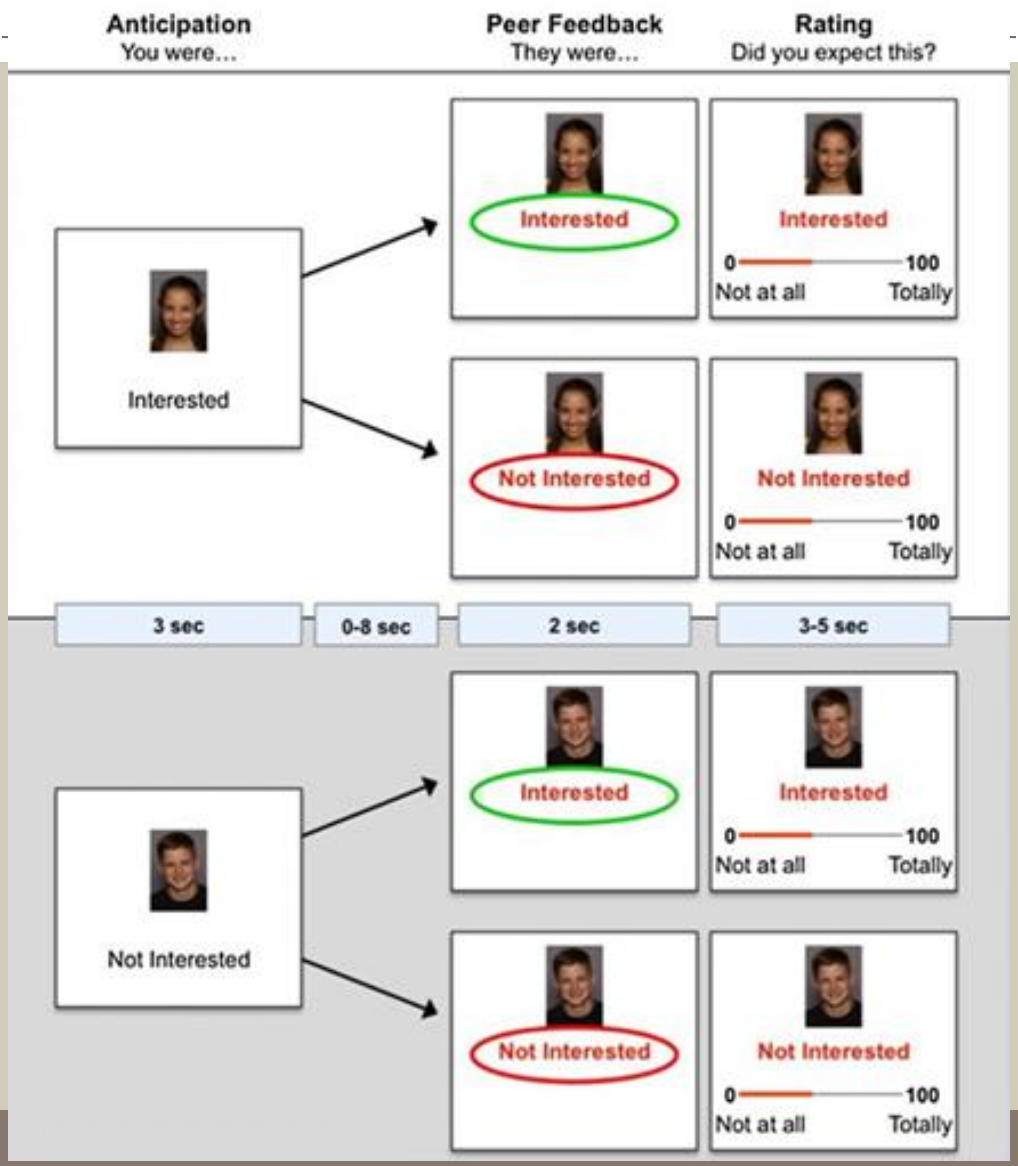
- Two visits:
  - Visit 1: Selection of peers
  - Visit 2: Neuroimaging
- Participants told task designed to learn about internet-based social interaction
- Shown photographs of 60 age-matched individuals
  - Led to believe photos were other study participants

Chatroom Task: Visit 1

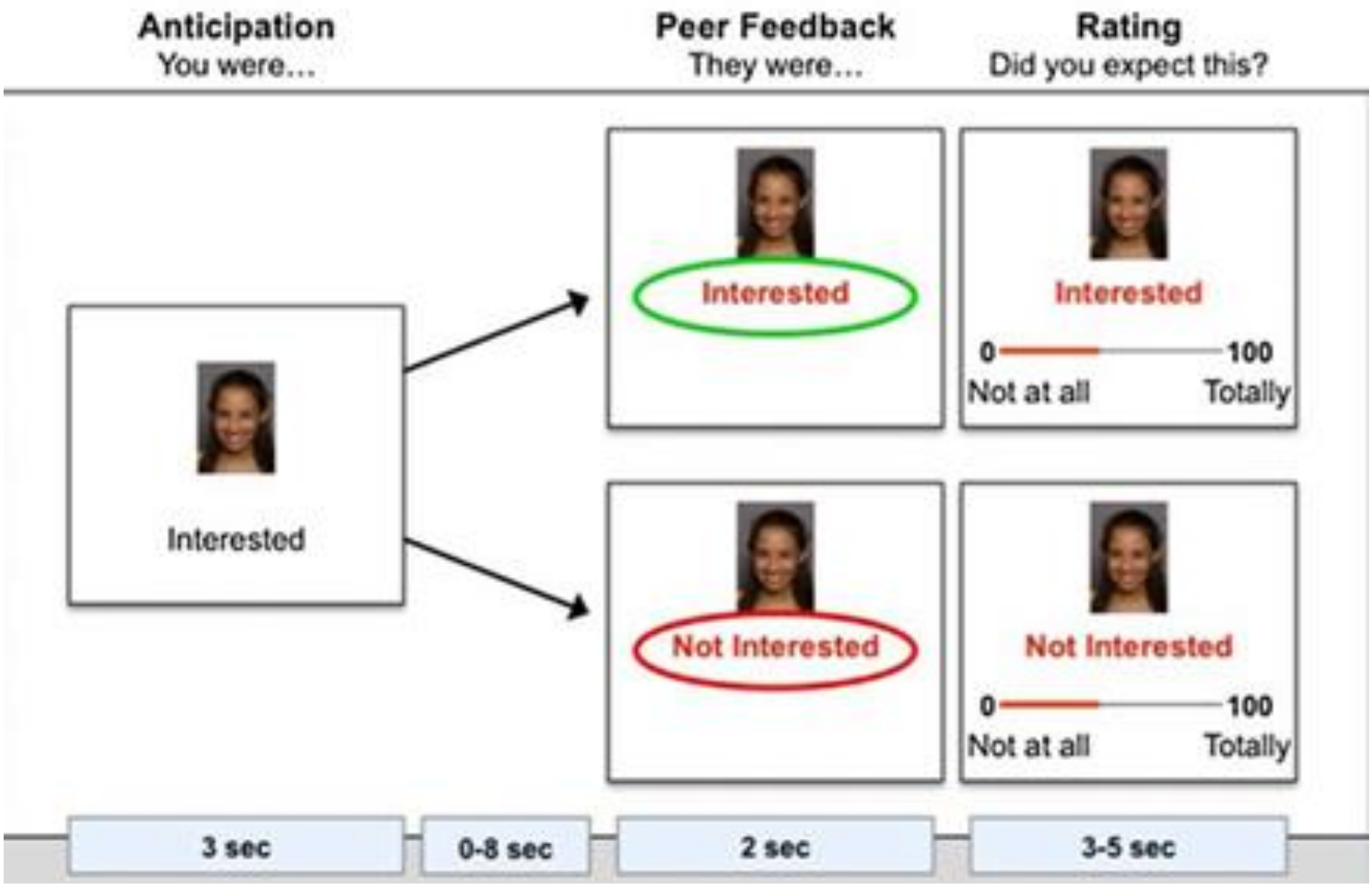




Chatroom Task: Visit 2

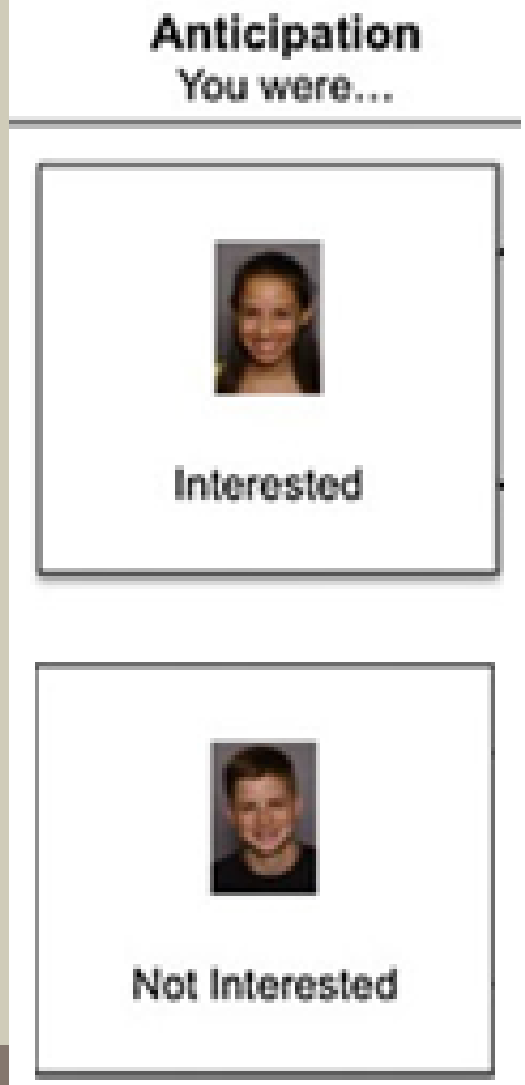


Chatroom Task: Visit 2



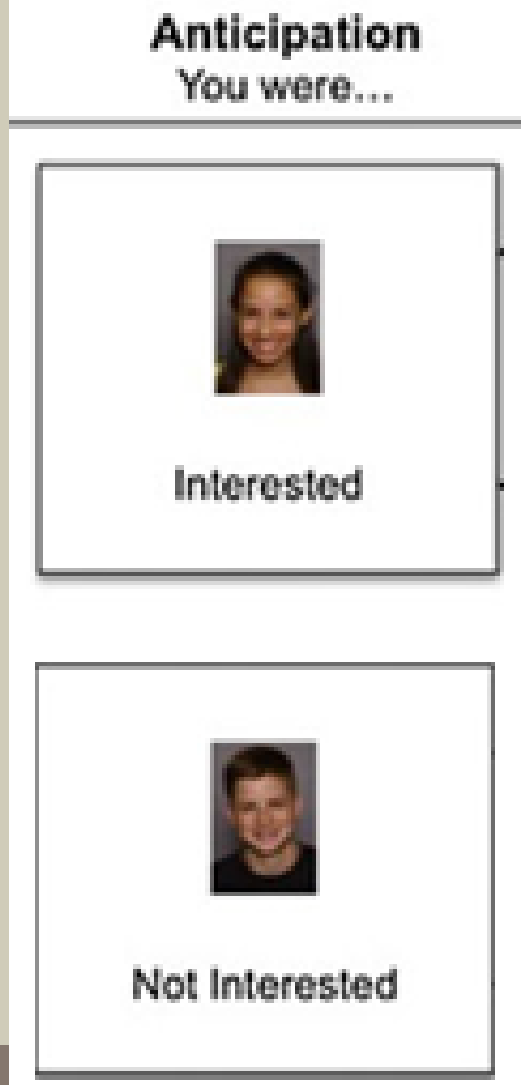
Chatroom Task: Anticipation

- Emotional engagement with social stimuli greatly affected by participant-specific attributions
- Compared activation:
  - Peers deemed socially desirable (selected) vs. peers deemed not desirable (rejected)



Present Study: Anticipation

- Is neural response to peers differ in youth with an anxiety disorder?
- Does neural response to peers change with development?
- Do neuromaturational trajectories differ in youth with anxiety disorder?



Hypotheses

- Amygdala
  - Identify salient stimuli, enhance processing of salient features[1]
- Ventral striatum
  - Predicting motivational relevance of stimuli[2]
- Ventromedial prefrontal cortex
  - Top-down biasing of amygdala[3]

[1]Pessoa & Adolphs, 2010; [2]Haber, 2009; [3]Phelps et al., 2004

Hypotheses: Activation

- Non-anxious adolescents:
  - Feedback from selected peers likely more salient than rejected
    - Greater activation in amygdala & ventral striatum to selected
- Anxious adolescents
  - Feedback from rejected peers likely more salient than selected
    - Greater activation in amygdala & ventral striatum to rejected
- Maturation
  - Greater control over motivational reactivity
    - Greater activation with age in vmPFC

Method: Participants

- 42 participants aged 8-17
  - 52% female
  - Mean age = 13.3 (2.8)
- Anxiety group
  - n = 16 participants (63% female, mean age mean = 12.7 yrs)
  - Met criteria for Social Phobia (n = 13) or GAD (n = 9)
- Healthy group
  - n = 26 participants (46% female, mean age mean = 13.7 yrs)
  - Did not meet criteria for any psychiatric disorder

Method: fMRI Processing

- Implemented via FSL[1] tools
- Motion-corrected, .0125 Hz. high-pass filter, spatially smoothed (FWHM = 5mm), slice-timing corrected, & intensity-normalized
- 2-level hierarchical model

[1]Jenkinson et al. (2012)

Method: fMRI Processing

- Level 1 predictors:
  - Two predictors modeling anticipation (selected & rejected)
  - Four predictors modeled the feedback period
  - Nuisance predictors modelling outlying volumes
- Contrast of interest:
  - Selected vs. rejected

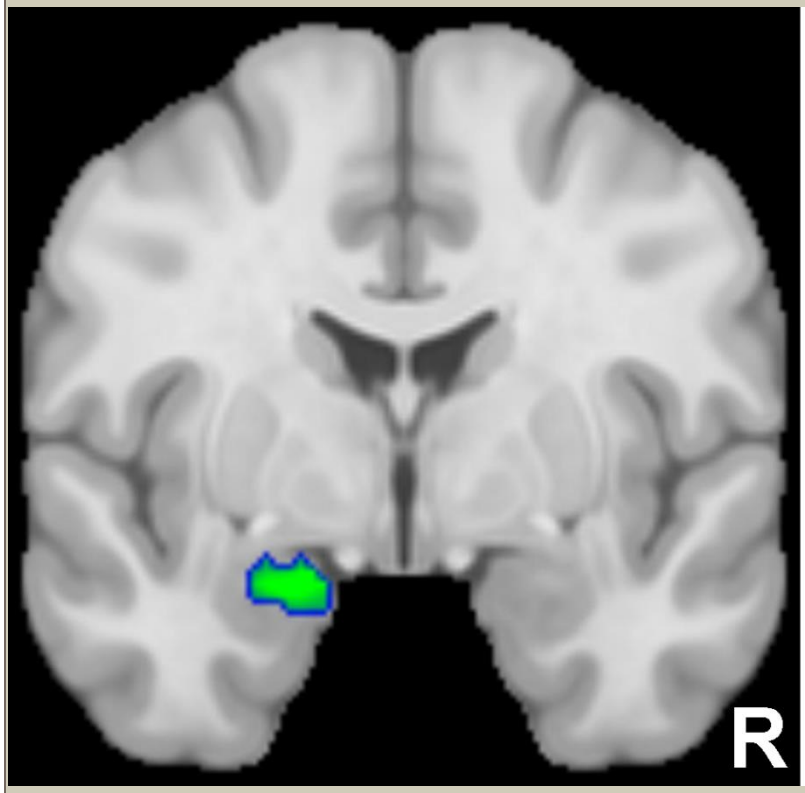
Method: fMRI Processing

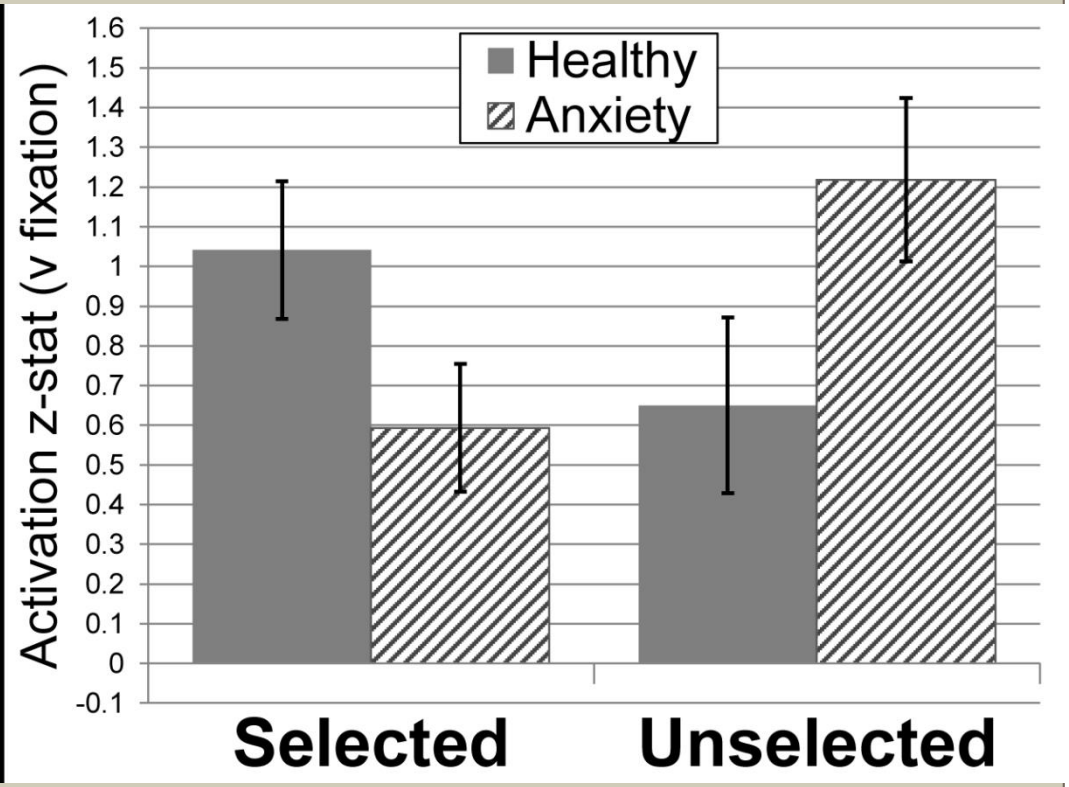
- Level 2 predictors:
  - Anxiety group
  - Age
  - Anxiety group X Age interaction

- GRF correction for multiple comparisons

Result: Anxiety Group

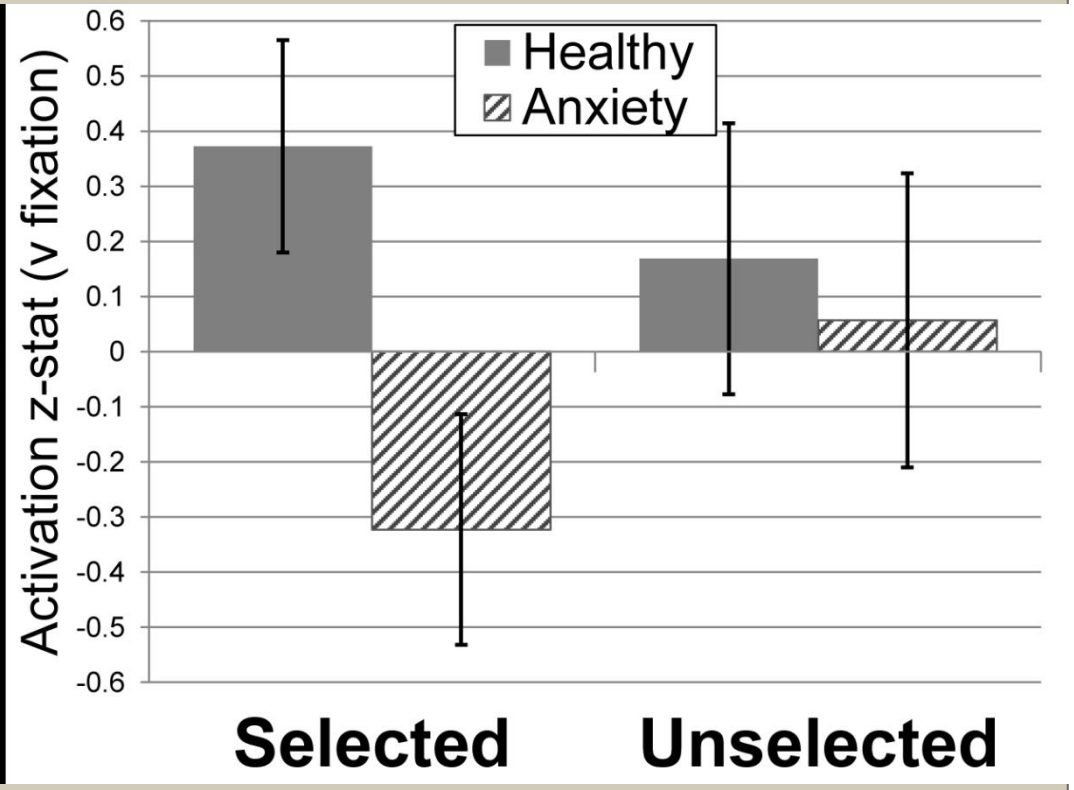
- Left Amygdala





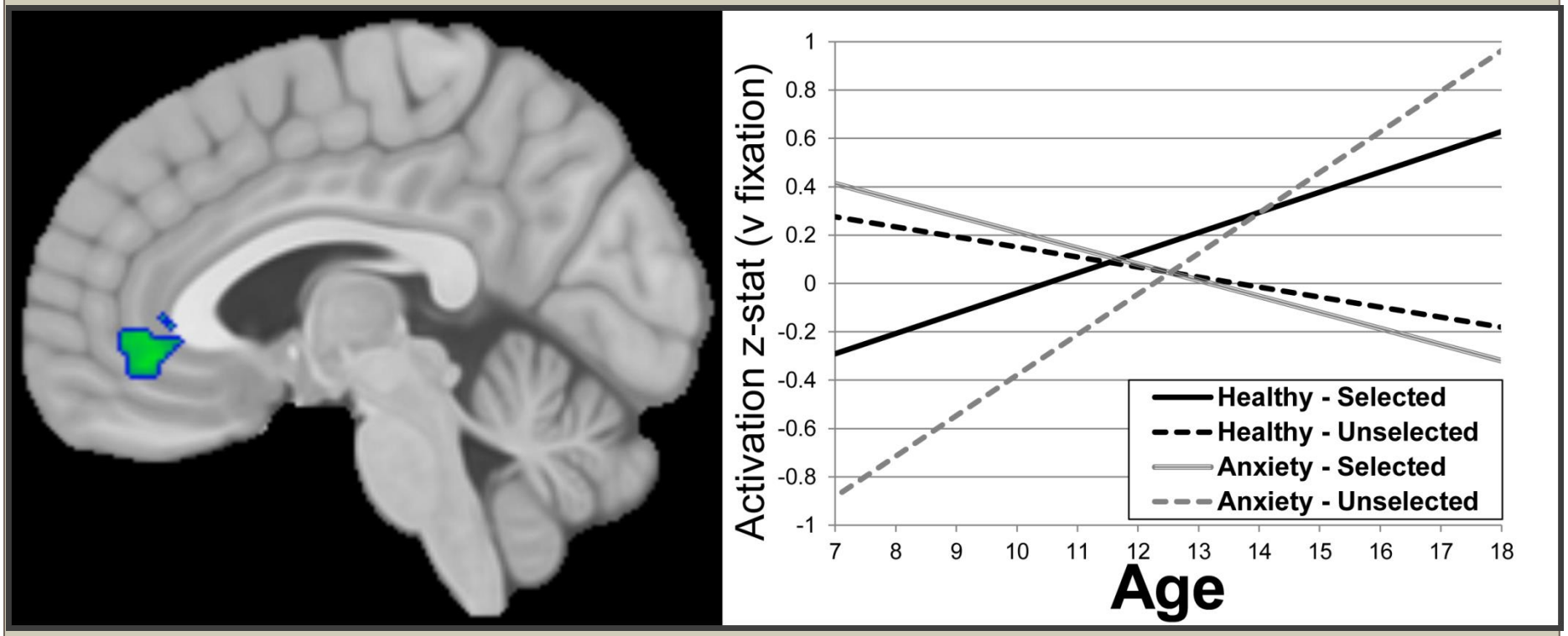
Result: Anxiety Group

- Bilateral nucleus accumbens (NAcc)



Result: Anxiety X Age

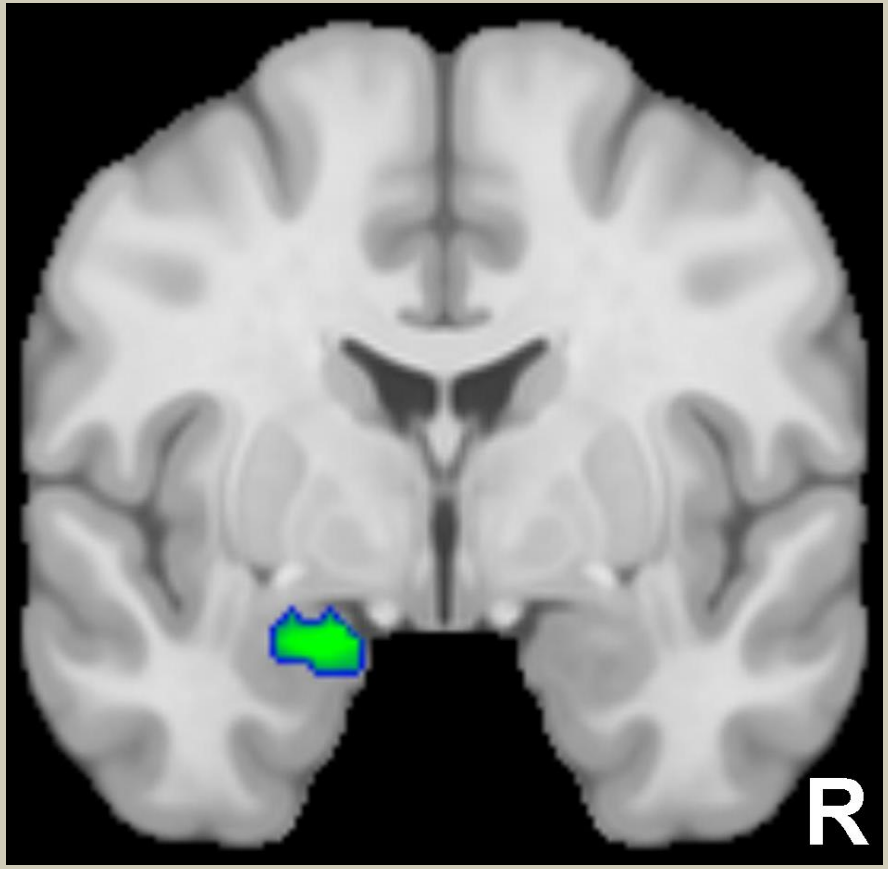
- Rostral anterior cingulate cortex (rACC)
  - Important for fear extinction[1]



[1]Phelps et al., 2004

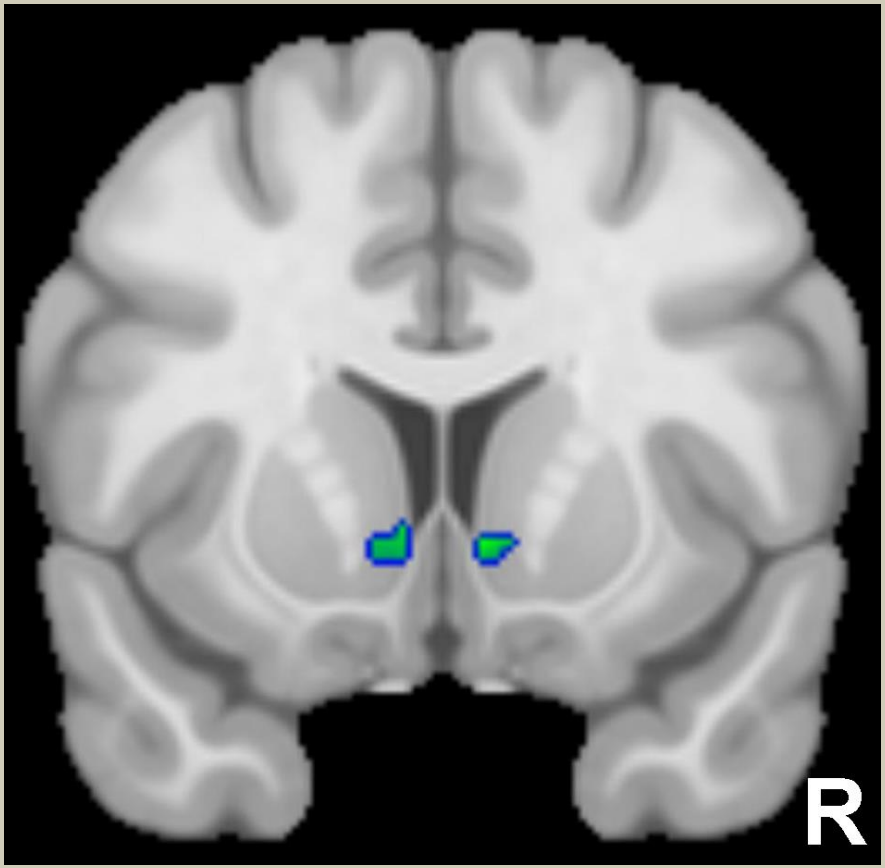
Discussion

- Greater amygdala for rejected in anxiety
  - Anxious youth ascribe more salience to interactions with potentially distressed peers (i.e., rejected peers)
  - Healthy youth ascribe more salience to potentially rewarding interactions



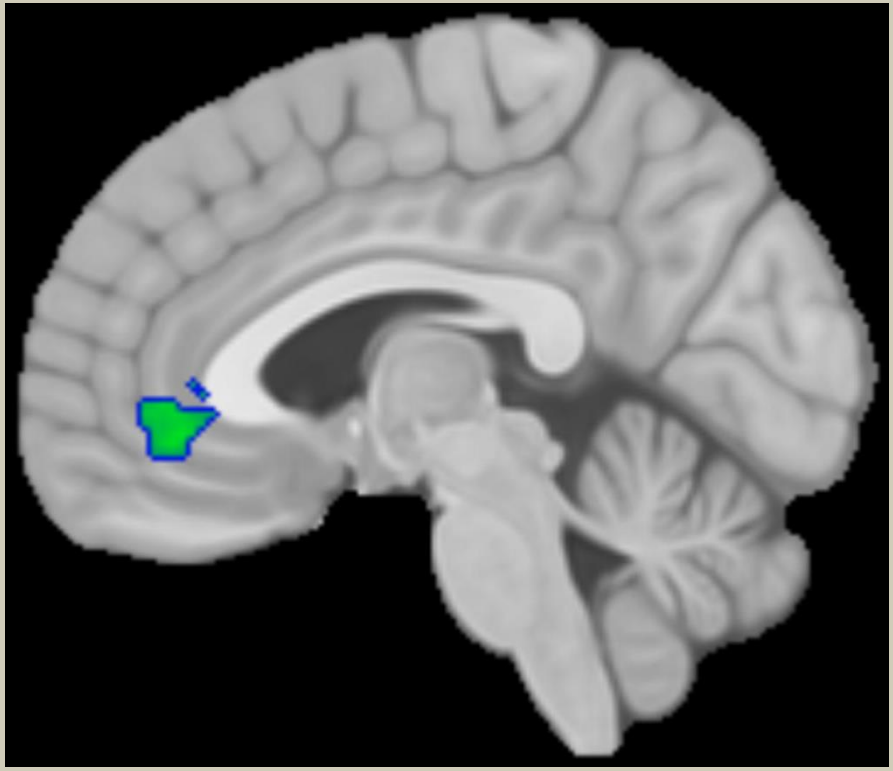
Discussion

- Decreased NAcc to selected in anxiety
  - Anxious youth do not anticipate interacting with selected will be rewarding
  - Healthy youth anticipate potential reward



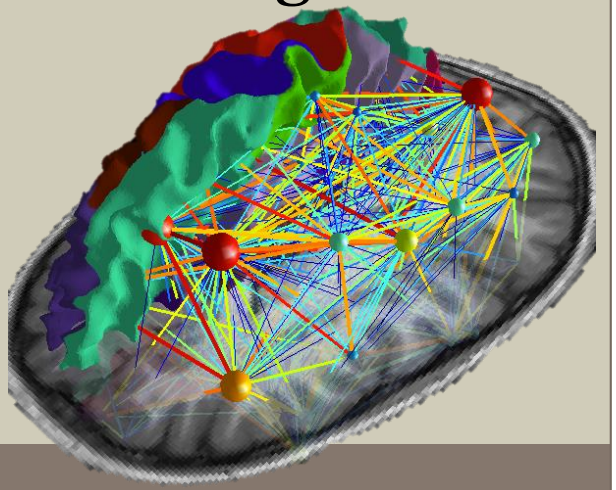
Discussion

- rACC
  - In healthy, age associated with greater control over fear of 'liked' peers, potentially facilitating approach behavior
  - Opposite true for anxious youth



Implications & Future Directions

- Differences in neural instantiation of anticipation by adolescence
- Divergent patterns of neural maturation in key areas involved in top-down control
- Examine patterns of connectivity between regions
- Parse development more finely
  - Specific processes (e.g., puberty)
  - Longitudinal measurement



Disclosures

- No disclosures to report
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