



# Brain Networks Related to Loneliness in Adolescents

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“If you want to go fast, go alone. If you want to go far, go together.”



-African Proverb

- According to the General Social Survey, Millennials are the loneliest generation yet



# Today's Presentation

- Introduction
  - Loneliness in Adolescence/Brain
- The Current Study
  - Methods/Measures
  - Results
- Discussion/Future Directions



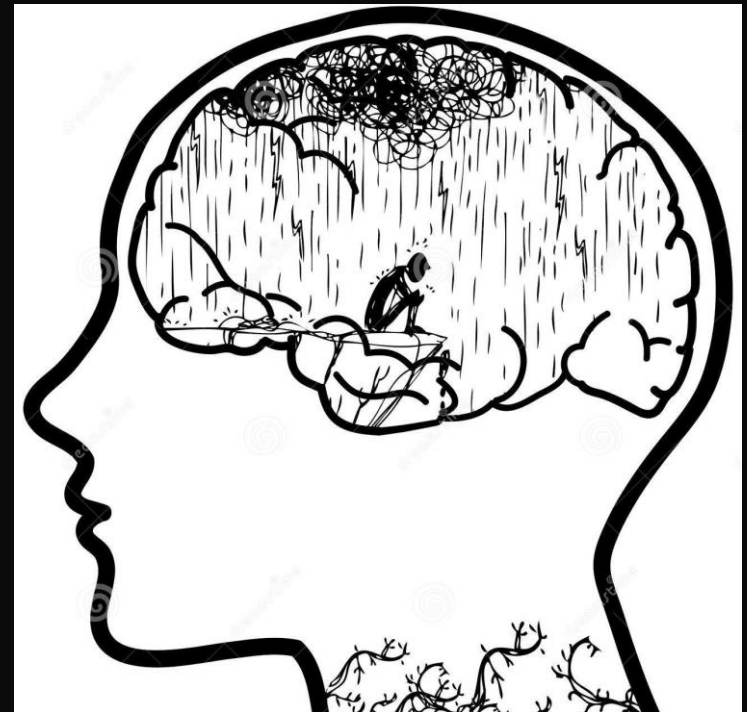
# Introduction: Defining Loneliness

- Webster Dictionary:
  1. sadness because one has no friends or company.
- “Perceived Isolation”
  - Being alone is not the same as being lonely
  - Loneliness can become a chronic issue



## Lonely Adolescents...

- Psychological Health
  - Personality Disorders
  - Depression (neuroticism)
  - Suicide
- Physiological Health
  - Obesity
  - Sleep Disturbances
  - Immune Function
  - Cardiovascular Health





# Loneliness in the Brain

- Loneliness activates:
  - Amygdala: experiencing emotions





# Loneliness in the Brain

- Loneliness activates:
  - Cingulate Cortex: emotion formation and processing





# Loneliness in the Brain

- Loneliness activates:
  - Prefrontal Cortex (PFC): Regulating emotions and emotional responses







# The Current Study: Brain Networks Related to Loneliness in Adolescents

- DevCoG- Developmental Chronnecto-Genomics (56 children from NM and NE)

<b>N=56</b>	<b>M (SD)</b>
Age (yrs.)	11.6 (1.9)
Education (yrs.)	8.6 (1.8)
Handedness	51R, 5L
Gender	30 M, 26 F
Race (% Caucasian)	80.7



## Measure of Loneliness

- NIH Emotion Toolbox Measures (ages 8-14)
  - Loneliness: “I feel that I have nobody to talk to” “I feel that I don’t have any friends”
  - Friendship: “I have friends to sit with at lunch” “I can find a friend when I need one”
  - Perceived Rejection: “People in my life put me down” “I don’t feel like I fit in”



# Resting State Functional Connectivity

- Functional Magnetic Resonance Imaging (fMRI)
  - Blood Flow  $\rightarrow$  Neuronal Brain Activity
- Measure of brain activity at rest!
- Advanced Functional Neuroimaging Analysis (AFNI)





# Hypothesis

1. In more lonely individuals, greater connectivity between amygdala and socio-emotional brain regions is seen
2. In more lonely individuals, less connectivity between cingulate cortex and socio-emotional brain regions is seen



# Results

## Regression Model on Loneliness

Predictor	B	$\beta$	SE	P	95% CI	F
Rejection	.6	.5	.1	< .01	.4, .8	6.6
Friendship	-.6	-.5	.1	< .01	-.7, -.4	-6.5

M=mean; SD= standard deviation.  $R=.876$ ;  $R^2=.767$ , ( $p<.01$ ); Adjusted  $R^2=.758$ ; SE= Standard Error; CI= Confidence Interval

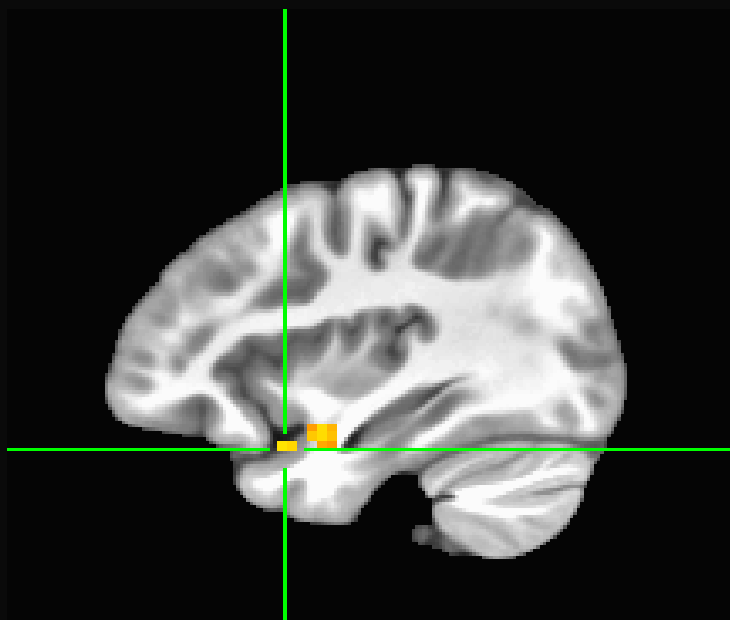


# Results

R Amygdala Seed



L Cingulate Gyrus



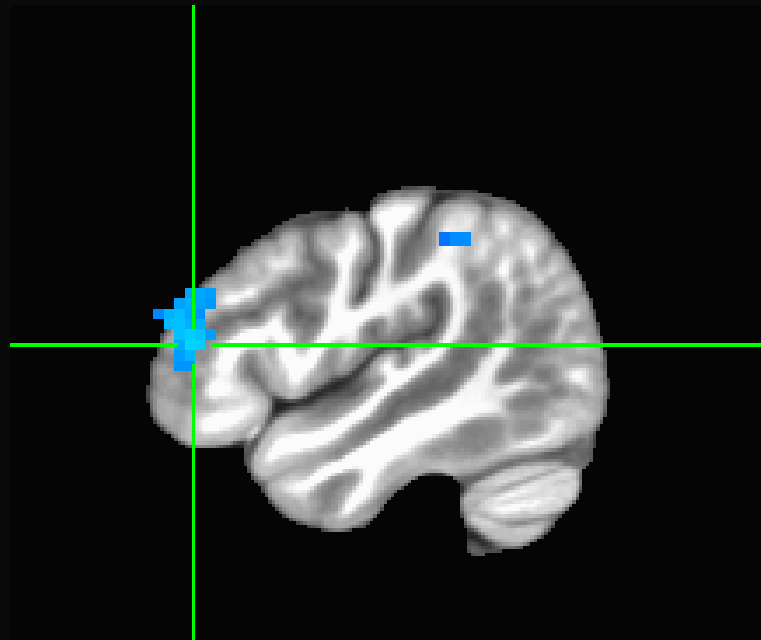
L Superior Temporal Gyrus



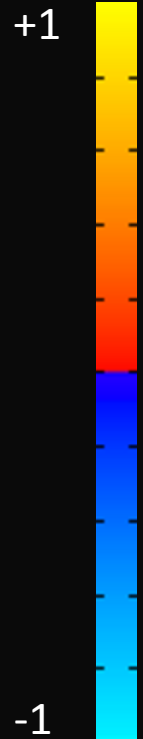
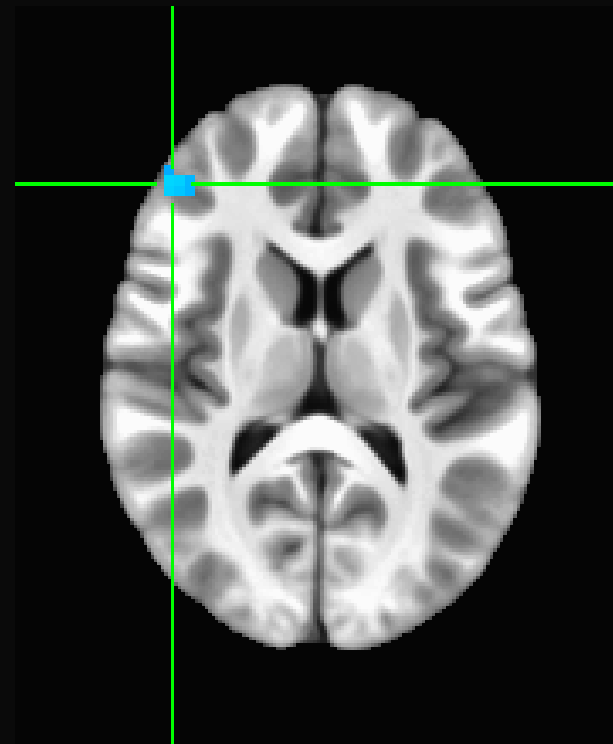


# Results

R Posterior Cingulate Seed



R Inferior Frontal Gyrus





## Discussion

- Increased amygdala rs-FC to the cingulate gyrus and superior temporal is consistent with depression and anxiety literature.
- Lonely individuals are at a greater risk for depression, anxiety and neuroticism.
- Decreased rs-FC between posterior cingulate and the inferior frontal gyrus reflecting social rejection, difficulty focusing on others' emotions.





## Implications

- Connectivity patterns used as a biomarker to predict future loneliness, depression and anxiety.

## Future Directions

- Independent Component Analysis
- Year 2 Measures
  - Personality, Empathy, Loneliness

# Questions?

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### Means and Correlations Among Variables

Variable	M (SD)	1	2
1. Loneliness	12.7 (5.6)		
2. Friendship	19.2 (5.0)	-.8*	
3. Rejection	9.6 (4.5)	.8*	-.5*

$p < 0.01$