Mapping Teenage Minds

21st Century Medicine Series

Professor Gin S. Malhi
Sydney Medical School

CADE Clinic

CADE Clinic
Clinical Assessment Diagnostic Evaluation
Framing the problem

a ‘SAD’ Story

› Stress

› Anxiety

› Depression
Depression & Anxiety

› 3 million Australians are affected by depression or anxiety

› Onset of the illnesses is often in teenage years or early adulthood

› Life long chronic illnesses
Signs and symptoms of depression

› Feel:
  - 'down', depressed, sad

› Think:
  - self-blame, poor self worth, pessimistic

› Physical:
  - poor sleep, fatigue, change in eating

› Consequences:
  - stop functioning,
  - social withdrawal,
  - self-harm
  - alcohol, drugs, suicide
Anxiety

- Excessive Worry
- Find it difficult to stop worrying
- Interferes with usual functions and everyday activities
  - study, work, social engagements

In addition:
- Fatigue
- Sore muscles
- Sleep problems
- Can’t concentrate
- Restlessness
- Irritability
Depression & Anxiety

› Often occur together but anxiety starts earlier

› Common yet diagnosis is often delayed

› Treatments are playing ‘catch up’

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Stress

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Review - 1

› Stress - is a part of our lives

› When poorly managed can cause or heighten our anxiety

› Intense and long term anxiety can lead to depression

› S-A-D

› How do we break these links and understand where it all begins?
Neuroimaging Technology

- CT/MRI: Anatomical Assessment
- EEG/ERP: Electrophysiological Measurement
- MRS: Metabolic Investigations
- fMRI: Studies of Cerebral Blood Flow
- PET: Probes of Neurotransmitter Functioning

fMRI Setup

- Magnet
- Gradient coil
- Radio-frequency coil
- Prism glasses
- Headphones
- Video screen
- Video projector
- Stimulus control computer
- Spectrometer control computer

Action Potential
Neuron

Neurotransmitter Release
Receptor Binding
Biological Response
What are they thinking?
Regulation

Emotion Regulation

Regulatory Regions/Networks
The teenage brain is still developing:

- Different parts develop at different rates
- The parts that control emotions develop later than those that generate emotions
- Recipe for:
  - poor planning,
  - poor decisions,
  - lack of consideration for consequences,
  - mood swings
Myelination

- Conception
- Neurulation
- Neuronal proliferation
- Neural migration
- Myelination
- Synaptogenesis
- Apoptosis

- Gestation (weeks): 4, 8, 12, 16, 20, 24, 28, 32
- Birth
- 4 months
- Adolescence
- Adulthood
Stages of Brain Development in an Infant

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Pruning of Connections

Synaptic Density

At birth 6 years old 14 years old

Source: Rethinking the Brain, Families and Work Institute, Nina Shores, 1997 (Founders Network site)
4 years old
Teenage development

› Advanced reasoning

› Abstract thinking

› Ability to think about thinking (metacognition)

Teenage Social and Emotional Development

› Identity

› Autonomy

› Achievement

› Relationships
› Training Evolving Emotion Networks (TEEN)

› We can now peek into the brain while it’s working using modern technology and imaging techniques

› We know that the teenage brain is developing

› And that basic emotions mature before we learn how to fully control and regulate them

› TEEN-agers are learning how to understand and regulate (get to grips) with their emotions
ARCHIVAL REPORT

Neural Antecedents of Emotional Disorders: A Functional Magnetic Resonance Imaging Study of Subsyndromal Emotional Symptoms in Adolescent Girls

Pritha Das, Carissa M. Coulston, Danielle M. Bargh, Michelle Taniious, K. Luan Phan, Vince D. Calhoun, and Gin S. Malik

Background: Emotional symptoms (ES) emerge from late adolescence, before manifesting as fully fledged emotional disorders. Studies indicate that subsyndromal ES precede the onset of emotional disorders. We hypothesized that adolescents showing subsyndromal ES will show perturbations in the emotion regulatory frontolimbic network (FLN) during emotion processing.

Methods: Fifty-eight female adolescents underwent functional magnetic resonance imaging while viewing an image-based emotion-processing task. Within this sample, 33 (56.9%) displayed emotional symptoms and 25 (43.1%) did not. Clinical measures, including assessments of mood and anxiety, were administered to participants and participants were allocated to one of two groups based on the presence (ES+) or absence (ES−) of subsyndromal ES. Group comparisons were used to identify differential patterns of neural engagement and their relationship to clinical variables.

Results: Groups displayed emotion-specific differences in FLN activity with increased frontal activity in ES+ girls during positive emotion processing and decreased frontal and limbic activity during negative emotion processing. Trait anxiety was the strongest clinical predictor of group membership (ES+ versus ES−) and displayed a significant negative correlation with hippocampal neural activity during negative emotion processing. In addition, between the groups, the hippocampus displayed a pattern of reverse coupling with the amygdala and insula that was also significantly correlated with trait anxiety.

Conclusions: There is divergence in the pattern of FLN neural processing in adolescent female subjects determined by emotional symptoms. Future research is needed to corroborate these findings and to undertake their implications longitudinally.

Key Words: Adolescents, anxiety, depression, emotional, FLN, 

Current Study

PARTICIPANTS

- 58 Adolescent girls aged 14-16 years

Exclusion criteria

- Neurological event (eg, Traumatic Brain Injury, LOC, Epilepsy/Seizures)
- Learning or Developmental Disorder
- Any medical or physical condition that precluded Neuroimaging
Procedure

- i) Self-report questionnaires
  - Personality, Coping, Self-Concept, Emotional Dysregulation, Mood, Anxiety, Eating Disorders, Psychosis, Substance Use, ADHD, Learning/Behaviour

- ii) Computerised neuropsychological tests (CogState)
  - Memory, Attention, Processing speed, Executive functions, Social cognition

- iii) Neuroimaging
  - Structural, functional and resting state acquisitions

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Groups

- Adolescents were assigned to one of two groups according to presence or absence of sub-clinical Emotional Symptoms
  - ES+ and ES-

- Defined by exceeding the cut-off score for one or more disorders assessed by the Child and Adolescent Psych-Profiler (CAPP)

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<thead>
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<th>Domain</th>
<th>ES+</th>
<th>ES-</th>
<th>Sig.</th>
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<td>State Anxiety (STAI)</td>
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<td>Trait Anxiety (STAI)</td>
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<td>Personality (NEO-FFI)</td>
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<tr>
<td>Neuroticism</td>
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<td>Extraversion</td>
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<td>Conscientiousness</td>
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<td>Emotional Dysregulation (DERS)</td>
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<td>Self-Concept / Self-Esteem (Piers-Harris)</td>
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<td>Intellectual Abilities</td>
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<td>Physical Appearance &amp; Attributes</td>
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<td>Popularity</td>
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Strongest clinical predictors of ES

Trait Anxiety was the strongest predictor of ES+.

Study Paradigm & Imaging Design

Total paradigm duration ~ 4 min
In Conclusion

- Neural antecedents to mood disorders are likely to emerge early and
- In the future may be used to identify those likely to develop disorders later in life

What next?

- Follow up of these girls as they become women
- Further studies in boys
- Start earlier? Maybe 12 years old and even 8 years old?
- See the effects of interventions – psychological and physiological
- Move thinking to prevention and cure
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Thank you