Trait anxiety and impoverished prefrontal control of attention

Sonia J Bishop, Nature Neuroscience, 2009

Presenters:
Damaris & Jak

Generalized anxiety disorder - Jake

DSM definition

Impact on society (potential negative impact + percentage)

Current understanding of underlying biology/neuroscience (introduction / abstract paper)

- Amygdala
- Prefrontal cortex
- DLPFC

Available treatments and why more research is needed

What is Generalized Anxiety Disorder (GAD)?

- Excessive anxiety and worry about <u>a number of</u> events or activities
- Occurring <u>more days than not</u>, for at least 6 months
- Difficult to control the worry
- Potential causes:
  1. Genetics
  2. Environmental factors (e.g. abuse, divorce, school works)

Impact of GAD on society

- 3.1% of the U.S population, or 6.8 million people, were affected by GAD, in any given year.

- 15.6% of adult experienced at least mild symptoms of anxiety in the past 2 week. (from national health survey of 2019)

- Symptoms were most shown among adults aged 18-29
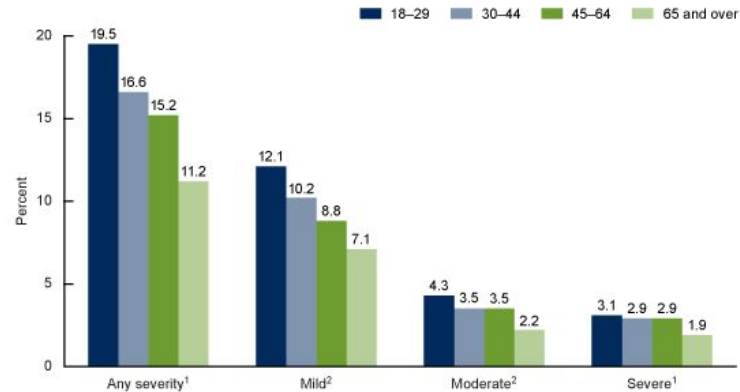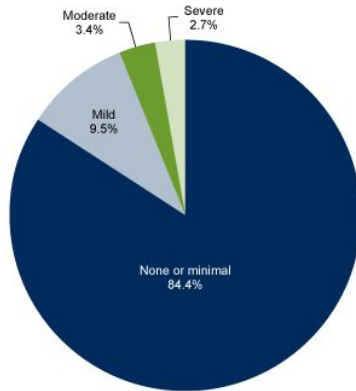
Cited from Centers for Disease Control and Prevention

Study information - Damaris

Define trait vs state anxiety

Define ACT (attentional control theory) and how it relates

Study design:

    -number of participants

    -fMRI definition/how it works

    -Task explanation and examples (low vs high load, congruent vs incongruent distractors) - based on Fig 1

Trait vs. State Anxiety

State- Occurs in a specific situation

Examples: test anxiety, public speaking

Trait- Pattern of thinking, happens frequently

Examples: Restlessness, tension, constant worry, increase in heart rate

Current Treatments

- Current treatments for GAD include:

    - Self-cares (i.e. yoga)

    - Medication (i.e. Antidepressant)

    - Therapy sessions

- Current treatments only for

    symptoms, more to investigate the

    mechanisms

Treatment Options for Generalized Anxiety Disorder

Medication

Psychotherapy

Self-help

well
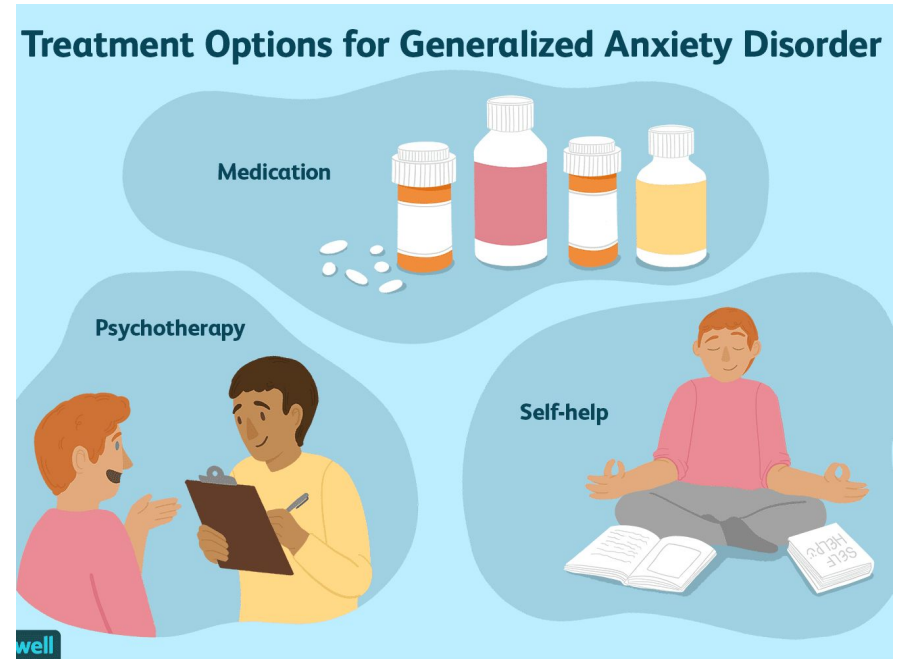
Current understanding of underlying neuroscience / biology

- Increased attentional capture to <u>threat-related stimuli</u>
    - Result of the threat-detection system center on the amygdala

- Prefrontal cortex: responsible for controlling attention.
    - <u>Dorsolateral prefrontal cortex</u> (DLPFC)
    - Helping to focusing on task-related information in a response competition.
    - <u>Response competition</u>: Response generated from irrelevant stimuli that conflicts with current task.
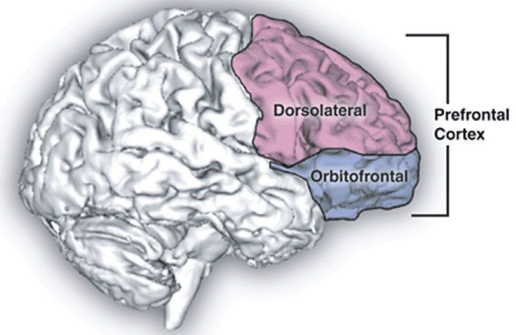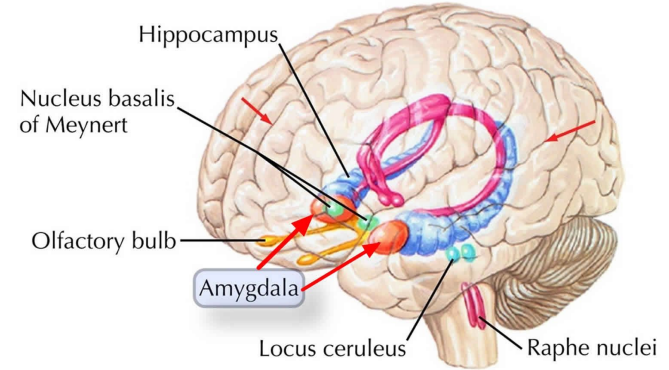
ACT and how it relates

- **Attention Control Theory**- Claims that anxiety is associated with reduced 'efficiency' of performance of cognitively demanding tasks.
- Predicts that individuals with high trait anxiety will display increased prefrontal activation to achieve a certain level of cognitive task performance.
- Set hypothesis on the participants' brain activity throughout the task assigned

Study design

17 participants (ages 19-48) completed a <u>letter search task</u> and the STAI test (Spielburger State Trait Anxiety Inventory)

<mark>fMRI-</mark> uses imaging to measure changes in blood flow occurring in active parts of the brain.

BOLD signal- increased oxygen level in active part of brain is detected.

Task Description:
Participants were asked to say whether an X or an N was present in the string of letters
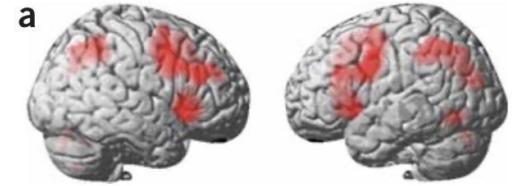
Task examples

1.Attention (Perceptual Load)

High perceptual load-Sequence contained one target letter

```
cxscdsdf
N
```

Low perceptual load-six X's or N's to reduce attention search

```
xuxdxxxoxp
N
```

2.Manipulate response conflict

Congruent distractor (low conflict)- Distractor letters would be the same letter as the target in the display

```
iusbdhdxcgta
X
```

Incongruent distractor (high conflict)- Distractors would be the same letter as the target that was not present in the current display

```
dfghxoijdha
N
```

Figure 2 Jake

Copy/paste figures from paper and write bullet point explanations of main findings.

DLPFC Activity Against STAI Trait Anxiety
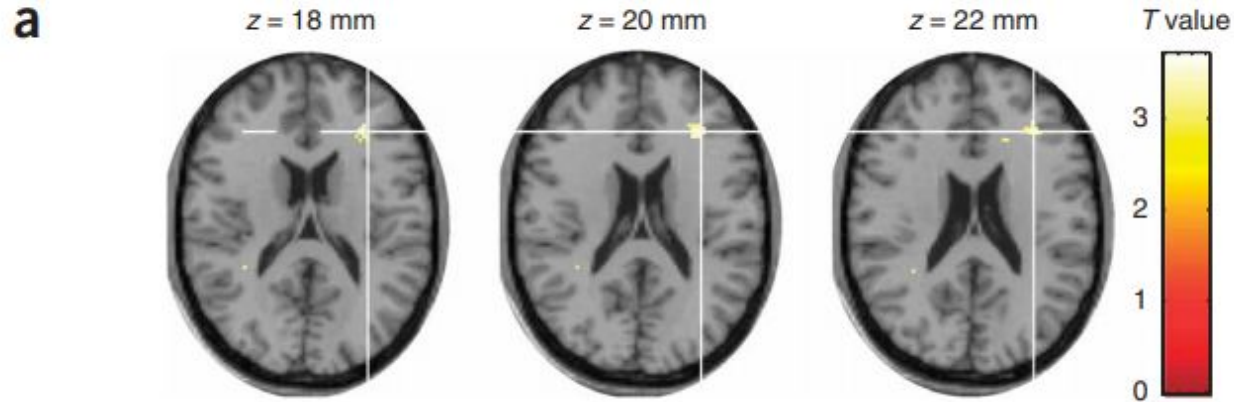
- fMRI images were gathered, normalized and analyzed using statistical parametric mapping (SPM) software.
- Activation of DLPFC region was observed when performing task

DLPFC Activity Against STAI Trait Anxiety
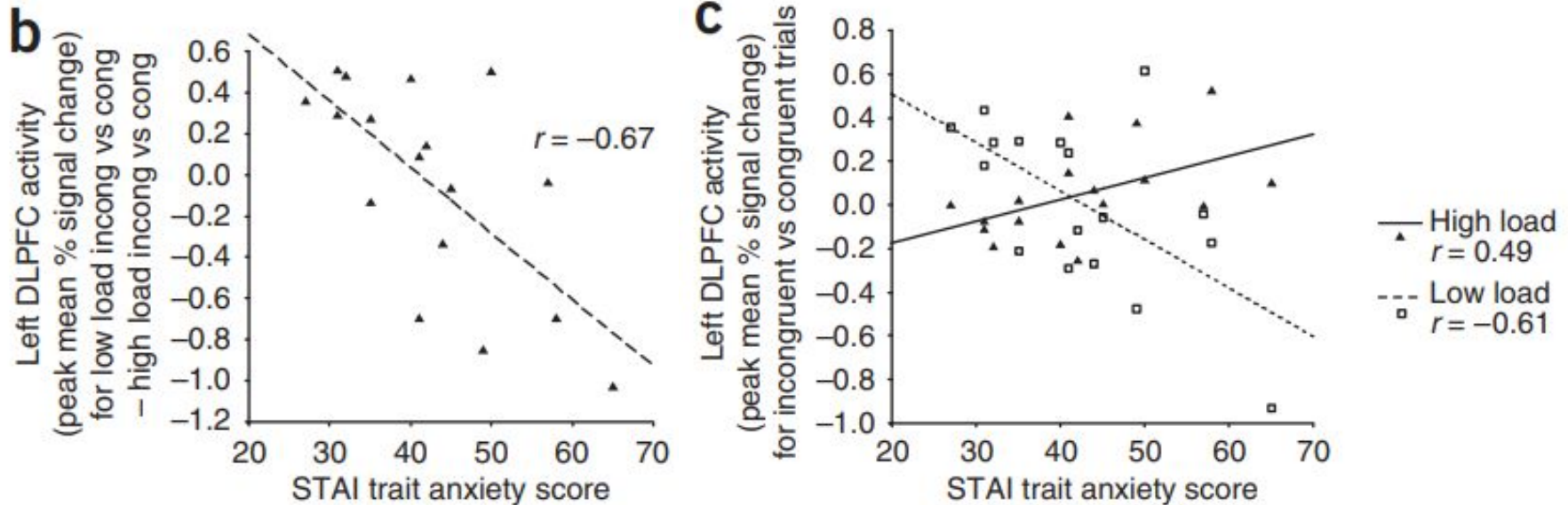
Regression model contradicts with the hypothesis from ACT

Figure 3 - Damaris

Copy/paste brain images, label highlighted areas, include bullet points for basic functions

High and Low perceptual load

fMRI images

Red- increased activation while completing the tasks

Participants were faster to identify the target letter present and made fewer errors in low-perceptual blocks

PFC mainly affected, other areas as well

PFC

*PFC-prefrontal cortex

(Location)

(standard deviation)

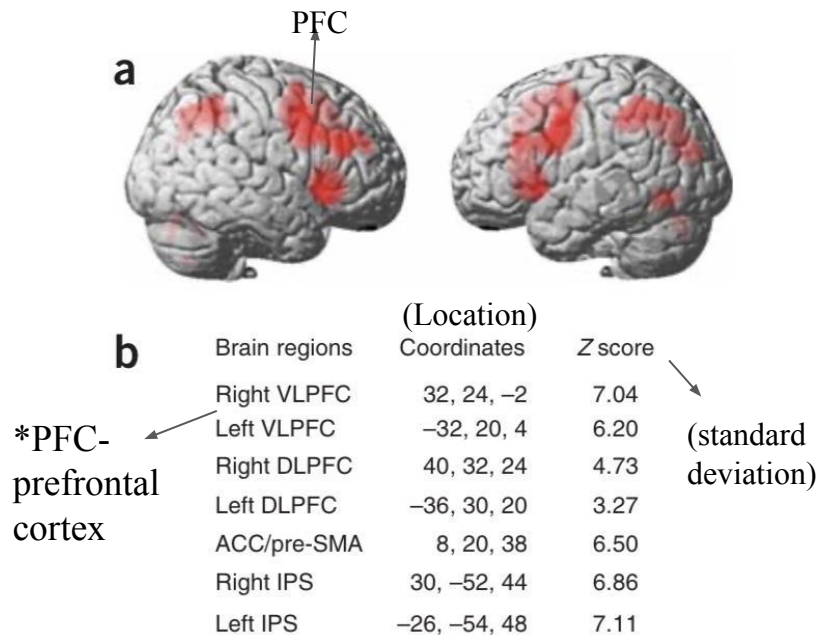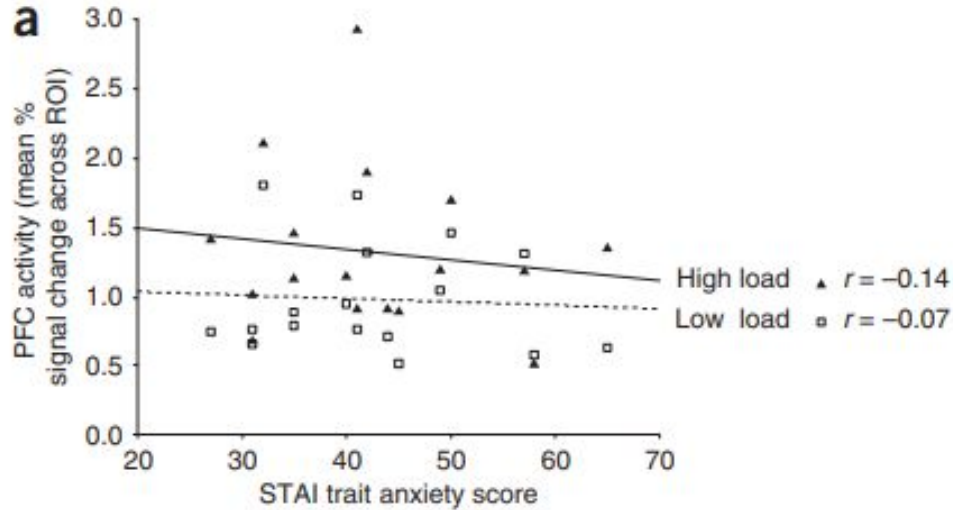| Brain regions	Coordinates	Z score
Right VLPFC	32, 24, –2	7.04
Left VLPFC	–32, 20, 4	6.20
Right DLPFC	40, 32, 24	4.73
Left DLPFC	–36, 30, 20	3.27
ACC/pre-SMA	8, 20, 38	6.50
Right IPS	30, –52, 44	6.86
Left IPS	–26, –54, 48	7.11

Figure 4 - Jake

Copy/paste figures from paper and write bullet point explanations of main findings.

PFC Activity

- No significant effect of anxiety score on PFC activities in both high and low load.

- Differs from ACT hypothesis

Reaction Time & Accuracy
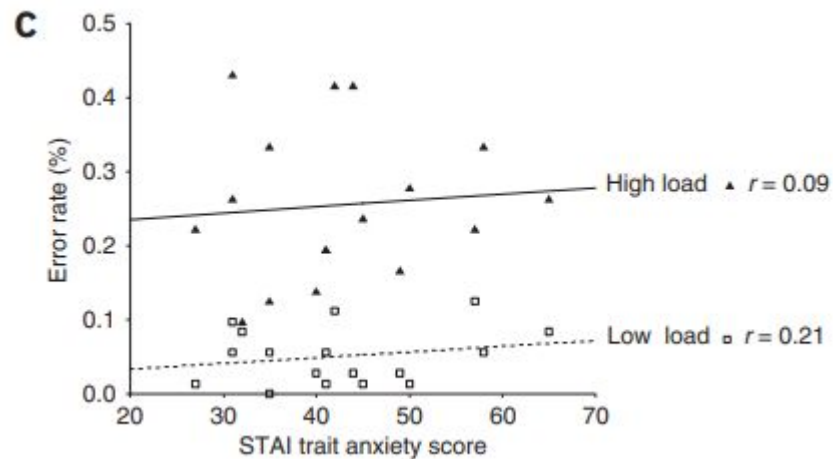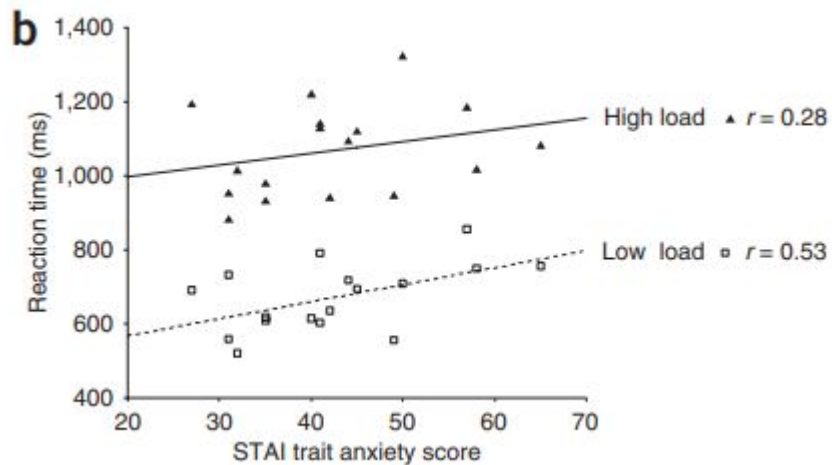
Figure 5 & Summary - Damaris

Copy/paste figure and bulletpoint explanation

Bulletpoint summary of paper

Perceptual load and reaction time

★ Mean reaction times as a function of distractor congruency and perceptual load

★ **No significant effect of distractor congruency by perceptual load on reaction time**

Relates to how a task with more distractors will generally take more time to complete
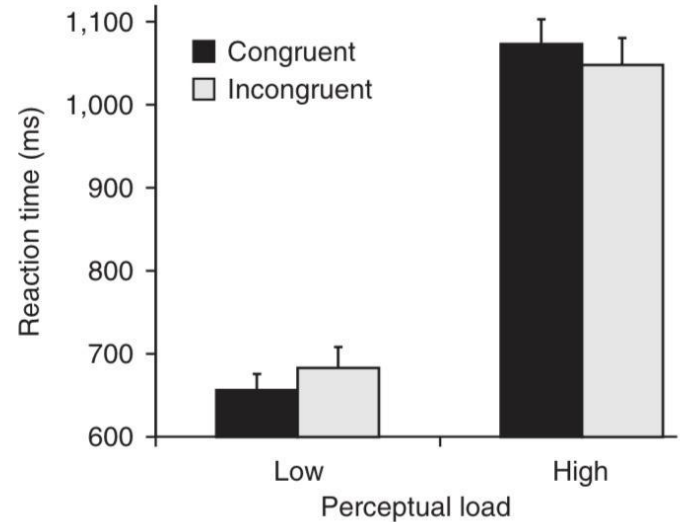
Summary

★ The effect of trait anxiety on attention was observed as participants completed a letter search task

★ Increased anxiety score associated with lower DLPFC activation in low load condition

★ Correlation of increased anxiety score and increased reaction time

★ Increased activation throughout the high and low conditions shown in fMRI

Discussion - Jake

What are the implications of this paper for understanding and treating GAD?

How does this relate to current treatments?

What questions did you have at the end of this paper?

Relation to GAD?

- Deficit characterized by impoverished prefrontal **active** attentional control reflects a predisposing factor to clinical anxiety, including GAD.
    - Difficulties to <u>inhibit any irrelevant</u> distractors

- Impairment of prefrontal mechanism **alone** is not likely to cause clinical anxiety
    - Comparison between population who have <u>clinical anxiety & attention deficit</u>.

- Deficit in attentional control can be observed even <u>when threat-related stimuli is absent</u>.

Treatments? Further Research?

- Similar prefrontal recruitment and accuracy in high load **(Figure 4a, c)**

  - This "weakness" of regulating attentional control might be a style rather than a deficit.

  - High trait anxious individuals can be trained to effectively use attention regulation mechanisms (such as mindfulness training)

- Further research is needed for:

  - Brain mechanisms function in relation to anxiety.

  - Potential underlying impact of anxiety.

  - **Treatment process of other clinical anxieties.**

Remaining Questions

1. How would trait anxiety related to working memory?

2. What would happen when the distractors are in auditory representation?

Discussion part 2 - Damaris

What were some of the follow-up studies from this paper? Where was it cited?

    -feel free to include any figures you may find from other sources that are relevant (optional)

What questions do you have about the overall field of attentional control and anxiety after reading this paper and seeing its follow-up? Where do you hope the research will go next?

Discussion part 2

Follow up study: During vigilance to painful stimuli: slower response rate is related to high trait anxiety, whereas faster response rate is related to high state anxiety (Meeker et al, 2021)
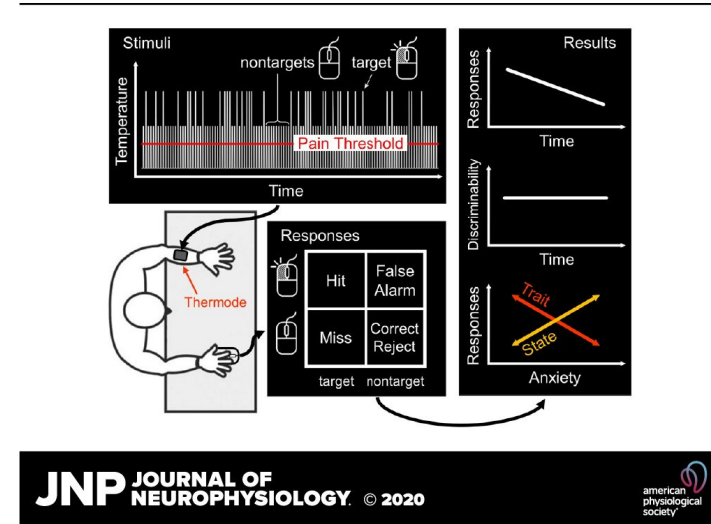
Question:What if the tasks weren't visual and instead kinesthetic?

Future research:

Impact of anxiety on short-term memory

Test anxiety (performance)

Memory loss and anxiety

Acknowledgements

BraiNY organizers and mentors

Your schools - any particular teachers or programs that encouraged you to participate in this

Thank you!