Empathy, Emotion, and Brain Regions Associated with Viewing Real Images Compared to Data

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Introduction

Questions

- How much **empathy** do people feel when viewing real images vs data?
- How much do people **feel moved** when viewing real images vs data?
- Which **brain regions** are associated with viewing real images vs data?
- Can you use **condition classification** to predict whether someone is viewing real images or data?

Real Image
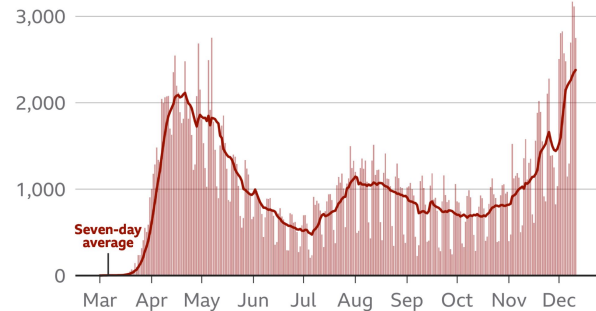
Data

Why this topic?

- **Real images** and **data** are common methods through which people choose to display information in order to persuade others
  - Ex: marketing, news reporting, government information, election campaigns
- Chosen **sub categories** (COVID-19, BLM, and voting inequality) are current topics that are likely to be central to news reporting, government information, and campaigns
  - Ex: persuading people to wear a mask or get vaccinated, encouraging people to donate to groups that support the BLM movement, advocating for voting policy changes or encouraging marginalized voters to vote

Methods

Categories

- Black Lives Matter
  - 10 images, 3 stats
- Covid
  - 18 images, 11 stats
- Voting Inequalities
  - 6 images, 4 stats

🇺🇸 United States
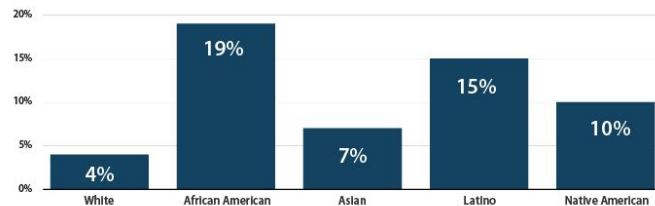
Coronavirus Cases:
46,298,611

Deaths:
756,222

FIGURE 2
People of color are more likely to report racial discrimination when trying to vote or participate in politics
Likelihood of experiencing racial discrimination when trying to vote or participate in politics, by race/ethnicity, 2017

White 4%	African American 19%	Asian 7%	Latino 15%	Native American 10%

Source: NPR, Robert Wood Johnson Foundation, and Harvard T.H. Chan School of Public Health, "Discrimination in America: Experiences and Views on Affects of Discrimination Across Major Population Groups in the United States" (Washington; Princeton, NJ; and Boston: 2017), available at https://www-w.rwjf.org/en/library/research/2017/10/discrimination-in-america--experiences-and-views.html.

CAP

We chose categories that we had both images and data for and that had at least 3 items in each category

Selection of Real Images and Data

- We filtered for images and data that at least 5 subjects placed into the appropriate category
- We went through and made sure all images were in appropriate categories and were the correct data type
- We went through and removed any images or data that had very low "get" ratings (average for all data was 71%, the average ratings for selected images and stats are 80% and 78%, respectively.)
- Our high "get" rating means that there's a greater chance that people understood the image or data they were viewing and could rate it accurately

Analysis

- Behavioral data analysis
  - one-sample t-tests, two-sample t-tests, and anova to determine our statistically significant results
- Brain data analysis
  - group level t-test with contrasts for each participant between real images and data (threshold = .005 uncorrected)
  - Condition classification for real images and data (6 training participants, 1 test participant)

Behavioral Data

Behavioral Data

- We decided to test two metrics to see how people responded to images versus data in terms of empathy: empathy and moved
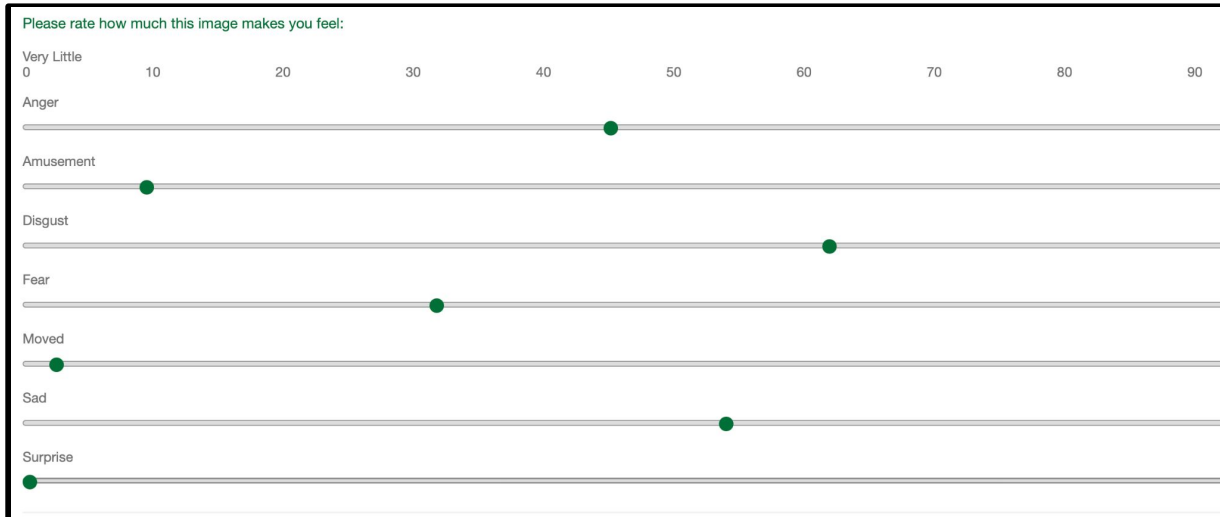
Behavioral Data - Empathy

First, we took the mean empathy rating across all images for each subject

Next, we found the mean empathy across all data for each subject

For each subject, we subtracted their mean empathy for data from their mean empathy for images

Finally, we ran a one-sample t-test across the list of subject individual differences to determine whether or not there was a statistically significant difference

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- Finally, we ran a one-sample t-test across the list of subject individual differences to determine whether or not there was a statistically significant difference*
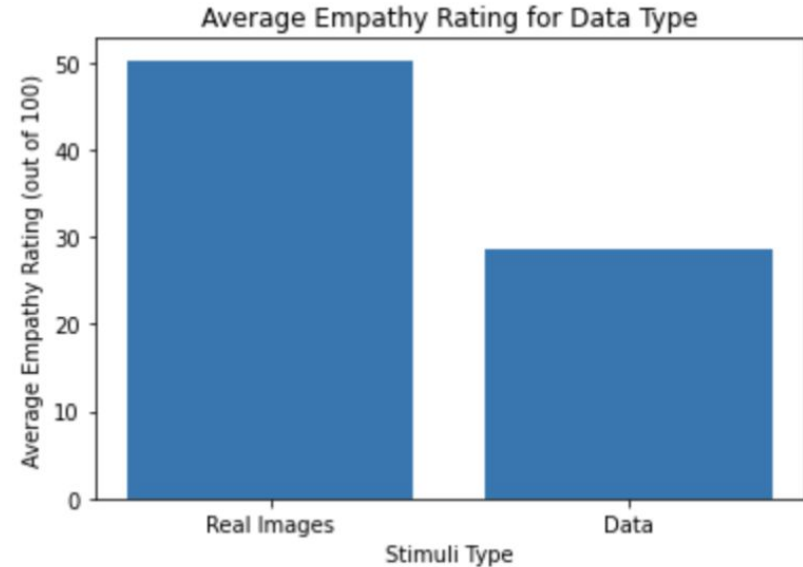- We found one!

*alpha for all statistical tests was set at 0.05

Figure 1. Mean difference in empathy ratings between real images and stats across all subjects. (t = 4.37, p = .005)

Behavioral Data - Empathy

- We also broke down images and data by category to see if the various categories showed similar differences:

- The Covid category had a significant difference

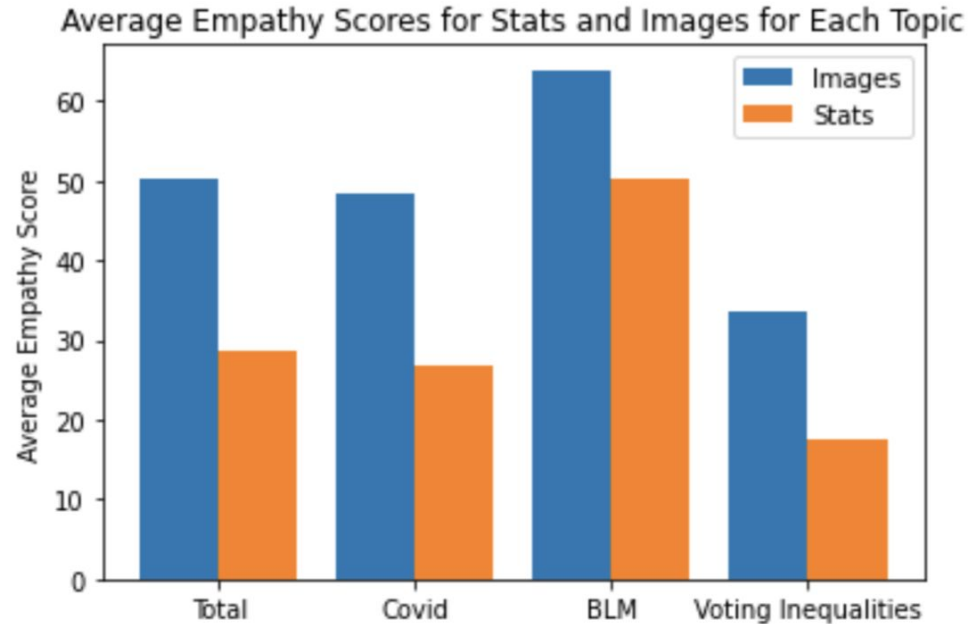- The BLM category was very close to being significant

Figure 2. Differences in means between image and data ratings for empathy for each category. Total significant at t= 4.10, p = .0002. Covid significant at t = 3.47, p = .002

Behavioral Data - Empathy

Surprises:

- We'd anticipated that Covid would have the highest empathy ratings, since it is something that has affected us all on a very personal level
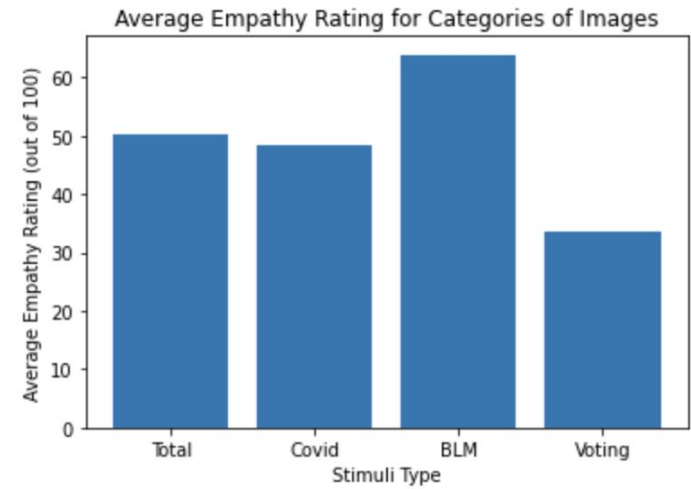- BLM had the highest empathy ratings for images and stats

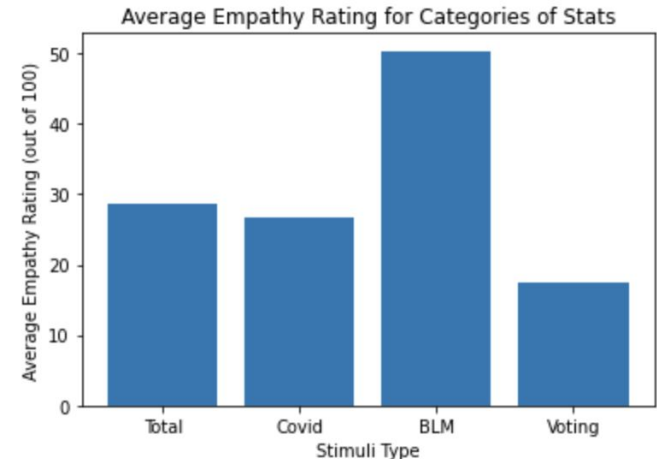**Figure 3.** Average empathy rating by category across all subjects

Figure 4. Average empathy rating by category across all subjects

Behavioral Data - Empathy

- For fun, we also calculated the difference between stats and image empathy for each subject

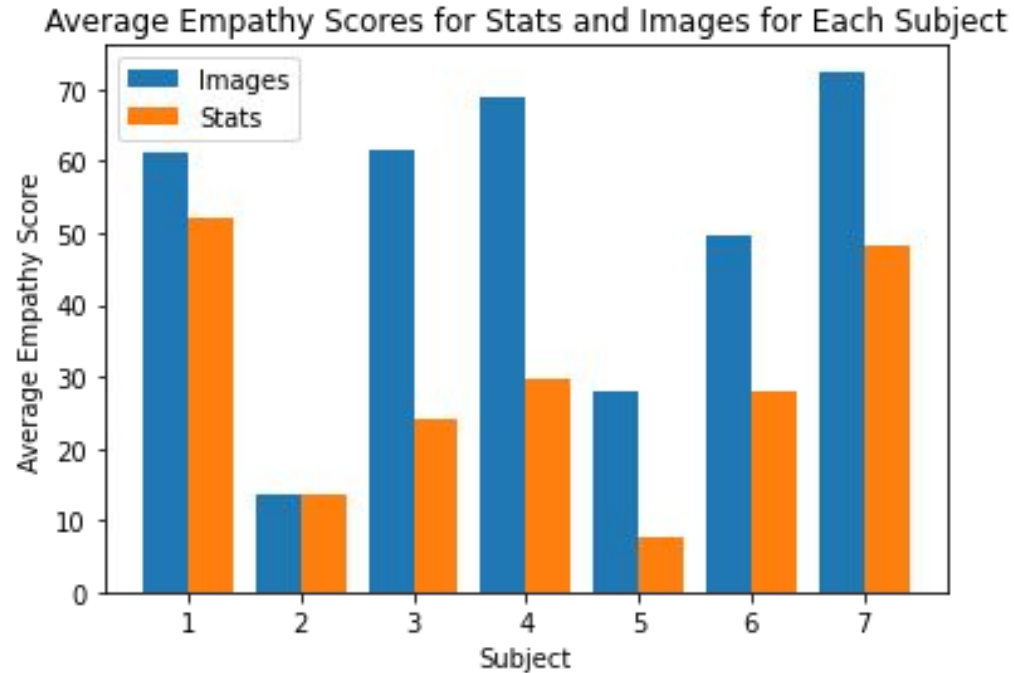- 5 out of the 7 had significantly different ratings for empathy

Figure 4. Average empathy scores for stats and images for each subject

Behavioral Data - Moved

- We ran the same tests on our moved data:
- We took the mean empathy rating across all images for each subject
- We found the mean empathy across all data for each subject
- For each subject, we subtracted their mean empathy for data from their mean empathy for images
- Finally, we ran a one-sample t-test across the list of subject individual differences to determine whether or not there was a statistically significant difference
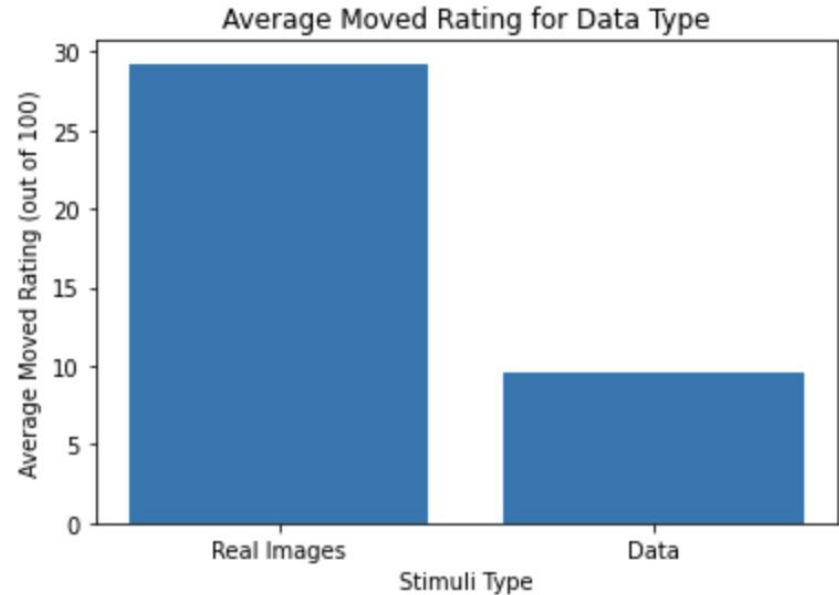- Once again, we found one!

Figure 6. Mean difference in moved ratings between real images and stats across all subjects. (t = 4.37, p = .005)

Behavioral Data - Moved

- Once again, we broke down images and data by category to see if the various categories showed similar differences:

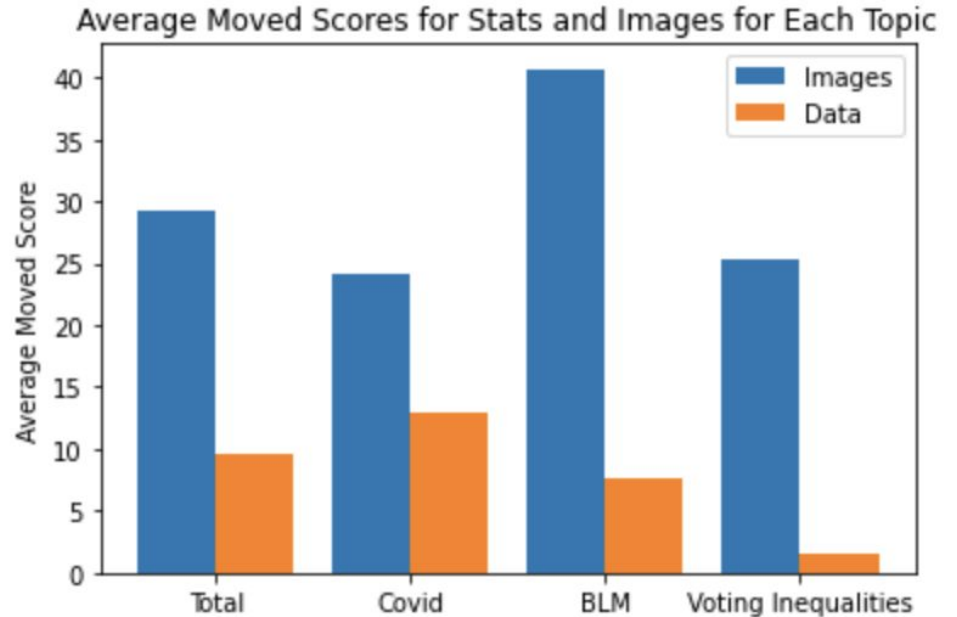- The BLM and and voting categories each had a significant difference

Figure 7. Differences in means between image and data ratings for moved for each category. Total significant at t= -4.02, p = .0002. BLM significant at t = 3.97, p = .002. Voting significant at t = 2.33, p = .048

Behavioral Data - Moved

- When we looked at moved ratings by category, we did not see as strong of an outlier for highest ratings.

- For images, BLM ranked highest again
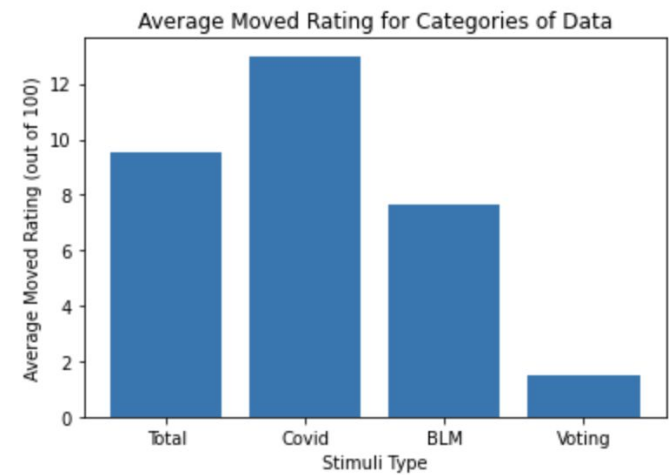
- For Data, Covid ranked the highest

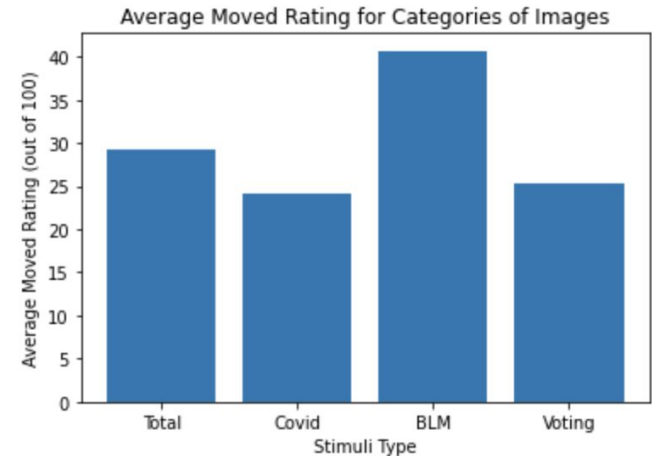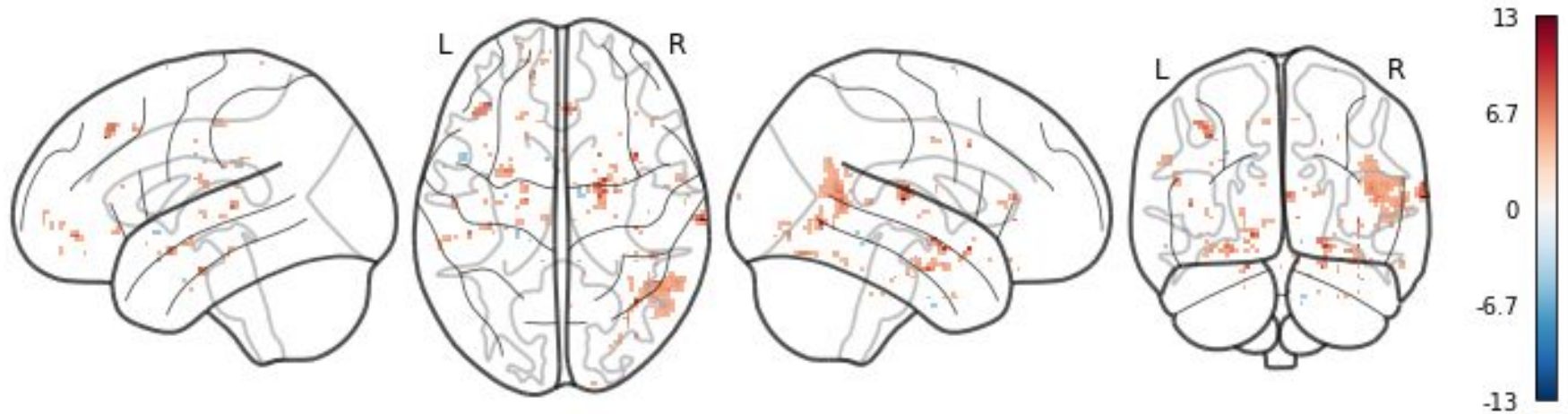**Figure 8.** Average moved rating by category across all subjects

Figure 89 Average moved rating by category across all subjects

Brain Data

# Group Level T-Test to Contrast Images v Data

Areas of Activation for Real Images

- Temporoparietal junction- theory of mind and empathy

- Ventral Medial Prefrontal Cortex (vmPFC)- appraisal, value judgements, social decision making

- Amygdala- emotion, fear

- Anterior cingulate cortex (ACC)- emotion regulation
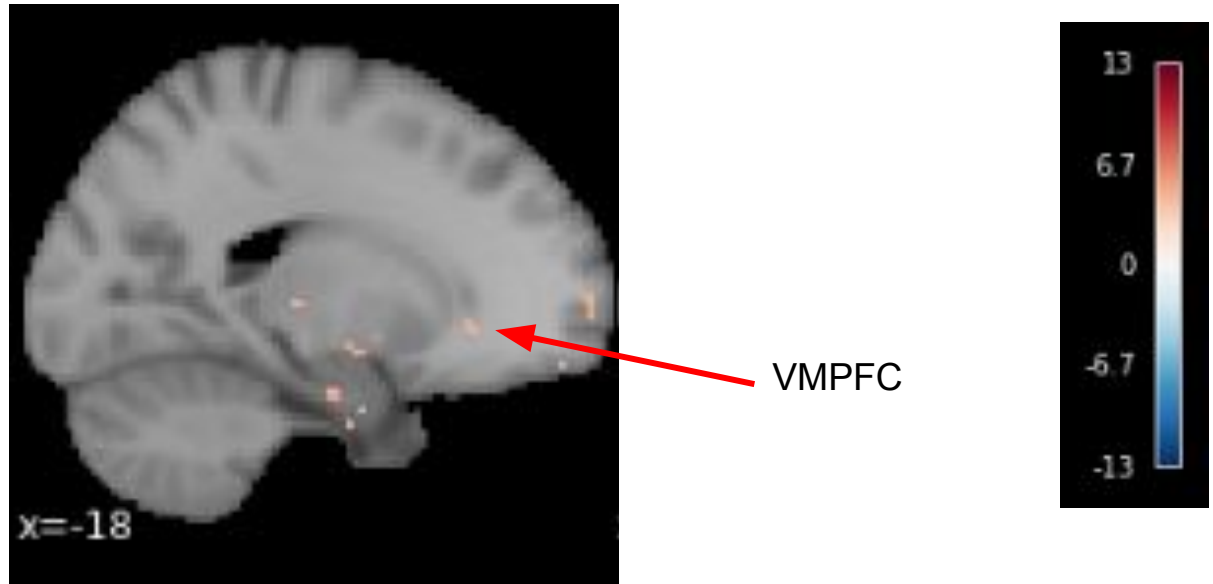
- Hippocampus- memory

Temporoparietal Junction

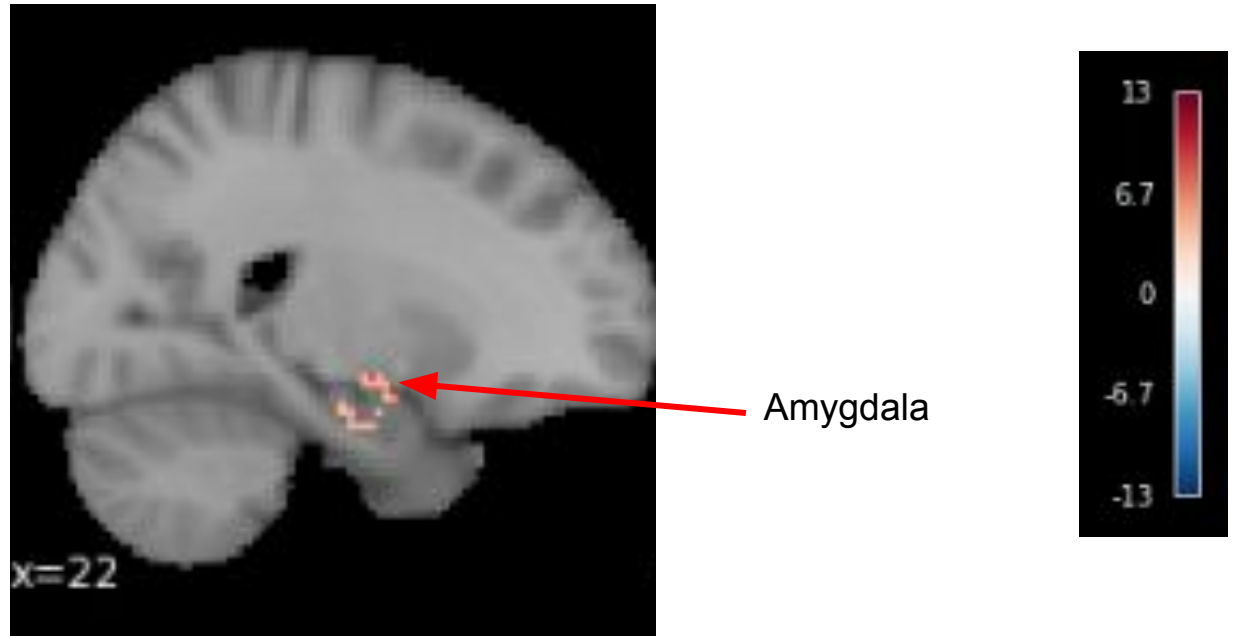- Theory of mind (a key component of empathy)

Temporoparietal Junction
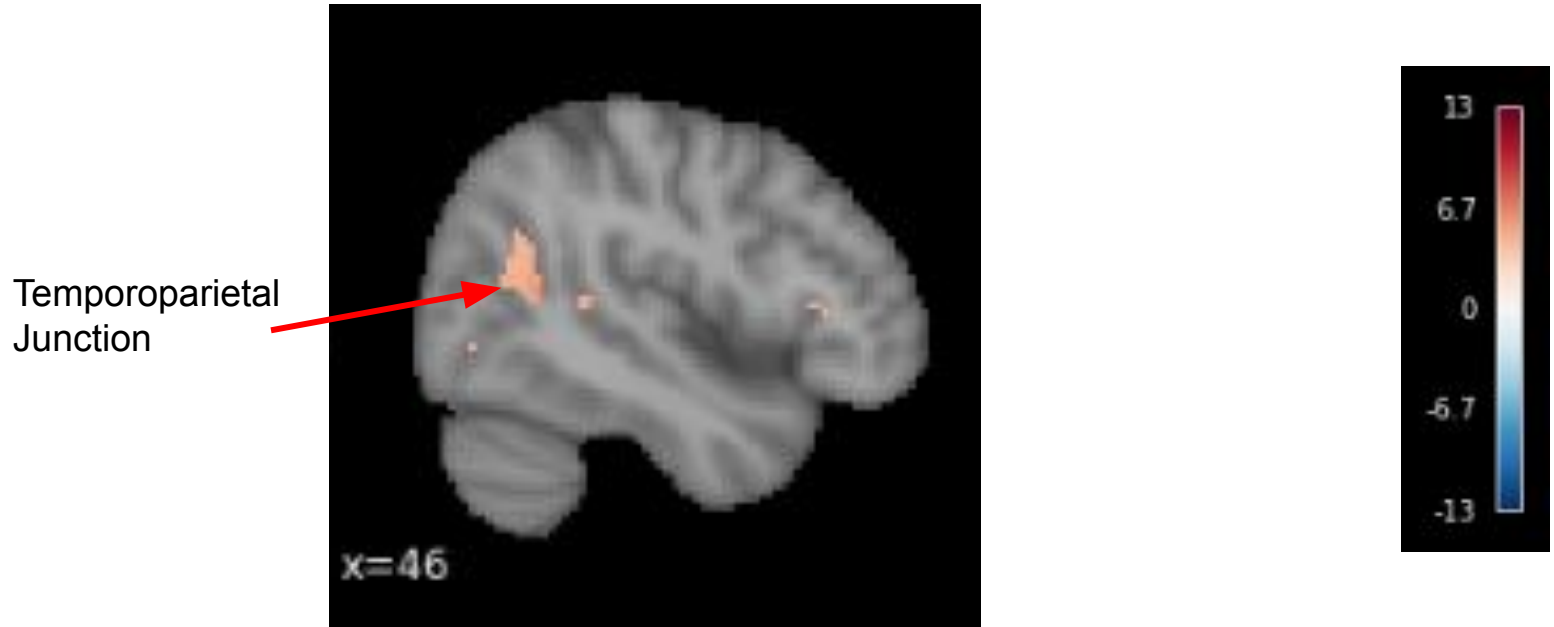
Ventral Medial Prefrontal Cortex

- Appraisal and value judgements
- Social decision making

Amygdala

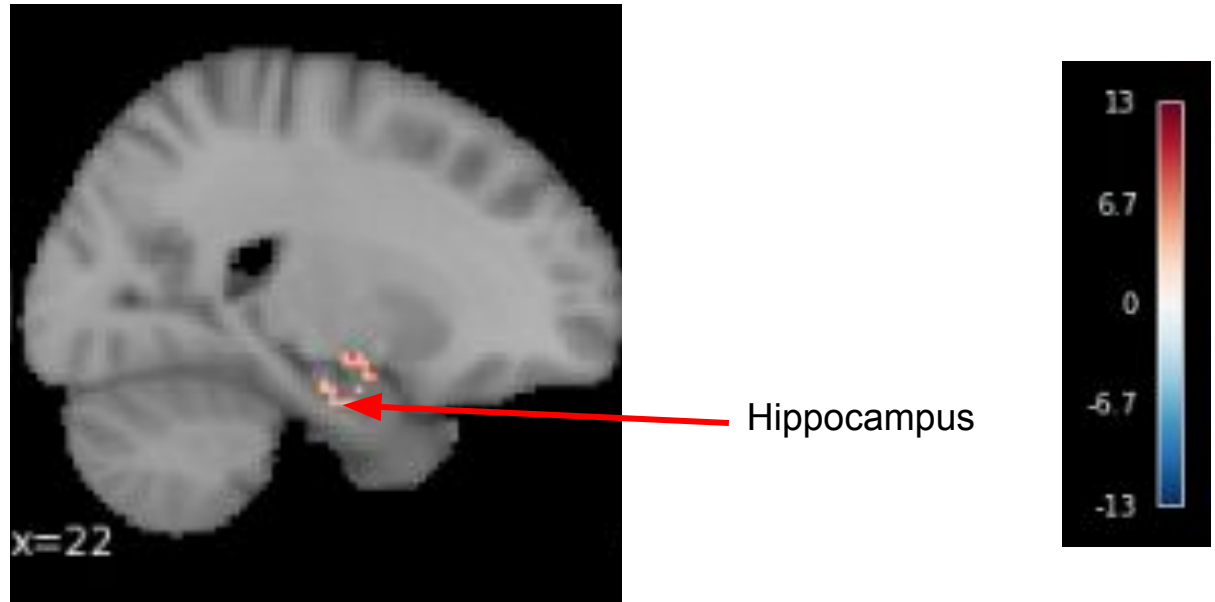- Fear and emotion processing

Amygdala

x=22

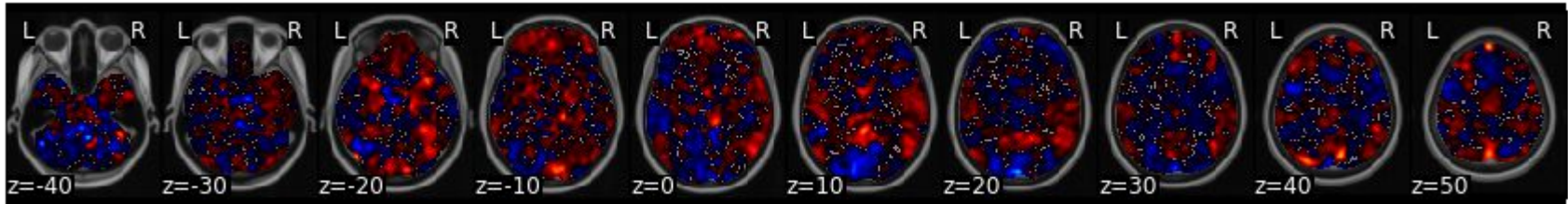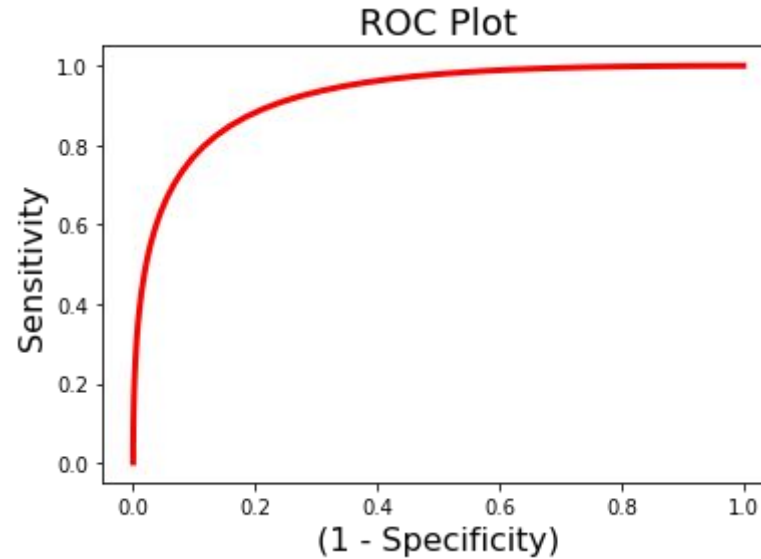# Anterior Cingulate Cortex

- Top down emotion regulation
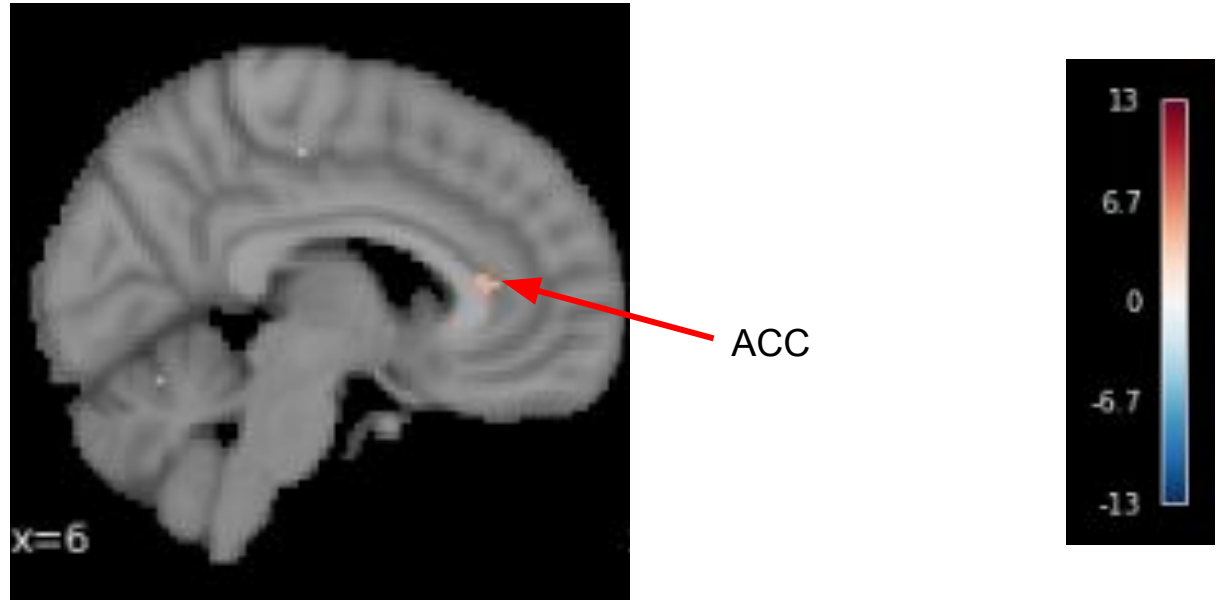
Hippocampus

- Memory consolidation and retrieval

Hippocampus

Condition Classification for Real Images and Data

- overall accuracy: 1.00
- overall CV accuracy: 0.71

ROC Plot

Conclusion

Results

- Behavioral analysis
  - Significant differences in scores for moved and empathy between real images and data
- Brain analysis
  - Activation in temporoparietal junction, VMPFC, Amygdala, Anterior cingulate cortex (ACC), and Hippocampus while viewing real images
  - Regions relate to empathy, theory of mind, emotion/emotion regulation, and memory
- Altogether indicates that people have different levels **empathetic** and **emotional** response depending on the type of stimuli they view (real images v data)

Limitations

- Small **sample size** (n = 7 for both behavioral and brain data)

- Participants were **familiar** with the task and stimuli (don't know how they would respond to data or images they hadn't seen before)

- Stimuli were **not piloted** before the experiment leading to uneven categories (more data for topics that people understood better)

Key Takeaways

- Real images **evoke more empathy** than statistics
  - This finding is supported by the brain regions that are active when viewing empathy v data
- Real images are likely to be a **more effective tool** for motivating people to care about something
- If you want your information to make more of an **impact**, present it in real images
- People can be swayed by **the way information is presented**
  - Ex: manipulating reactions in advertising to sell things or make consumers feel a certain way

Future Research Ideas

- Replicate this finding with a **larger sample size** and participants who have not already seen the stimuli
- Test whether this effect is true for **other categories of stimuli** and find potential exceptions where data evokes as much or more empathy than images
- Examine **individual differences** in empathy for types of stimuli
  - Are there people who have more empathy for data and people who have more empathy for real images?
- Compare empathy for **video clips** in these categories instead of images
- **Combine** stats and real images to create a hybrid group of stimuli
- Design an **intervention** (lab based or real world) that implements this idea
  - Ex: examining how likely people are to get vaccines after seeing real images of patients (with control group that sees data about cases)

Questions?

References

Hare, T. A., Camerer, C. F., & Rangel, A. (2009). Self-control in decision-making involves modulation of the vmPFC valuation system. *Science*, *324*(5927), 646-648.

LeDoux, J. E. (1992). Emotion and the amygdala.

Samson, D., Apperly, I. A., Chiavarino, C., & Humphreys, G. W. (2004). Left temporoparietal junction is necessary for representing someone else's belief. *Nature neuroscience*, 7(5), 499-500.

Squire, L. R., & Knowlton, B. J. (1995). Memory, hippocampus, and brain systems.

Stevens, F. L., Hurley, R. A., & Taber, K. H. (2011). Anterior cingulate cortex: unique role in cognition and emotion. *The Journal of neuropsychiatry and clinical neurosciences*, *23*(2), 121-125.