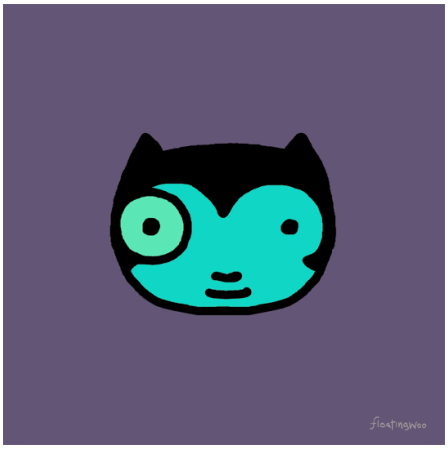
Faces & in-groups



Upcoming

- **Today:** 11:59pm deadline to submit multiple choice exam question for 1% of your grade
- **Thursday:** Review session
- **Midterm 1 Next Tuesday:** In-class, pencil and paper – bring a pencil, don't be late
  - Closed book: No laptops or devices
  - 1 short answer question, 40 multiple choice questions

Questions?

Midterm study guide

- **Experimental papers:**
  - **Read the tips.**
  - **Answer the questions in them**. These are the basis for the short answer questions.
  - **Read the papers BEFORE the lectures on them.** Bring your questions to the lecture.
  - **Read the papers again alongside your notes from lectures**!
  - Classes 3 and 4 go into detail about material in Poldrack & Farah
  - Class 7 will cover key points about the Harada et al. paper
- **Practice exam questions (MC and SAQ) posted on Canvas (under Useful 365 Resources)**. They reflect the level of content of the real exam questions. **Do the practice quizzes in the class modules!**
- Slides: Focus on information on the slides! That is most of what you will need to know from lectures. Lecture text around it is typically explanation to help you understand it.

How do we classify faces?

Some questions about faces

- Does our brain really treat faces as special? If so, how?
- How do our brains sort out information about face category (age, gender, race) and identity? What information do we use?
- Can understanding how we recognize faces help us understand some of what underlies racism?

Learning objectives

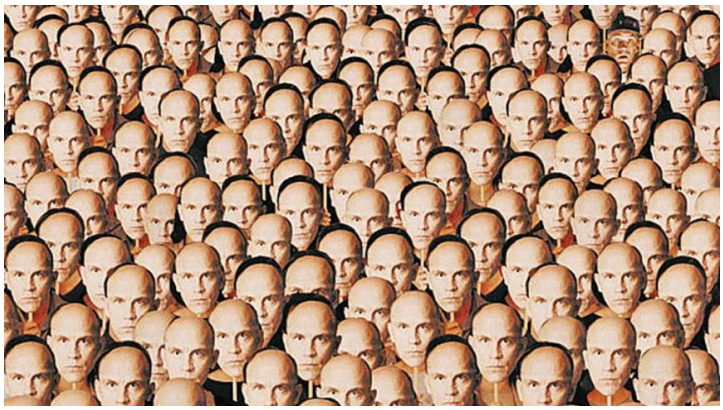
- Explain why faces are special
- Localize face processing networks in the human brain
- Describe information we use to tell facial identity and emotion
- Critically evaluate research on neural systems underlying biases in face processing linked to race and culture

What is special about faces?

Holistic processing: The Thatcher Effect

The Thatcher effect, also known as the inversion effect, was identified by researchers in the early 1980s. Here are two pictures of Maggie Thatcher, who was prime minister of Britain in the 80s, upside down. [click] Here are the same two pictures of Maggie Thatcher right side up Startling, huh? We see whether a face is smiling or frowning instantly. But if it is flipped upside down a it is not nearly so clear. This phenomeon has been held up as evidence that faces are special because we view them holisticially. That means that instead of looking at them one feature or piece at a time – e.g., mouth, nose, eyes etc separately – we process faces as whole objects in a way that is quite special. This idea that faces are fairly uniquely processed is supported by evidence from both neuropsychology and brain imaging studies.

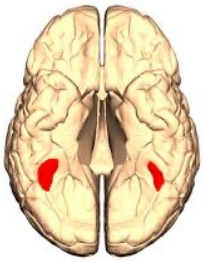
Specialized system: Prosapagnosia

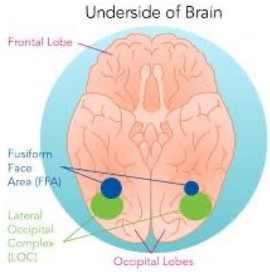


Prosopagnosia is a condition where you have no problem recognizing objects but you can't recognize faces. So it's the opposite of Kevin Chapelle, who couldn't recognize objects but his ability to recognize faces was spared. Some people are born with prosopagnisoa. Some people acquire it through damage to the temporal lobe – usually to the right side. This suggests that, although they are objects, faces are processed by their own dedicated system in the ventral visual stream.

Neural Circuitry for Face Recognition

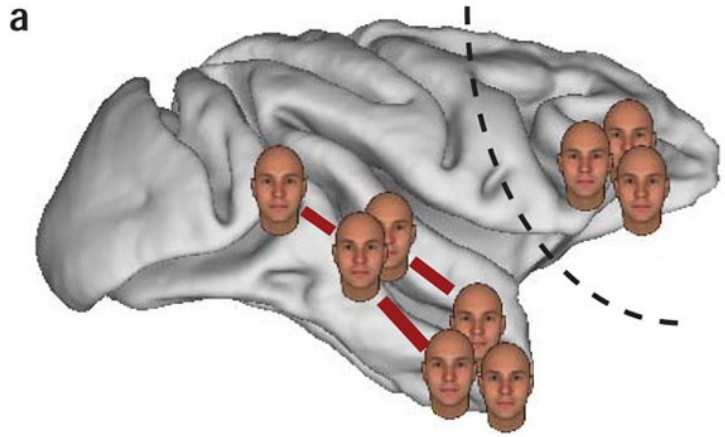
- One of several areas of the brain that play a key role in face recognition is a region of the *fusiform gyrus* called the fusiform face area (FFA)
- The FFA is part of inferotemporal cortex (IT) in the ventral visual stream
- Becomes specialized slowly over childhood-teen years



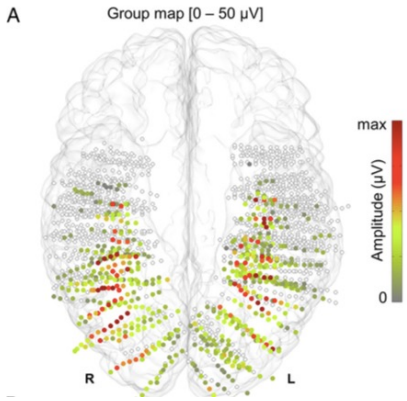


- [click]fMRI studies consistently show that a region known as the fusifofrm face area, wgich is part of IT in the ventral stream, liights up more to faces than houses or other objects. Below are two images of the underside of the brain showing where it is, and the right side shows it in relation to our old friend the LOC. In fact there are face-specialized regions in LOC as well. It is often right lateralized. And as I mentioned, people with damage to that area of cortex have a hard time recognizing faces.
- Based on early lesion and imaging evidence that focused on the FFA, some people have claimed that brain systems that respond more to faces than other objects are indication that we come ADAPTED to look at and recognize faces.
- While that may be true, the FFA actually isn't necessarily evidence for innate face recognition machinery
- Some researchers suggest it reflects expertise, and from birth we get a LOT of experience with faces [click].

Monkey studies: FFA is only one part of a face-selective network!



ECoG study shows distributed patches of face-preferring neurons



- *Face-selective* groups of neurons widely distributed
- FFA biggest (but not ONLY) cluster of face selective neurons

This image is from a study with many epilepsy patients who had grids of electrodes impolated in their occipital and temporal lobes. There's a lot of variability. They found that face selective groups of neurons – that's the coloured circles in the grid. were widely distributed, Some patches of neurons respond to faces but a bunch of other stimuli too. The dark red really like faces and prefer them to other types of object. And you can see these face-preferring neurons all along the LoC and IT. The FFA as identified by fMRI WAS the biggest patch – so it gives you a sense of how the standard approach to fMRI can find specialized locations if they are a certain size but can miss more subtle ones. So this is the state of the field now: We have istributed patches of neurons that are more likely to fire for faces than other types of objects

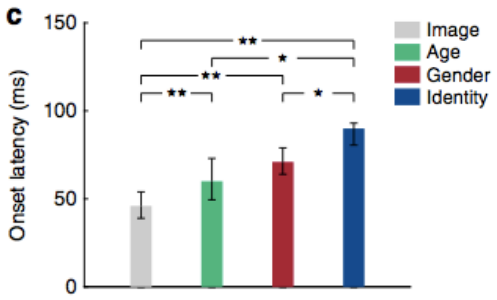
Summary so far: What is so special about faces?

- Holistic processing
  - Inversion effects
- Specialized system for faces relative to other objects
  - Prosopagnosia
  - FFA
  - Distributed specialized network

How do we recognize categories of faces?




The time course of face representations



- MEG study using RSA to look at representations of information from as they emerge over time
- Age & gender before identity (course to fine categories)

1) A recent MEG study where participants looked at familiar and unfamiliar faces used RSA to look at this question: After you are presented with a face, how fast does information about different face characteristics, such as gender, age, or identity, get extracted? One possibility is that different types of face information are extracted at different stages of processing. For example, gender information might be extracted before identity information, following a coarse-to-fine pattern where more general order information is extracted before more specific information. Alternatively, different face dimensions could be processed at the same time, suggesting greater interdependence of their processing. [1] Here are the main results. On the Y axis is the time it took for the brain to represent face information in ms. Each coloured bar is a form of face information. Green is age, Red is gender, blue is identity. Image is just how long it took the brain to represent that it was looking at an object of some kind. You can see that age was represented significantly before identity, gender slightly later, both significantly before identity. So [2]: Age and gender were represented before identity.

Dr. Jennifer Eberhardt

Dr. Jennifer Eberhardt

How do race and culture influence face perception?

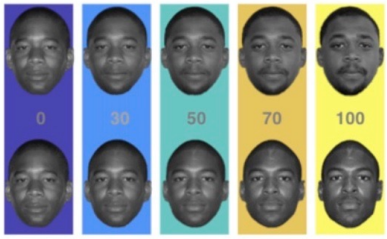
Race is another broad category (perceptual vs conceptual influences of race & culture)

Beyond age and gender, a body of research has examined how we also rapidly categorize faces by race. Humans extract social information at a glance. Race is a particularly salient social category that is detected within fractions of a second and implicates a wide range of cognitive processes, from attentional allocation to memory With regard to identity, there is a phenomenon called the "other race effect" where it's typically harder for us to tell pictures of people of other races apart. In the first months of life babies can discriminate between pictures of people of all races equally well – and even monkey faces. But by the time one year old they have developed more expertise in discriminating the type of faces they see all the time, typically humans of their own race. But this expertise comes at the cost of being able to discriminate between other races and species as well. Expertise comes at the cost of bias.. And of course sometimes, as Jennifer Eberhardt just illustrated, this kind of bias is very dangerous.

Inter-group bias

- You perceive members of your own group as individuals and other groups as categories
- Is this effect a function of perception as well as higher order processes?

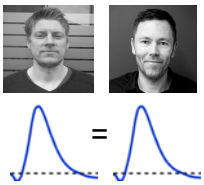
Hughes, Eberhardt et al (2019): The other race effect



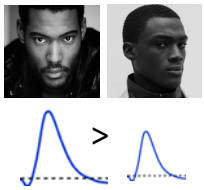
- Participants: 20 White Stanford Students
- Stimuli: Separate sets of Black and White male faces
  - 2 face identities of the same race morphed into each other from 0 to 100%
- Collected fMRI data while participants observed faces
  - Task: respond to a face with scrambly noise in the middle

Using adaptive suppression to measure other-race effect

Narrow tuning



Different!



Same!

Broad tuning

- Early face-selective cortex in the ventral stream adaptation showed that White participants were more likely to perceive two White faces as different and two Black faces as the same
- Behavioural judgments showed that Black faces had to be much more dissimilar to White faces to be perceived as different

One question is whether the other race effect involves making errors of memory or errors of perception. That guy looked like Daddy. Was that an issue with problematic memory for daddy or problematic perception of the differences. The Eberhardt study started from the understanding that while the consequences of these biases for stereotyping and discrimination are well-documented, the early perceptual underpinnings remain less understood. Are these behaviours based in errors of recollection and judgment, or do they emerge in perception -- in the very way that we SEE members of other social groups? According to the authors of this study, one possibility is that neural systems responsible for face perception may be narrowly tuned to distinguish between different identities for ingroup members but more broadly tuned to category membership, for outgroup members. And we just saw how these two different dimensions are represented at different points in time. Using fMRI adaptation, such as we saw in the last lecture, this study found the following results. [click]. For White participants, early in the ventral stream (LOC) there was less likely to be adaptation when one white face followed another. [click]. So it treated them as different people. [click] In contrast, they were more likely to show adaptation for two black faces [click], indicating that the LOC was confusing two different people of another race with each other. And they varied degrees of similarity and found that two

black faces needed to be much more dissimilar to NOT see adaptation effects. [click] So this study demonstrated that there is reduced neural sensitivity to variability among other-race faces early on in the ventral stream– suggesting our ventral streams are much more likely to perceive two different individuals of another race as the same person. Other-race faces elicited less adaptation in the ventral stream compared with own-race faces. **That is, it took way more difference for the brain to treat the face as different!** [click] Also black faces had to be much more different in appearance from black faces to be perceived as different. This suggests that the other race effect is partly an error of perception. Plus the sheer size of the regions of ventral temporal cortex showing face-selective activation was much larger for own-race than other race faces in this population. They conclude "individuals are more sensitive to physical variation among own-race faces and, conversely, have broader tuning to other-race faces, habituating to them as repeated instances of the same social category rather than distinct individuals. "And if you're more likely to see someone as an exemplar of a broad category, you're more likely to associate them with traits you associate with that category, such as criminality. But what about cultural effects on how we perceive faces -- and how we perceive the emotions they are expressing?

Cultural In-Group Advantage

- Better detection of identity and mental states in your own racial or cultural group.
- Hughes & Eberhardt study suggests in-group advantage is not just conceptual – it's actually perceptual!

Racial disparities in discriminating individual identities *emerge in the tuning of face-selective cortex* and mirror behavioural differences in memory and perception. This occurs at relatively early stages of facial perception. Described as narrower neural tuning for own-race faces, broader for other race faces. Question: What are some of the consequences of mis-identifying members of other groups?

Harada et al., 2020: The Big Picture Question

- How does culture influence biology?
- Do cultural factors influence how we perceive facial emotion in other cultural/ethic groups?

Dr. Joan Y. Chiao

Background: What influences emotion perception?

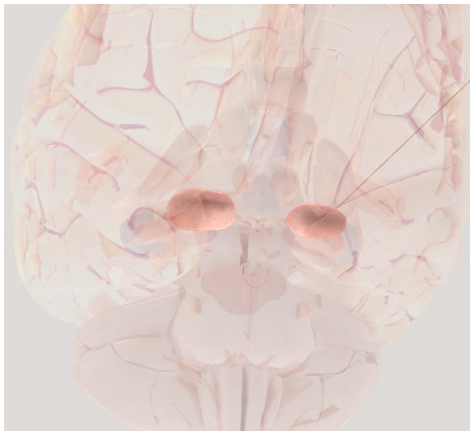
- **Culture:** It's not just identity! We're better at perceiving emotions from our own cultural group
- **Race:** The more we identify with our own racial group the more we empathize with the suffering of group members
- **Self-Construal** as collectivist vs. individualist varies with culture and may affect how emotion is perceived.
- **Open question:** How does culture influence how the brain responds to emotional faces in in-group relative to out-group members – especially for bicultural people?

When they set out to do this this study, what did we know from relevant areas of research and what were outstanding questions that led to the specific research question?. **[1]...** Part of this has to do with cultural norms about what emotions are most appropriate to show in certain situations that tune us to certain emotional signals over others. Because of shared cultural norms we can think about it as having more accurate predictions about what we're going to be seeing and being more sensitive the signals **[2]....** We feel the pain of those who are like us more. And the more active brain systems involved in empathetic responses are. If we feel they are more like me than not like me. And so we perceive their suffering as our own **[3]** *people who endorse individualistic values perceive themselves as stable entities, autonomous from other people and their environment, while people who endorse collectivistic values view themselves as dynamic entities, continually defined by their social context and relationships.*

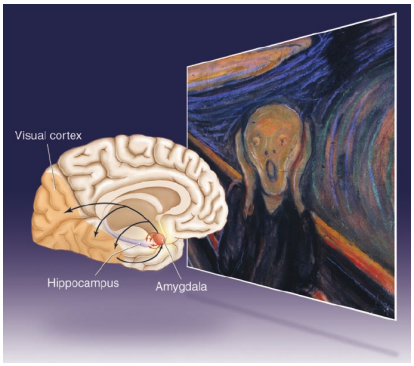
So for example people from east Asian cultures tend to be more collectivist –

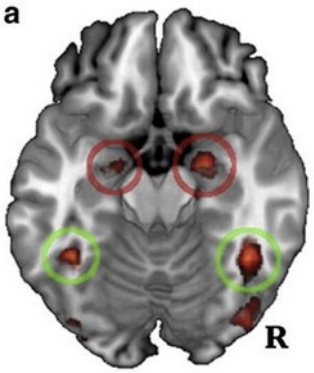
that is to say they emphasize the importance of relationship and the good of the collective– and people from Western cultures tend to be more individualistic. So in the paper, an example question for how collectivist you are was “I often have the feeling that my relationships with others are more important than my own accomplishments.”
And an example of a question measuring individualism is “My personal identity, independent of others, is very important to me.“ This can influence the degree to which you would empathize with another's emotions [4]... More specifically, they wanted to know: how does culture influence how the activity in the amygdala, which is sensitive to the emotional and motivational relevance of faces --- and is tightly connected to the FFA --- responds to emotional faces depending on race and culture? So to get to that, let’s review what we know about the amygdala and its coordination with the ventral visual stream.

Amygdala: Learning, attending, and remembering relevance



Amygdala Connections to Fusiform Face Area (FFA) and Ventral Visual Stream (VVS)





In this case we are interested in the brain's response to faces, and that of course. brings us back to the FFA. As it happens the AM is connected structurally to every section of the ventral stream, and is strongly connected to the FFA. It functionally lights up with the FFA when looking at emotionally relevant faces. So if you are looking at motivationally or emotionally relevant faces, the FFA will usually follow the lead of the amygdala and process what the amygdala tells it is important in more depth.

Background

- Amygdala and Fusiform Face Area
  - More activation for emotionally/motivationally relevant stimuli
  - Different activation patterns for racial out-groups and in-groups
  - In some contexts, more sensitive to in-group than race!
- Outstanding question
  - For bicultural individuals does exposure (familiarity in everyday life or do genetic factors (physical similarity) influence amygdala activation more?

So what do we know from previous research about the AM and FFA relevant to the current study? [1] … [2] So you would see more or less activation looking at faces of your own race than when looking at faces of another race. [3]. Researchers Jay van Bavel and Wil Cunningham did a study where they assigned a group of white participants to one of two "teams" called leopards and tigers and then taught them that a bunch of photos of black and white faces were members of their own team or the other team. They then scanned their brains while participants looked at the photos. In this study they found more amygdala and FFA response to the faces of members of their own team than the other team, regardless of race, and in this context there was no effect of race at all.

Questions

- What is the cultural in-group advantage hypothesis?
- What is the difference between cultural group and racial group?
- What cultural group(s) do you think the Japanese American (JA) group belong(s) to?

The cultural in-group advantage hypothesis suggests that cultural group members show an advantage in the perception and recognition of signals of social communication from other group members.

Cultural: US vs. Japanese culture. Racial: Are they ethnically Japanese or Caucasian.

Research Questions & Hypotheses

Research Question: What is the influence of culture on amygdala responses to negative emotional expressions of racial in-group and out-group faces?

Hypothesis 1: Bicultural (Japanese-American) participants will show greater amygdala activation to racial in-group members than Japanese or Caucasian American participants

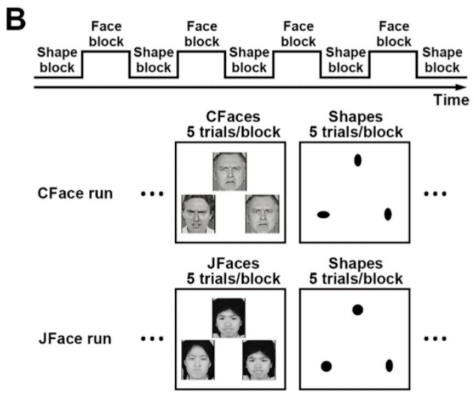
Hypothesis 2: Collectivistic tendencies would be related to neural responses to negative facial expressions in other groups.

Q. What is the difference between a big picture question and a research question? A. Big picture questions ask a question more on the theoretical level. Can be answered over time by many studies. Research questions focus on the specific dependent variables you've chosen to operationalize your question and test your hypotheses RQs.

In this study the specific research question was **[1].** One open question they mention is whether previously observed effects of in-group are due to familiarity with faces of one's own group, due to exposure, or a preference for faces that are like one's own for genetic reasons. Basically the nurture vs. nature question of amygdala preference. For the Japanese Americans they presumably see a lot of White faces, which gives them familiarity, but of course the genetic similarity is with the Japanese faces. **But can this study can really get at that nature/nurture question of amygdala function? [3]:...** H1. I want you to go look through the Introduction carefully and see if you can fijnd the previous research that justified making this hypothesis**.** Can you find the rationale for it? **[4]** Again, look in the Introduction and make sure you understand the evidence and rationale supporting this hypothesis.

Method

- Participants – young adults
  - 24 Japanese (11 female)
  - 19 Caucasian American (14 female)
  - 15 Japanese American (6 female)
- Stimuli - pictures
  - 12 Caucasian & 12 Japanese faces
    - Angry or fearful
  - Shapes



Experimental Task: Indicate which bottom face/shape matches the top face/shape

First. Who participated in the study**? [1]...** Next what were the stimuli? What did the participants see or hear of feel or taste? In this case see.... **[2]** What was the task? What did the participants do? **[2]** (B) This little schematic on the top shows that while they were in the scanner they had series of trials where they saw faces and did a face matching task alternating with series of trials where they saw shapes and did a face matching task. **Q: Why angry and fearful faces?** (Intro talks about previous study where Japanese and N Am Caucasians showed an in-group bias for negative but not positive emotions) What were the matching tasks? They had to show which face or shape on the bottom of the screen matched the face on the top of the screen.

Question

- Why do you think they included the shape matching task?
- Based on what you've learned about the ventral visual stream what might be a problem in using shapes as control stimuli for faces?

Might be looking at the differences between activation in higher level object processing – not specific to faces, drawing on amygdala connections with completely different regions of the ventral stream. Note they spend a lot of time in the Discussion defending the choice, and say they don't want the control stimuli to evoke cultural differences in perception but a lot of studies get around things like that by using upside down faces, and thinking about what you learned about the thatcher effect you should be able to see why

Variables

Independent

- Participant Group
  - Japanese
  - Caucasian American
  - Japanese American
- Stimulus type
  - Face vs. shape
- Face stimulus race
  - Japanese vs. Caucasian
- Face stimulus emotion
  - Anger vs fear

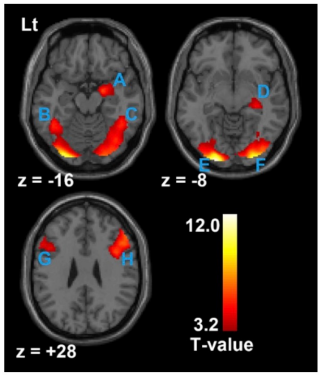
Dependent

- Accuracy
- Reaction time
- BOLD response
  - Face > shape
- Collectivism score

In all of the tips I ask you to identify the dependent and independent variablesFor this first study I'm going to tell you what they are. . [1]....[2]... [3]....[4] first the behavioural responses -- accuracy and response time in the matching task. Dependent BOLD response: This study used an **encoding** or **standard** approach to fMRI data analysis. You may remember this involves comparisons of different conditions. In this case they subtracted the BOLD activation in response to the shape task from the BOLD activation in response to the face task. Why? For a reminder look back at Passingham Chap 1! Collectivism score is harder to categorize. On the one hand it's a dependent or outcome variable they collected. But in the fMRI analyses they also used it as a predictor variable rather than an outcome - so it went from being a dependent variable to a predictor which is more like an independent variable.

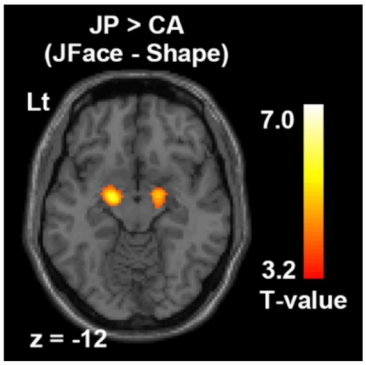
Results 1

Conjunction Analysis



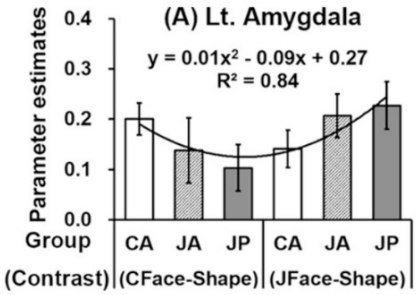
All participants showed right amygdala and bilateral FFA activation viewing negative facial expressions

Amygdala ROI: Direct comparisons between groups



Japanese participants showed more amygdala activation for Japanese (in- group) faces than Caucasian Americans did (outgroup).

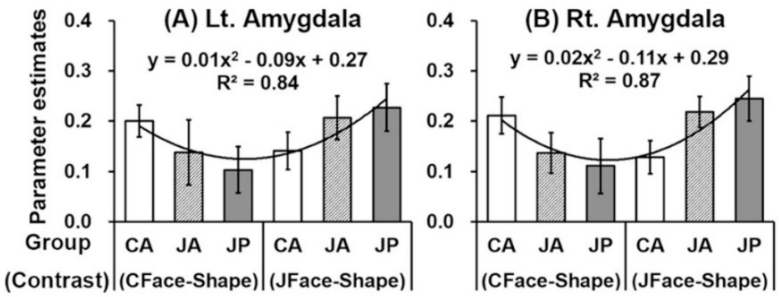
Results 2: Amygdala activation across all groups



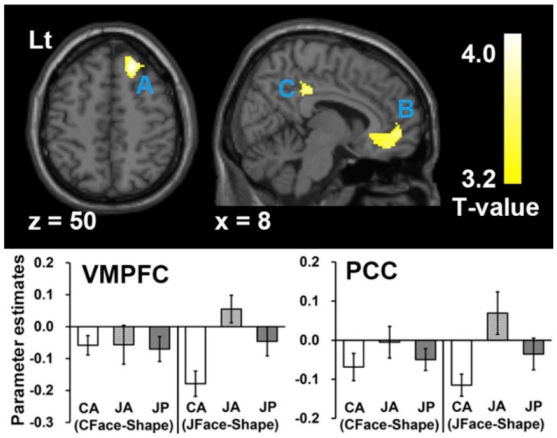
This plot is slightly terrifying, even for me. Since it's exactly the same for left and right amygdala let's just look at the left [1]. It shows the results of an analysis that is a different way of looking at the patterns of activation in the amygdala we saw in the ROI data in the last slide. So it's a different analysis of the same data from the ROI analysis, but instead of comparing pairs of participants for each face type separately, they looked at the overall pattern of activation across all groups for each face type (looking at the contrast Faces > Shapes) in the amygdala. This is what they describe as curve-fitting with a polynomial function in the 2nd to last paragraph on p. 4. It's a way of looking at trends across stimulus type and group rather than simply doing direct contrasts between pairs of groups. Each bar is the activation - the magnitude of the BOLD response.in the left amygdala for each group for Caucasian faces – shapes (remember shapes is the control condition) on the left – the left 3 bars and Japanese faces on the right 3 bars. And what you see is that for Caucasian Americans they show greatest activation for Caucasian faces and least for Japanese faces. And for Japanese faces, the Japanese and Japanese Americans show more activation for Japanese faces than for Caucasians. So everyone is showing most amygdala activation to negative expressions for their own race/in-group. To quote the authors' interpretation: "Activity in the amygdala was highest to negative faces of the

same cultural and racial members (i.e. in-group members) and lowest to those of the different cultural and racial group members (i.e. out-group members). Interestingly, Japanese-American participants showed neural responses that were intermediate in height between those of Caucasian- American and Native Japanese participants to both of Caucasian and Japanese faces. Suggest they have to be able to switch to be sensitive to information in both" [click to summarize]

Results 2: Amygdala activation across all groups



Results 3: Whole brain analysis



Japanese American participants showed greater midline activation than Caucasian participants for Japanese faces (JFaces > shape)

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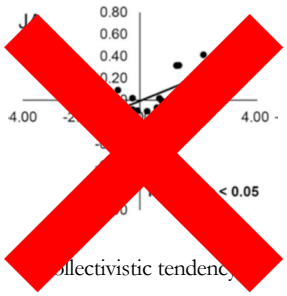
They also looked at whole brain responses to faces of each type in each group separately. This is the BOLD response to Japanese faces in the Japanese-American group compared to the Caucasian American group. Compared to Caucasian-American participants, Japanese-American participants showed significantly larger responses to Japanese faces in the right superior frontal gyrus (A), ventral medial prefrontal cortex (B) and posterior cingulate cortex. **Parameter estimates** on the y axis for the plots below. It refers to a statistic of the degree of BOLD activation in a voxel. It's a measure of the BOLD response.) Note these are key nodes in the DMN and more active the more self-relevant something is. They are also important for autobiographical memory.

Uh oh. What's wrong with this correlation?



Brain-behaviour Correlations with small sample sizes are known to produce unreliable, misleading results!

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Collectivism scores were higher for Japanese Americans than Caucasian Americans – though interestingly not between the Japanese group from Japan and Caucasians. Maybe because the number of participants, or sample size, was so small. But the main purpose in collecting collectivism scores was to correlate them with brain activity. Count the number of dots (or number of Jap Am participants) in this correlation. Correlations with this few participants are not reliable and you can get a lot of dead salmon style false positives. Now I want to remind you that cognitive neuroscience is a young and fast-evolving field, and 10 years ago this kind of brain – behaviour correlation was very common. You saw it all the time. But it's been found that these correlations simply don't replicate. If you did the same experiments in another 20-25 participants you'd find a different set of results.

In fact, recent studies have suggested that for really reliable individual differences in brain imaging responses you actually need hundreds of participants. So these days these small sample correlations don't fly, and if I were a peer reviewer for this paper I would have said it has a lot of good things in it but they absolutely should not publish these correlations – that with this few people they are pretty bogus. And anything the authors say about these results in the Discussion I would disregard.

Summary

- Native Japanese participants showed greater amygdala activation for angry and fearful faces of their own race than other-race faces.
- *Cultural in-group effect*. Overall amygdala activation showed a cultural in-group effect of greater amygdala activation for faces from each group of participant's own own in-group. Bicultural participants responded to both!
- Japanese American participants showed greater response to Japanese faces in midline areas of the brain that respond to self-relevance and autobiographical memory

They say: 2. The authors mention the Cultural Ingroup Advantage Hypothesis: Because of their motivational significance in a variety of contexts (e.g., economic, psychological, and evolutionary), in-group members often warrant greater, or deeper, processing than out- group members. We may pay more attention to them. They cite the Eberhardt study indicating a perceptual advantage for in-groups. . **Q: How does this map on to recent MEG findings that familiarity rapidly enhanced representations of identity?** WRT Japanese Americans amygdala response to both groups they suggest that they are required to attend and process communicative information from both groups

Question

- How would you think about the finding related to the cultural ingroup effect in relation to the MEG study findings that familiarity rapidly enhanced representations of identity?

Some limitations

- Only angry and fearful faces – no face control condition
- Insufficient sample size for correlations/low power for group comparisons
  - So, was the second hypothesis really supported?
- Whole brain findings involve a lot of "reverse inference" using a standard or encoding approach

Harada et al., 2020

It's really important to have a critical eye. [1] In the results of the conjunction analysis they interpret the findings of regions activated for all faces in all groups as reflecting a set of brain regions specialized for basic emotion. **Q But can they conclude the findings are unique to emotion when they only compared negative emotion faces with shapes?** They say that because the amygdala responds to threat that it must be about emotion and not just faces. But in fact the amygdala responds very strongly to all faces relative to shapes! What are some others you can think of? Reverse inference: "In the current study, greater response within the ventral medial pre- frontal cortex and posterior cingulate cortex likely reflects greater informational demands of self-relevant memory, because their recognition of their racial identity might be automatically strengthened when negative facial expression of racially in-group members was presented." But in fact those midline structures involve very flexible populations of cells that participate in many networks and respond as part of many different cognitive processes, so how solid is that inference? re there other limitations you can think of?

Conclusions

- *Cultural in-group effect*: Cultural group members show an advantage in the perception and recognition of signals of social communication from other group members
  - Facilitate social harmony within group?
- Amygdala responses shaped by culture – not just ”hard-wired”

Face processing take-home 1

- Faces are processed holistically and by specialized brain systems
- We know from lesion studies, fMRI and cortical stimulation that the FFA is a region that plays a causal role in perceiving facial structure
- It develops its *selectivity* very slowly right through the teen years
- But it is only one node in a distributed network of face selective neuron clusters sensitive to different face features

Face processing take-home 2

- Representations of broad categories like gender and age are discriminated faster than identity. Identity represented more strongly for familiar faces.
- fMRI adaptation in face-sensitive cortex supports better perceptual discrimination of identity for our own (familiar) race
- Our amygdalae are more sensitive to negative facial emotion within our own cultural-racial in-group– suggesting they may be more motivationally salient in-group members
- What does it mean for how we respond to out-groups?

See you next class!

- Review session

b. Going beyond comparing 2 experimental conditions and “reading” the brain to see what a person is looking at. O