

A Neuroscience Approach to Social Status Perception and Health

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Social hierarchy in the animal kingdom



What is status?

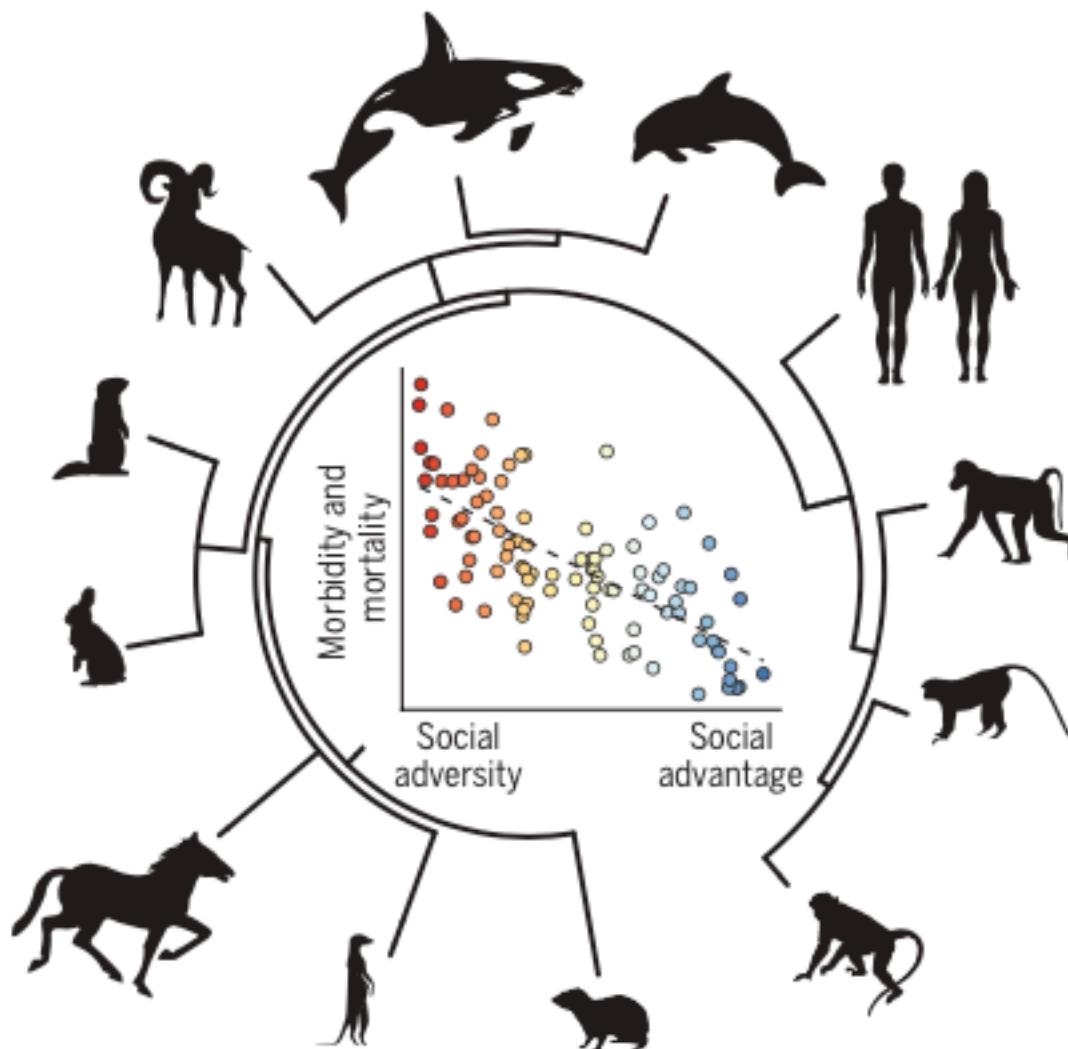
- Relative rank of an individual along one or more socially valued dimensions



An intersectional approach

- Stereotypic links with race (Moore-Berg & Karpinski, 2018) and gender (Ridgeway, 2006)
- These links shape evaluative biases for:
 - Race (Mattan et al., 2018, *SCAN*; Mattan et al., 2018, *eNeuro*; Mattan et al., 2019, *PSPB*)
 - Gender (Mattan & Cloutier, 2020, *Royal Soc. Open Sci.*; Barth, Mattan, et al., 2020, *Scientific Reports*)
- Status associations predict intergroup hierarchy maintenance (Dupree et al., 2020)

Status-health gradient (Adler et al., 1994)



Neuroscience of status and health

Social Psychology & Neuroscience

- **Implicit prejudice**
 - Mattan et al., 2019
 - Mattan & Cloutier, 2020
 - Barth et al., in prep.
- **Impression formation**
 - Mattan et al., 2018a
 - Mattan et al., 2018b
 - Dang, Mattan*, et al., 2019
 - Barth, Mattan*, et al., 2020
- **Decision making**
 - Mattan et al., 2020
 - Mattan et al., in prep.

Social Determinants of Health Disparities

- **Race-related stressors**
 - Johnson et al., under review
- **Poverty and smoking**
 - Mattan et al., in prep.
- **Status and immunity**

Health Psychology & Neuroscience

- **Physical activity**
 - Mattan et al. in prep.
- **Tobacco retailers**
 - Mattan et al., ongoing
 - Andrews et al., in prep.
- **COVID-19 messaging**
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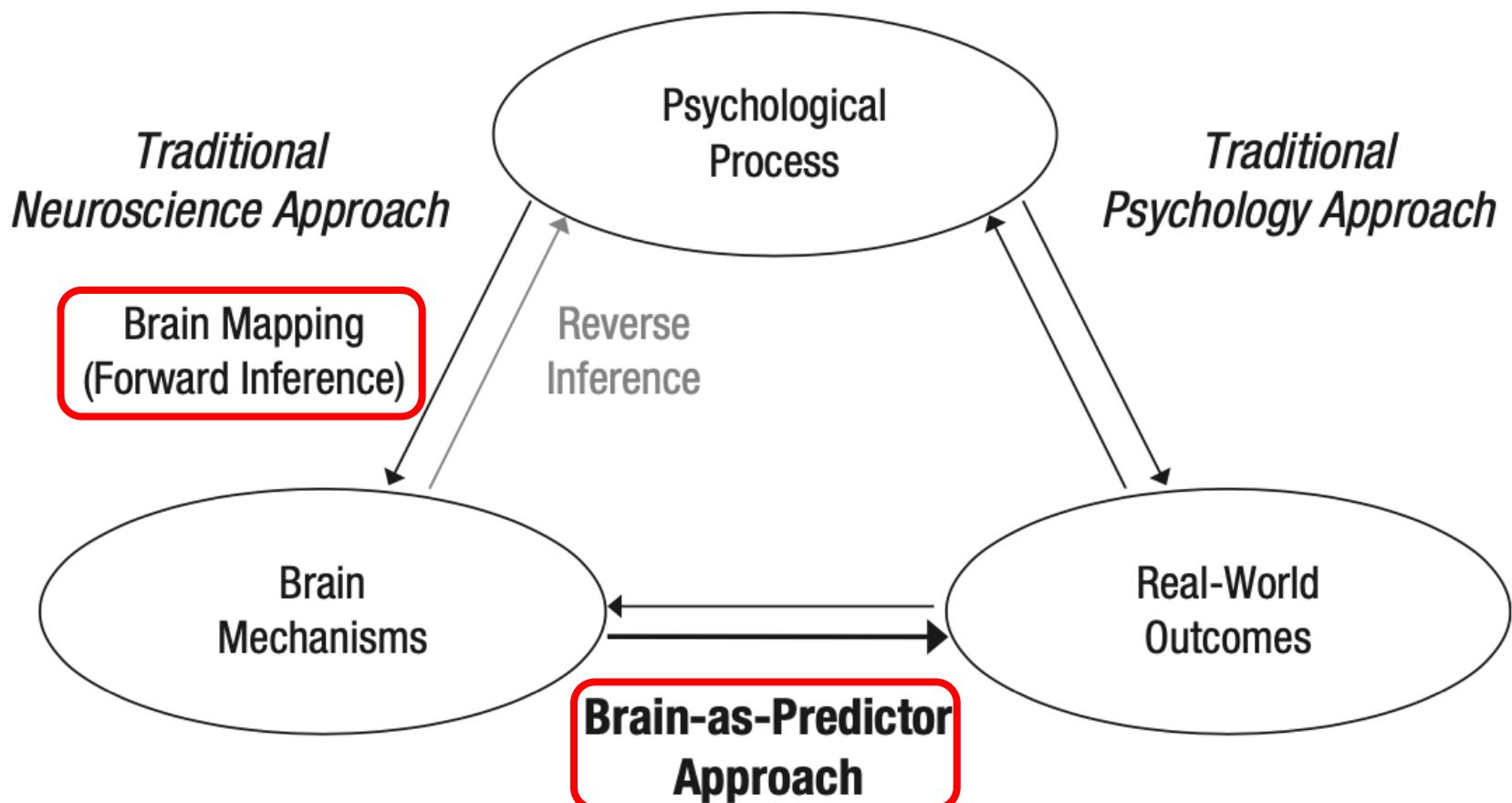
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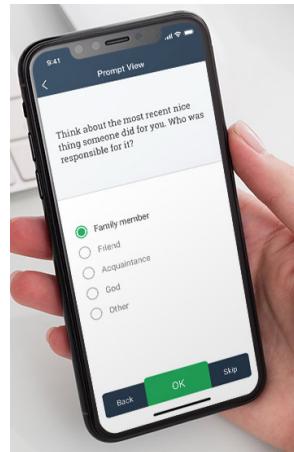
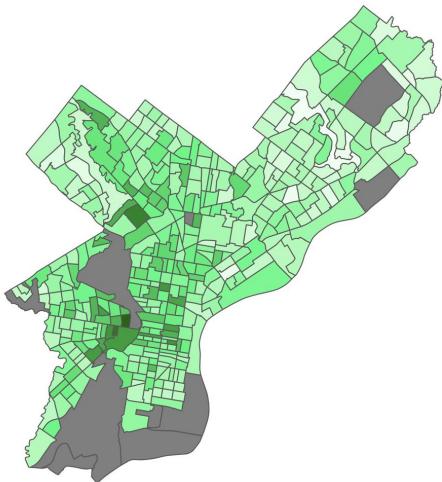
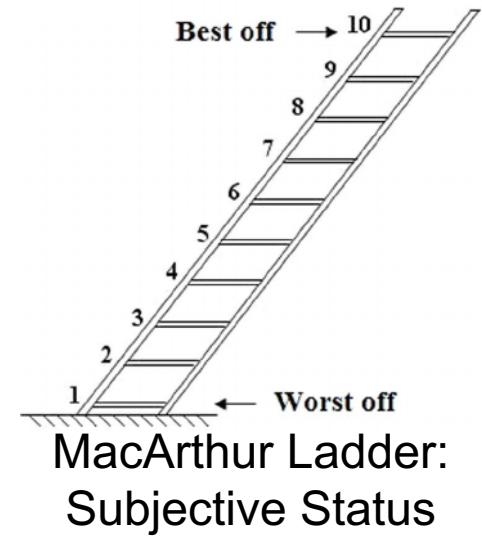
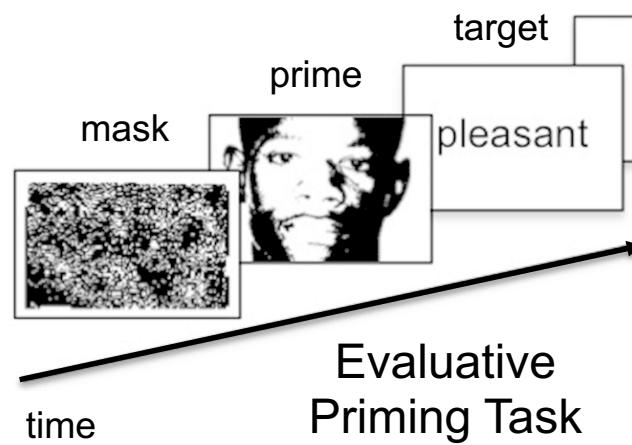
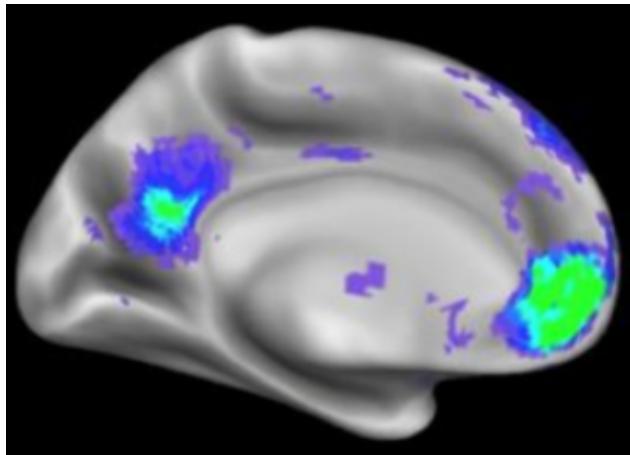
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Neuroscience approaches



Multi-level approach

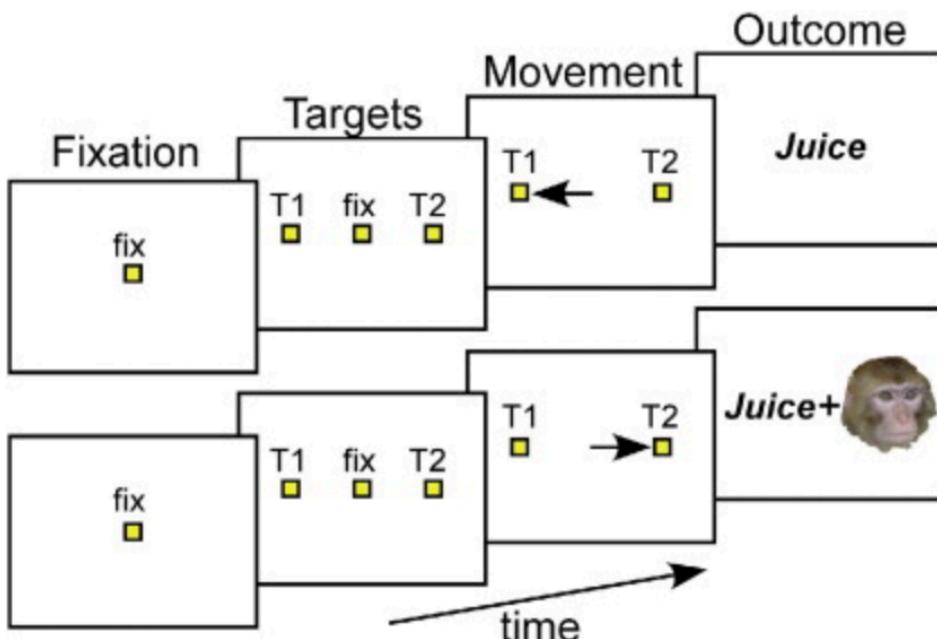


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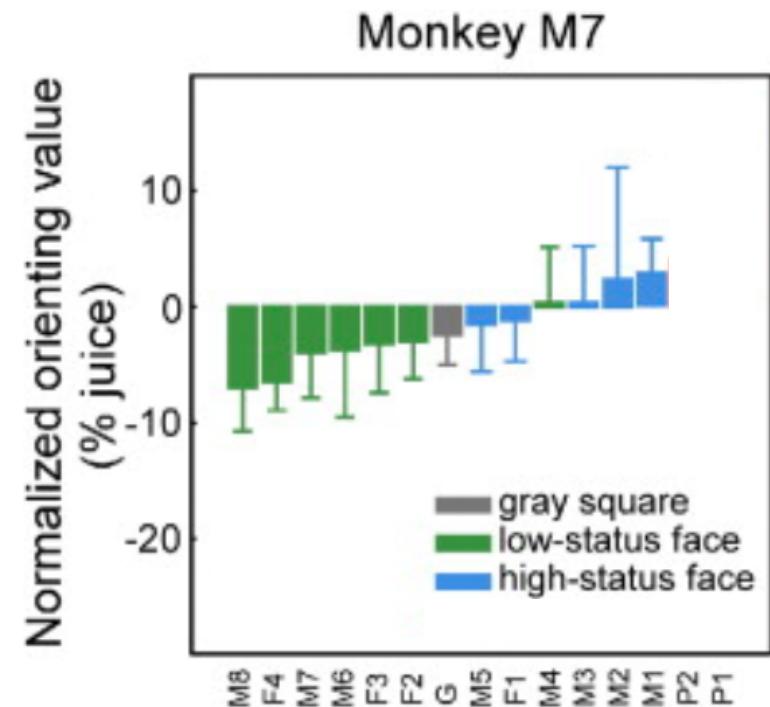
Overview

- What neural processes support impression formation based on perceived status and race?
- Can we isolate neural signatures of self-relevance and valence to predict health message effectiveness?
- Future directions

The value of seeing high status

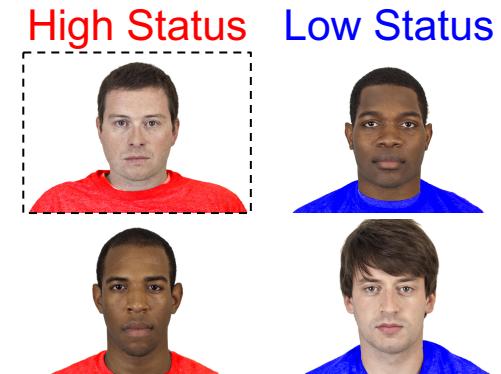


Deaner et al., 2005



Status-based evaluation in humans

- Explicit evaluations favor high status, but are context sensitive (Cuddy et al., 2008; Horwitz & Dovidio, 2017; Rudman et al., 2002; Varnum, 2013)
- High status favored at implicit level
 - Evaluative priming (Mattan et al., 2019, *PSPB*)
 - Affect misattribution (Boukarras et al., 2019)
 - IAT (Mattan & Cloutier, 2020, *Royal Soc. Open Sci.*)



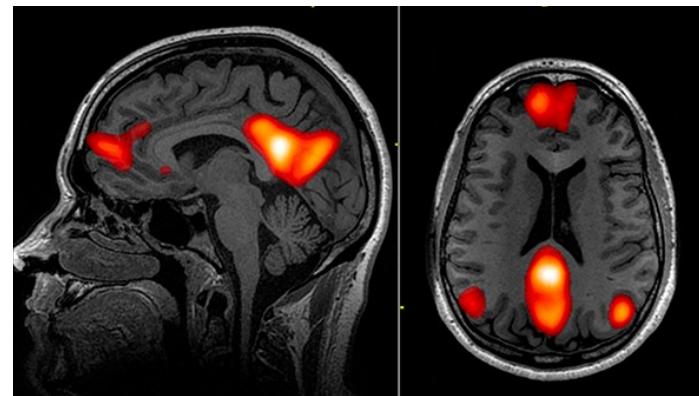
Deliberate impression formation



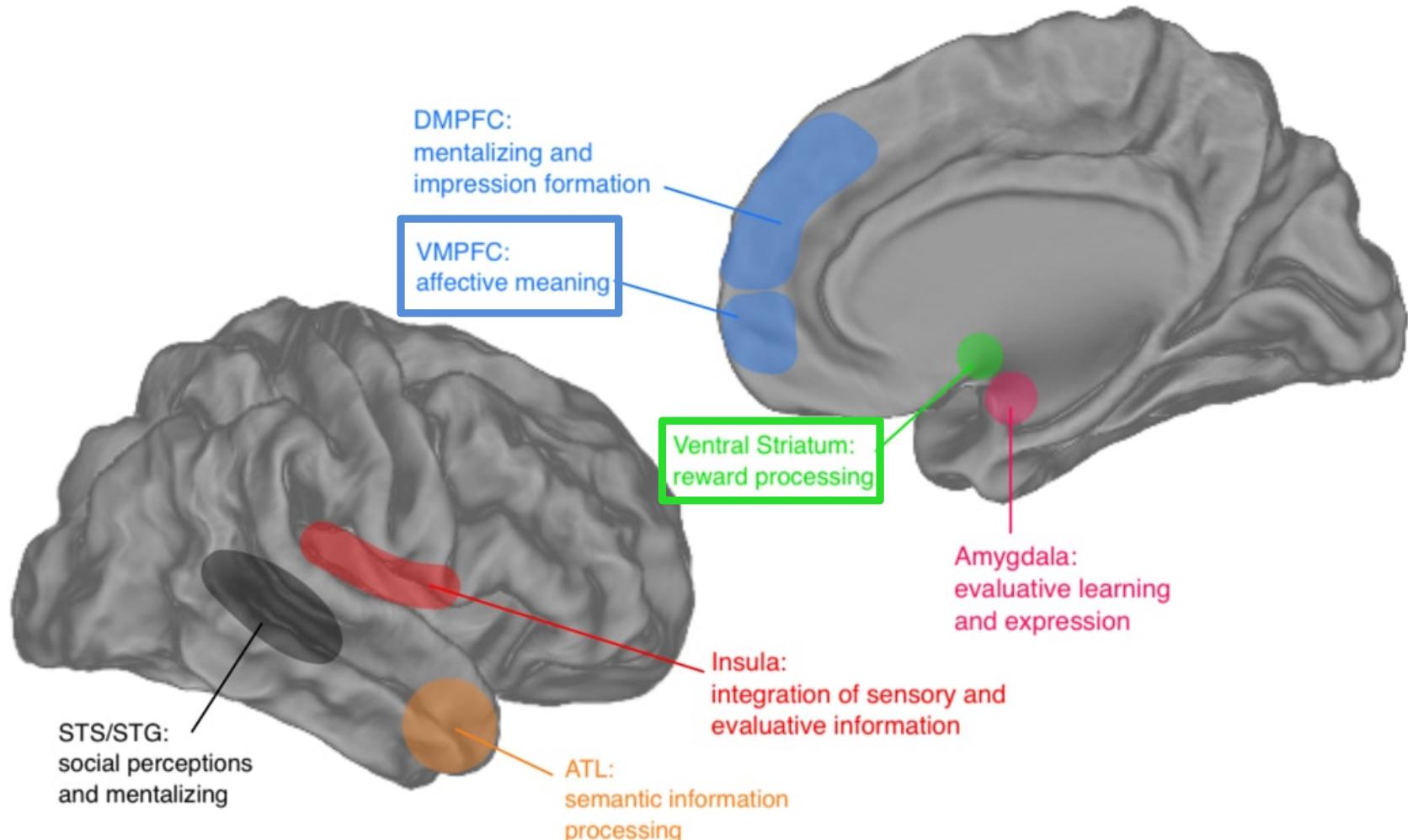
How do status and race shape
deliberative impression formation?

Neuroimaging approach

- Offers novel insights into psychological mechanisms
- Helps circumvent demand characteristics



Neural substrates of prejudice



Impression formation study

- “Those who have the **HIGHEST** social status tend to have the **most** money, the **most** education, and the **most** respected jobs.”
- “Those who have the **LOWEST** social status tend to have the **least** money, the **least** education, and the **least** respected jobs (**or no job**).”

High Social Status
in the US



Low Social Status
in the US



SOCIAL PSYCHOLOGY

Status beyond what meets the eye

Conveying an impression of competence is important for jobseekers and politicians alike. New work from Oh, Shafir and Todorov suggests that subtle differences in clothing shape our impressions of how competent people are. In particular, subtly richer-looking clothes elicit greater perceived competence.

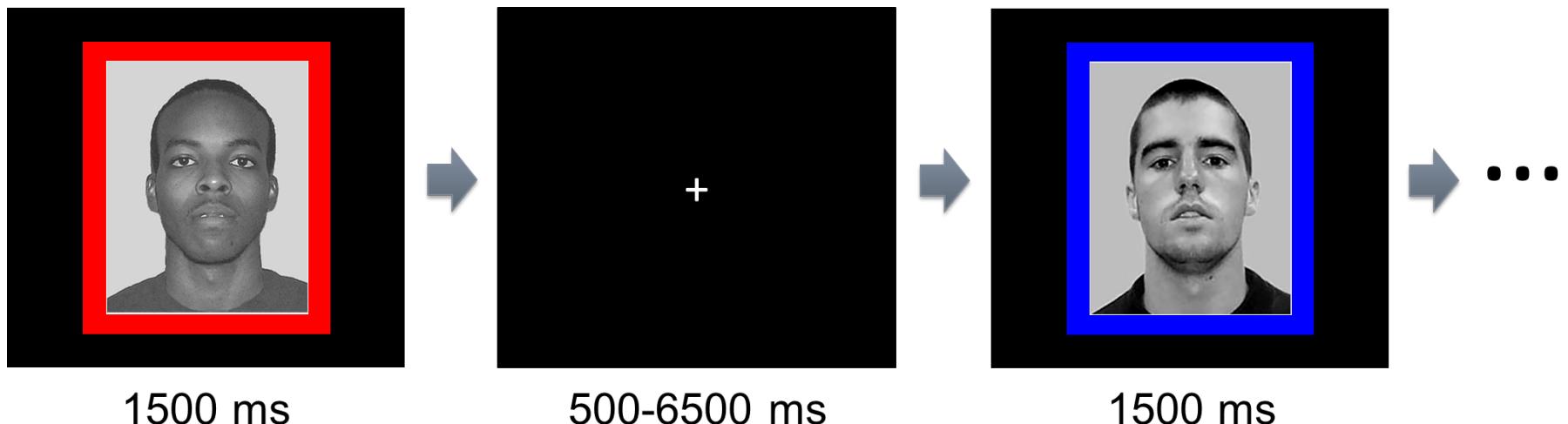
Bradley D. Mattan and Jennifer T. Kubota



Mattan & Kubota, 2020, *Nat. Hum. Behav.*

Impression formation study

- fMRI impression formation task:



Individual differences in motivation to regulate bias

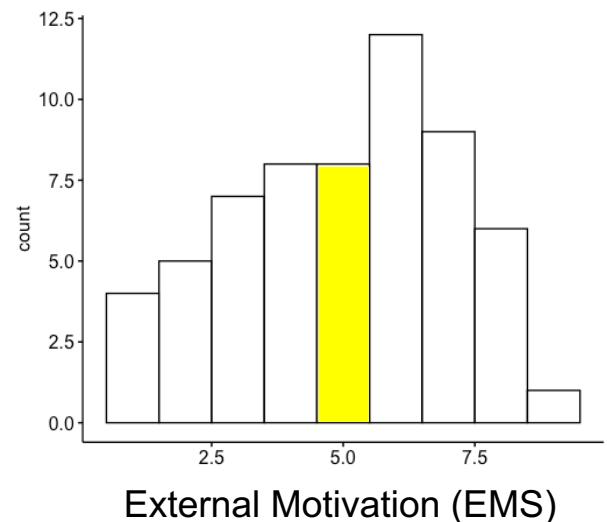
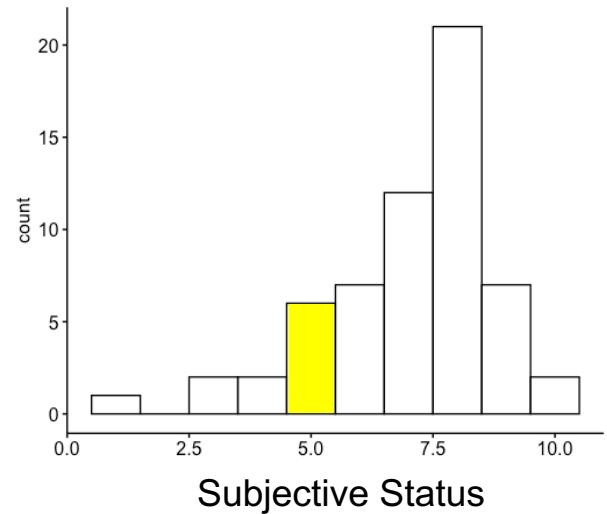
- External motivation (Plant & Devine, 1998)
 - Discomfort (Amodio et al., 2006)
 - Effortful but inefficient self-regulation (Richeson et al., 2003)
 - Focus on alternative attributes/topics (Apfelbaum et al., 2008; Norton et al., 2006)

Assessing external motivation to respond without racial prejudice

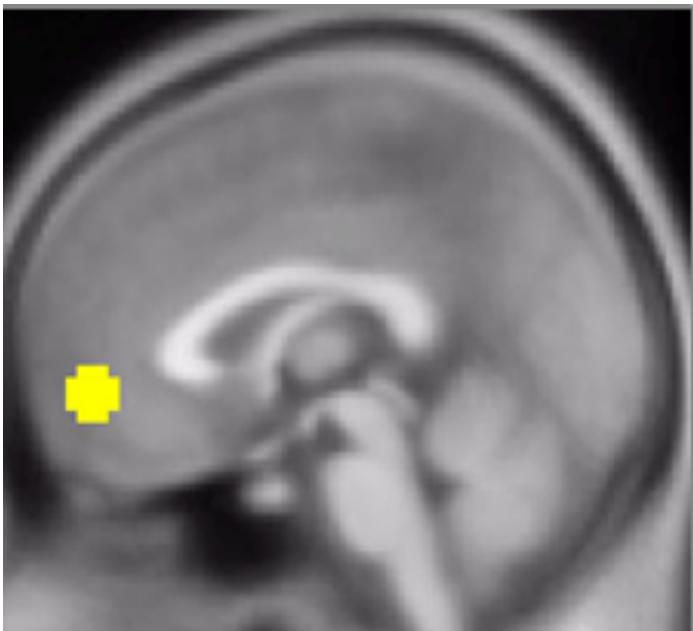
- EMS: 5-item subscale (Plant and Devine, 1998)
 - “Because of today's PC (politically correct) standards I try to appear nonprejudiced toward Black people”
- Internal motivation (IMS): 5-item subscale

Sample and analyses

- Sample characteristics
 - 60 White men
 - Chicago area
 - 18-35 years old
- Examined relationship between external motivation and neural responses to status/race

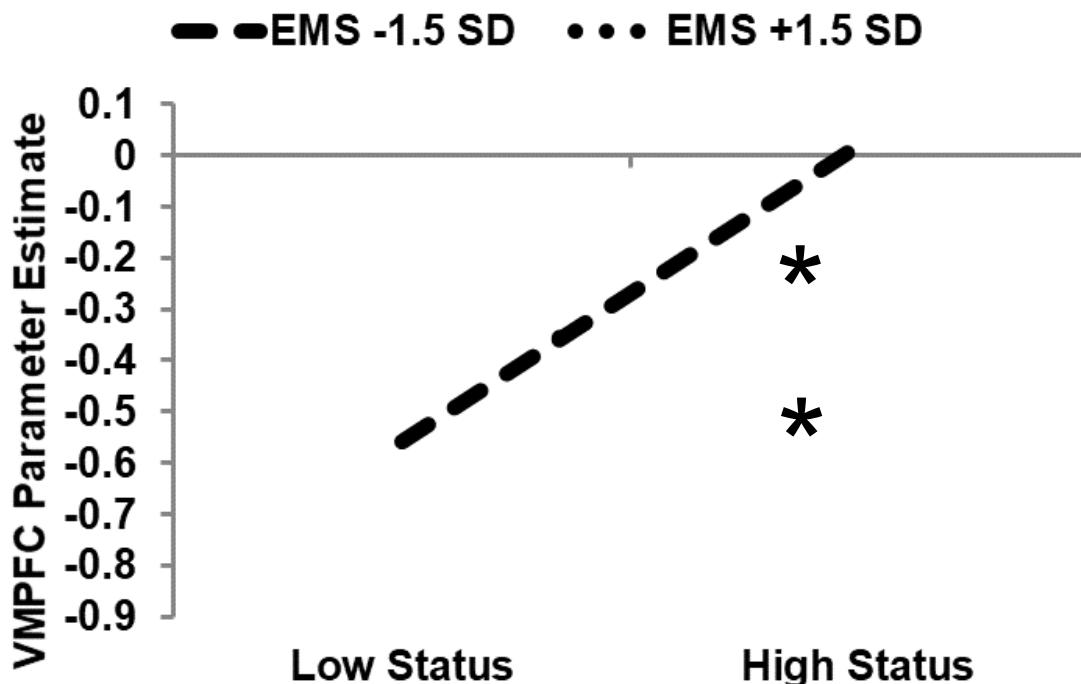


External motivation (EMS) predicts responses to status but not race

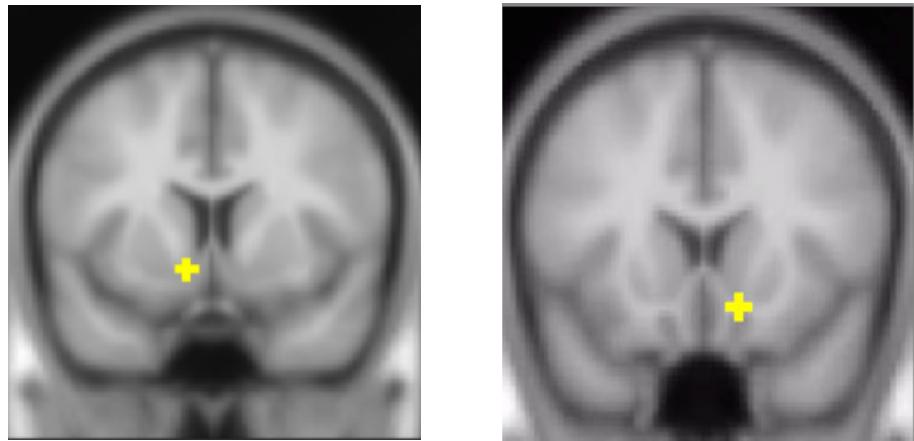
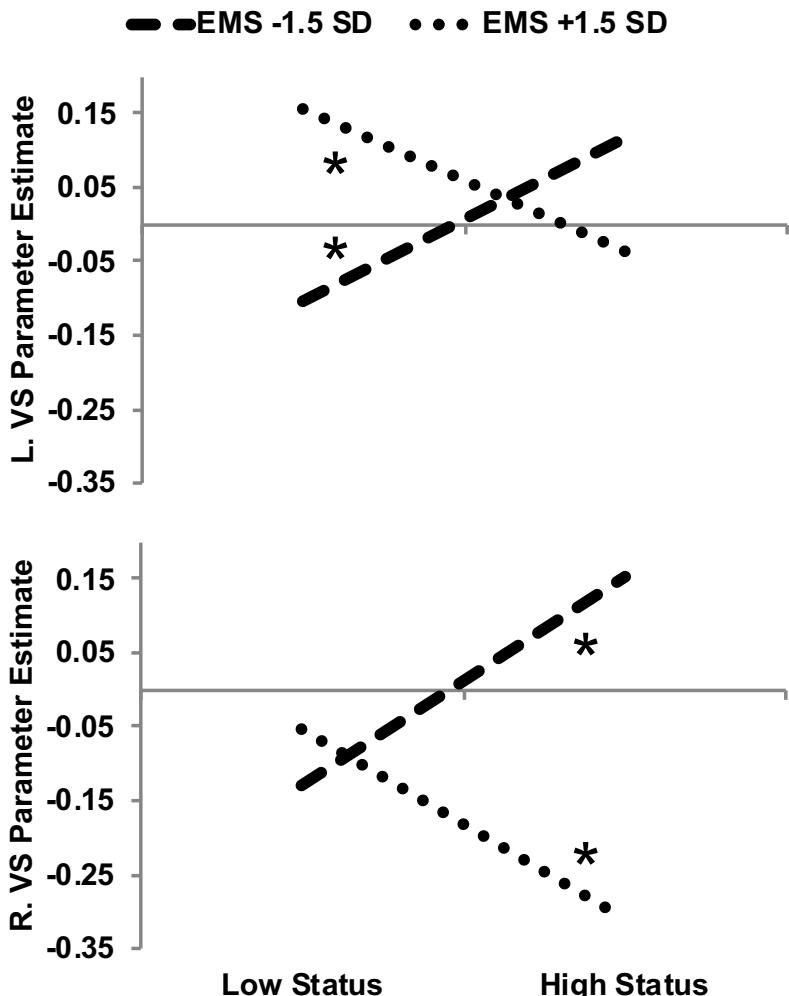


Status × EMS Interaction

<i>b</i>	<i>SE</i>	<i>t</i> (174)	<i>p</i>
-0.187	0.065	-2.85	.005



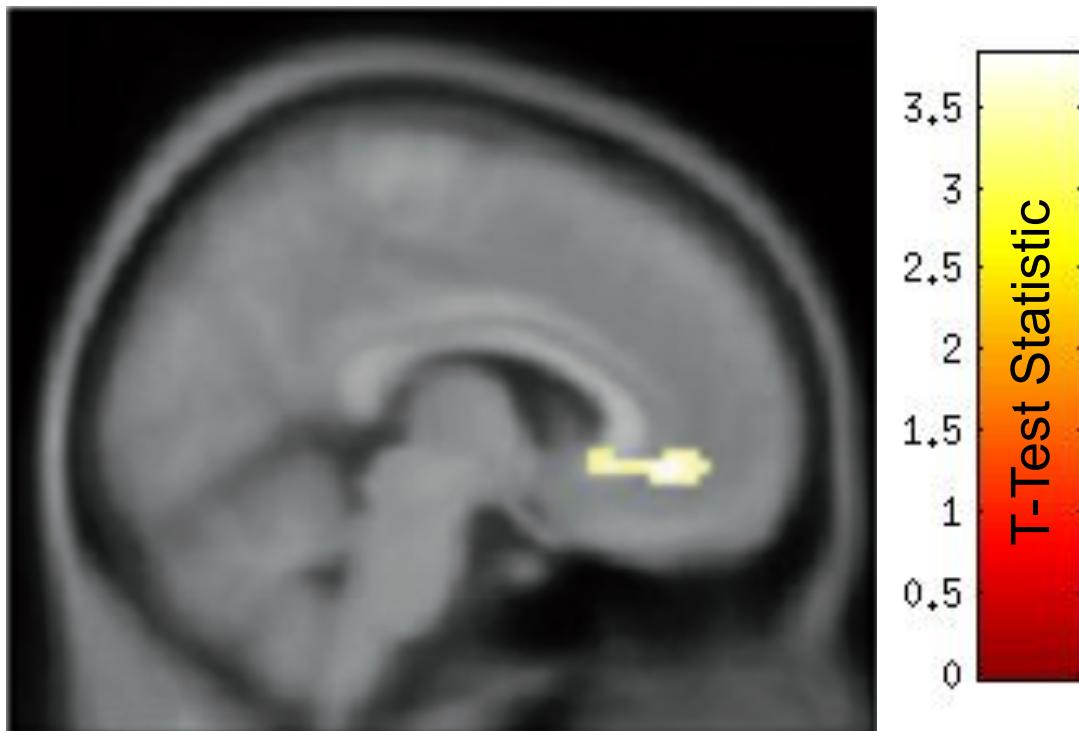
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Status × EMS Interactions

Region	<i>b</i>	SE	<i>t</i> (174)	<i>p</i>
L. VS	-0.067	0.022	-3.02	.003
R. VS	-0.060	0.030	-2.90	.004

Reduced sensitivity in VMPFC to high (vs. low) status with increasing EMS



VMPFC Cluster ($k = 56$)

Peak Statistics

MNI [6, 39, -6]

$t(59) = 3.81$

$p < .001$

External motivation altered evaluative responses to status in the VMPFC

- Low motivation
 - Typical positive evaluations for high vs. low status
(Cloutier et al., 2012; Cloutier & Gyurovski, 2014)
- High motivation
 - Reversal in positive evaluations of high status

How is EMS associated with coordination
between brain regions involved in social
cognition and prejudice regulation?

Partial Least Squares Overview

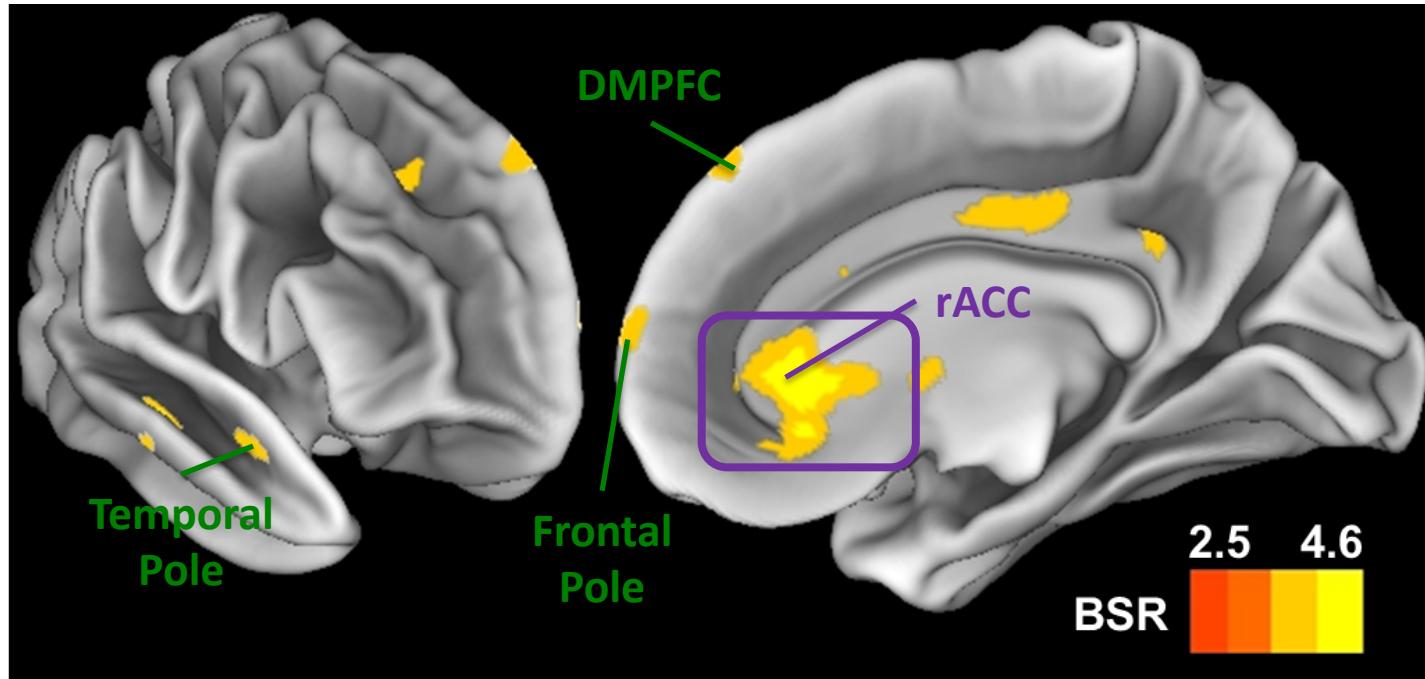
(PLS: McIntosh & Misic, 2013)

Partial Least Squares Overview

(PLS: McIntosh & Misic, 2013)

- Finds weighted patterns of co-activating voxels called Latent Variables (LVs).
- LVs maximize explained covariance between two sets of data.
 - External motivation scores
 - Beta maps for each participant and condition

Increasing EMS associated with reduced co-activation in a network of regions supporting affect regulation and social cognition



Behavioral PLS revealed a significant 1st latent variable, $p = 0.028$
Crossblock covariance = 61.4%
 $n = 60$

What does this mean for evaluations?

- Race-related discomfort
- Poorer ability to regulate prejudice

Importance of a multi-analysis approach

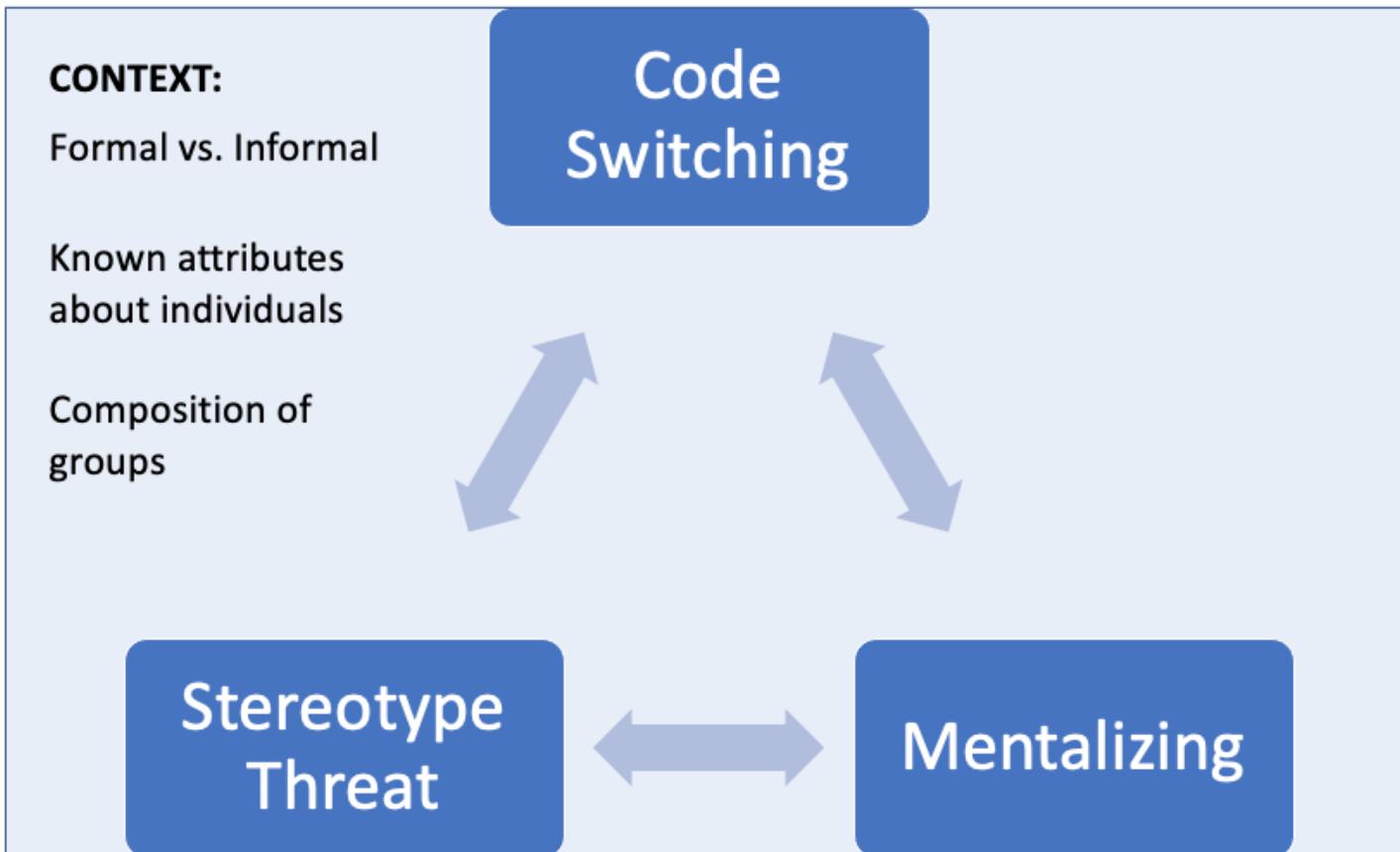
- VMPFC Analysis (task-specific)
 - EMS → reversal of pro-high-SES bias
- Multivariate (task-general)
 - EMS → less neural coordination

What could this mean for interracial interactions?

- Suspicions of high-EMS White people
(LaCosse et al., 2015)



Code switching

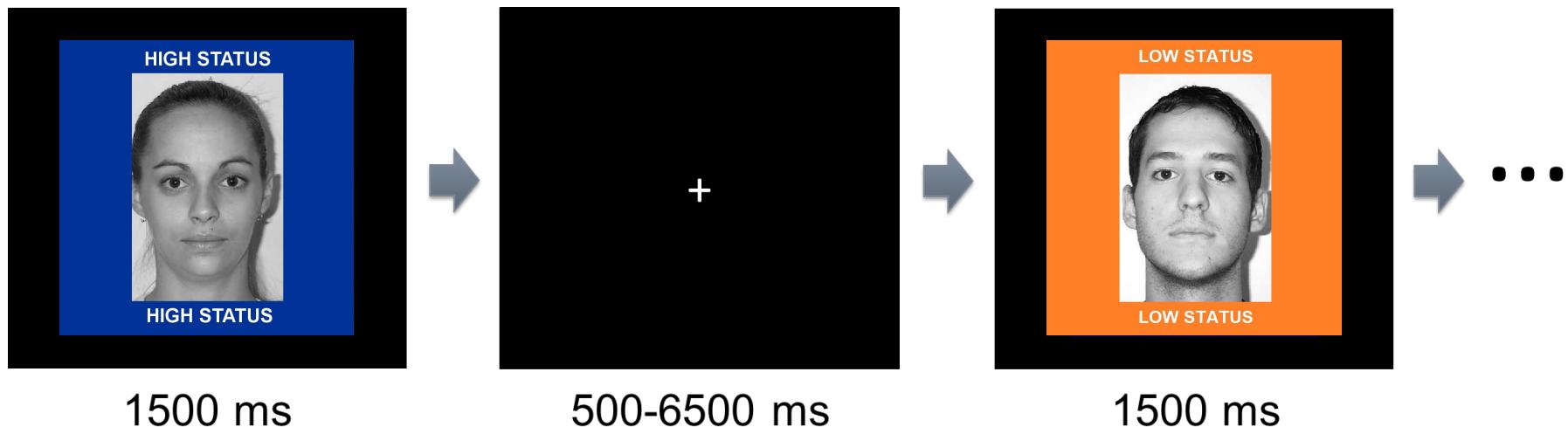


Gender and social status

- Status acquisition is linked to masculine roles (Eagly, 2009) and identity (Vandello et al., 2008)
- Men show greater status bias on the IAT (Mattan & Cloutier, 2020, *Royal Society Open Science*)
- Men show greater neural sensitivity to status (Barth*, Mattan*, et al., 2020, *Scientific Reports*)

Impression formation study

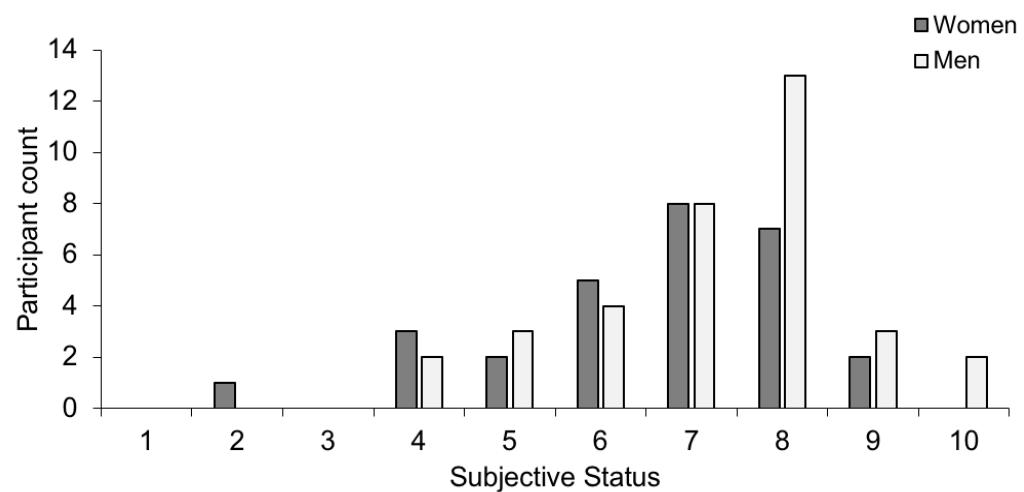
- fMRI impression formation task:



Sample and analyses

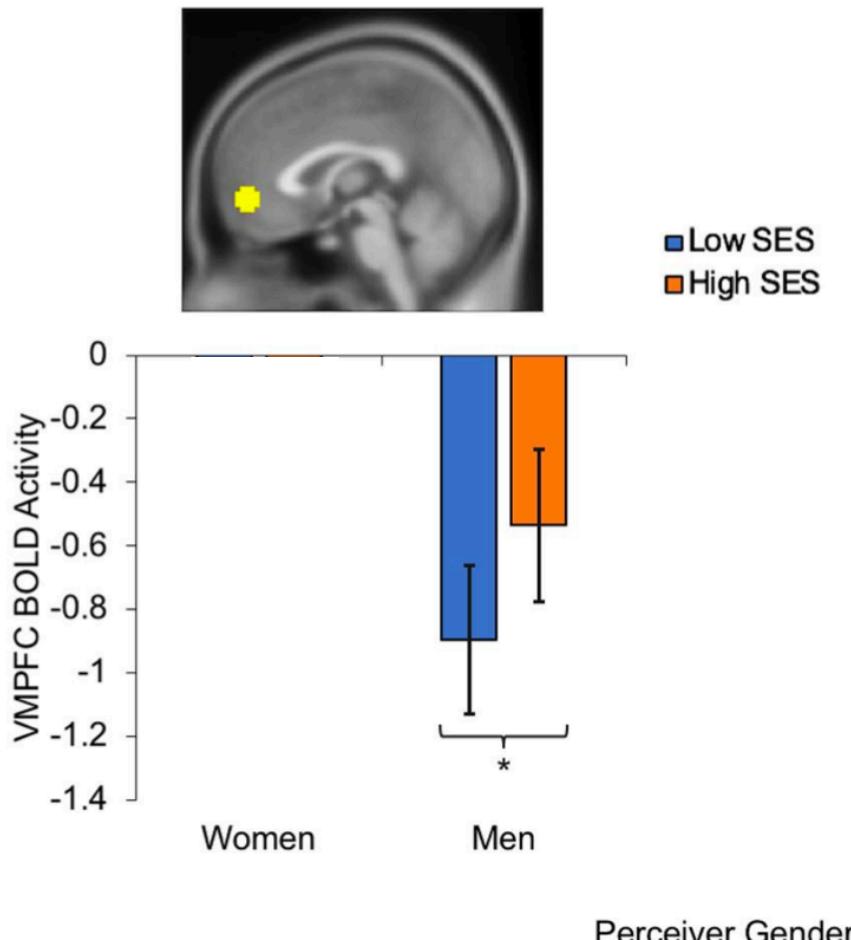
- Sample characteristics

- 28 women, 37 men
 - White non-Hispanic
 - Chicago area
 - 18-35 years old

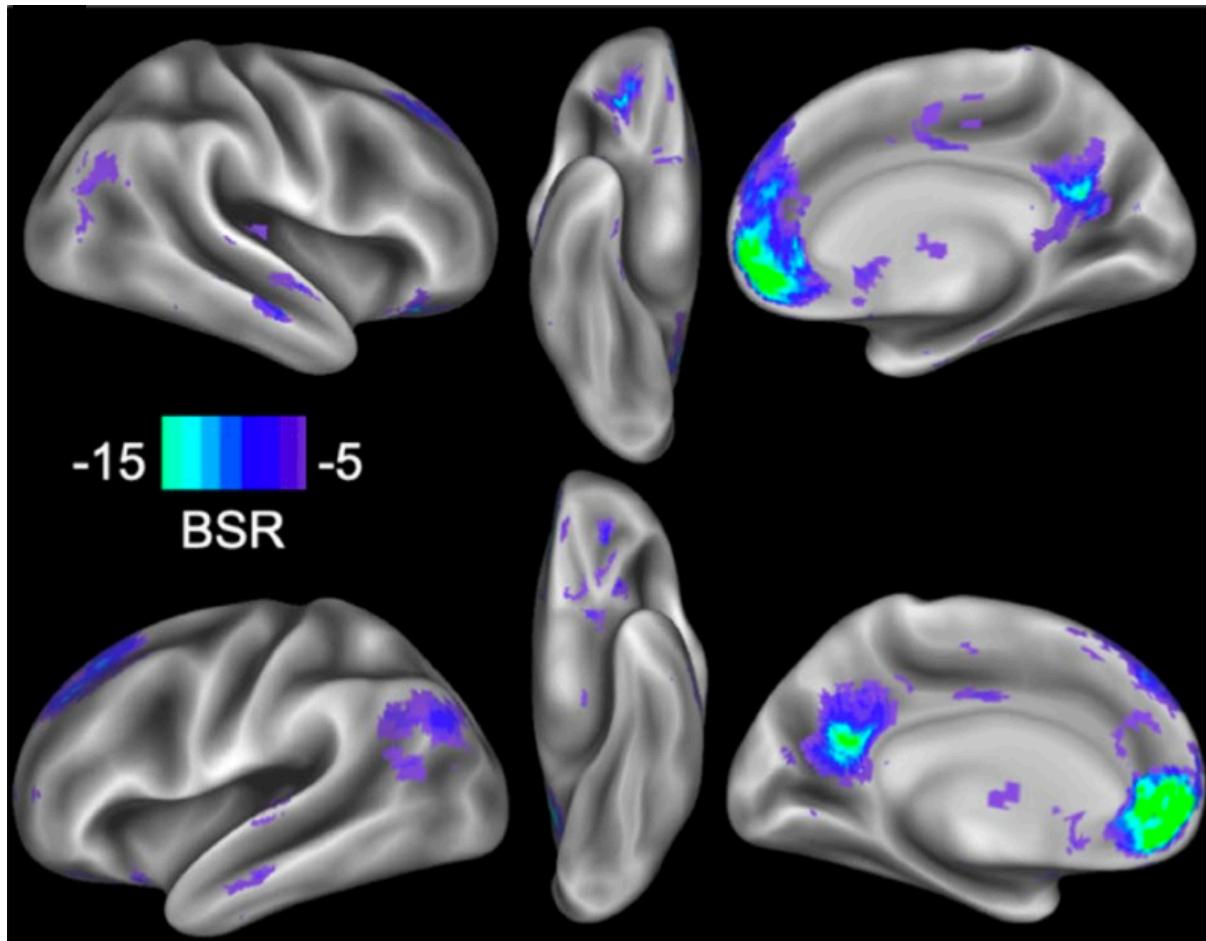


- Examined relationship between participant gender and neural responses to status/gender

Men showed larger neural responses for high status in the VMPFC and VS



Greater VMFPC-PCC coactivation with larger status effects in the VMFPC



Summary

- Men showed greater pro-high-status bias
 - Supports social determinants of gender
 - Constrains mate selection theory
- Genders did not fundamentally differ in the functional network supporting status-based evaluation

Overview

- What neural processes support impression formation based on perceived status and race?
- Can we isolate neural signatures of self-relevance and valence to predict health message effectiveness?
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Aims: Self-relevance and valence

- Theoretical (Wagner et al., 2018)
 - Can we meaningfully differentiate self-relevance and valence in the brain?
- Application (Berkman & Falk, 2013)
 - Brain as predictor

Analytic approach

- Step 1: Identify brain maps that differentiate relevance and valence judgments
- Step 2: Test if maps predict receptivity to health messaging

Sample

(see Kang et al., 2018)

- Participants
 - 220 adults
 - Philadelphia area
 - 96 Black, 86 White, 16 Asian, 9 Non-White Hispanic, 13 Other
 - Age: $M = 34$, $SD = 12$
- Inclusion criteria
 - < 200 min. of physical activity per week
 - BMI > 25

Words Task ($n=163$)

- Explicit judgments about traits
 - Upper vs. Lowercase
 - Me vs. Not Me
 - Good vs. Bad

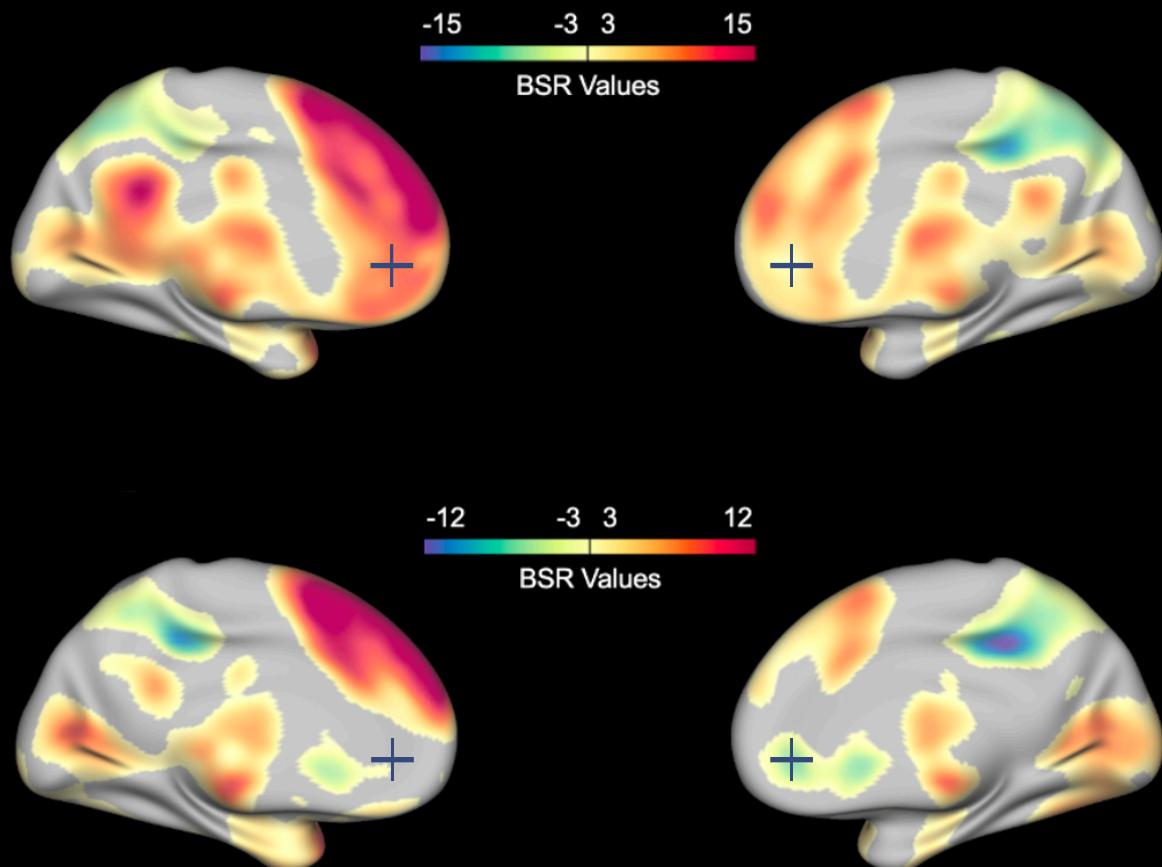


Partial least squares analyses

- Generated a pair of co-activation maps:
 - Valence (vs. control) judgments
 - Self-relevance (vs. control) judgments

Relevance and valence judgments were associated with distinct VMPFC co-activation

**Relevance Judgments vs.
Case Judgments**
LV ($p < .001$)

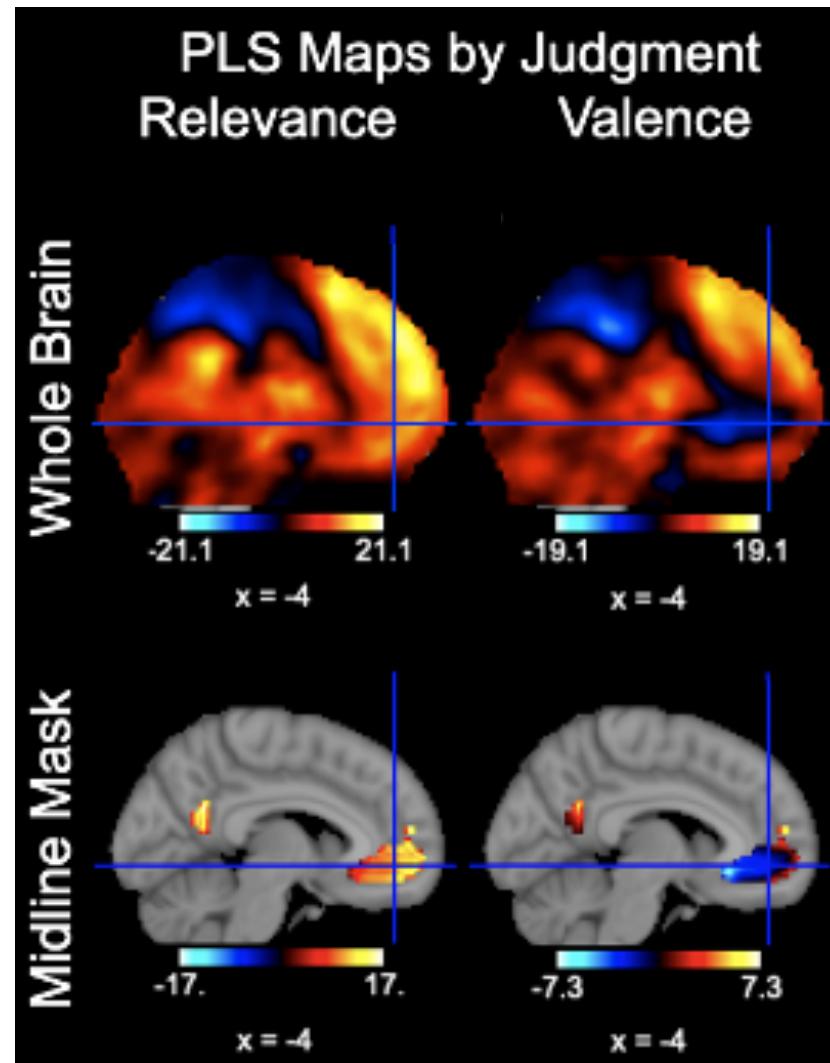


**Valence Judgments vs.
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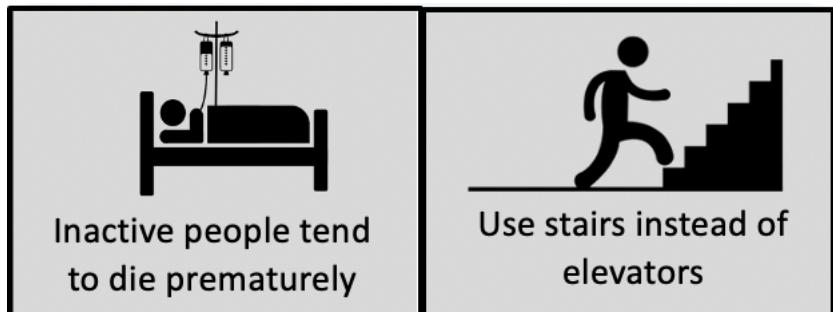
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Masking the cortical midline



Health Messages Task ($n=170$)

- Listen to each message and rate message relevance
 - activity-related
 - non-active control

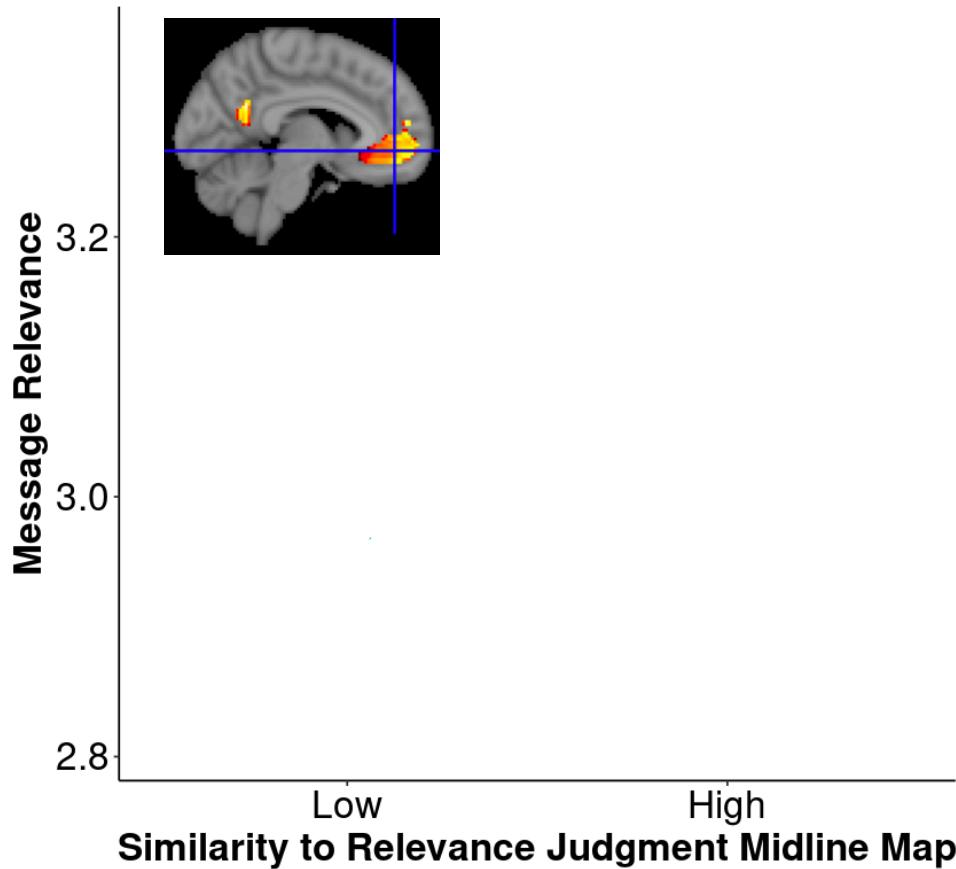


Predicting message receptivity

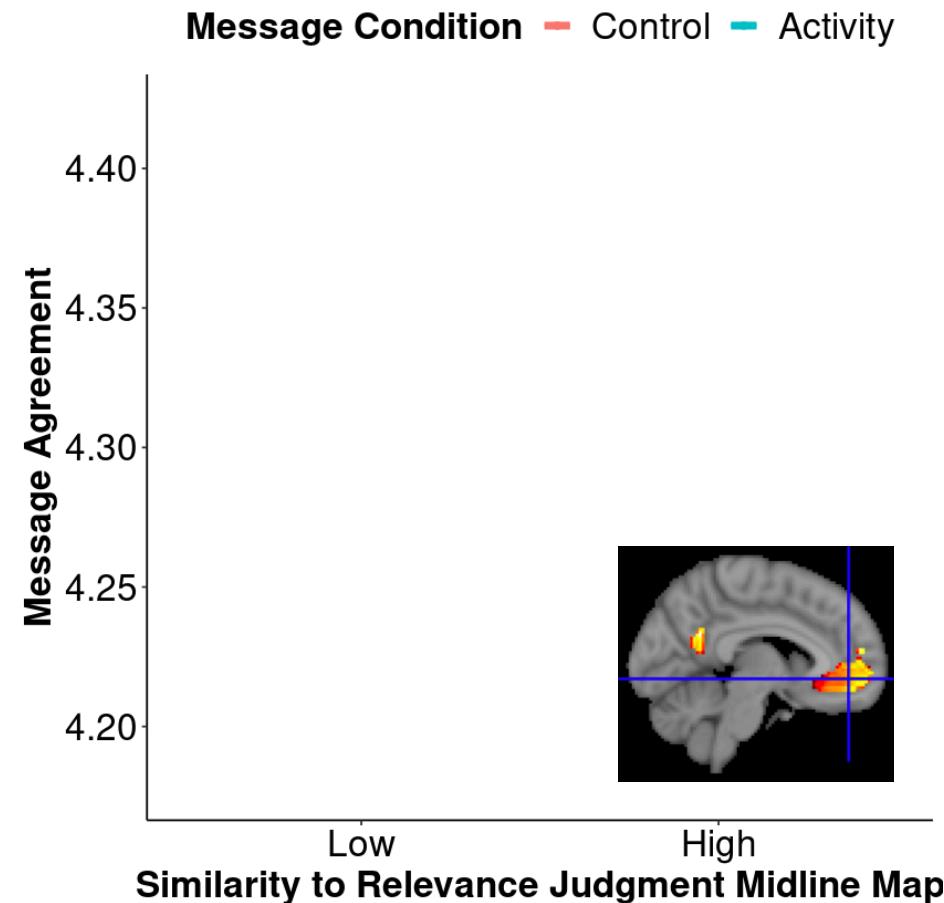
- Separate GLM for each health message (LSS approach: Mumford et al., 2012)
- IV: Similarity between level-1 and PLS maps (nltools: Chang, 2018)
- DVs
 - In-scan perceived message relevance
 - Post-scan message agreement

Relevance and valence maps differ in predicting perceived message relevance

Message Condition — Control (red) — Activity (cyan)

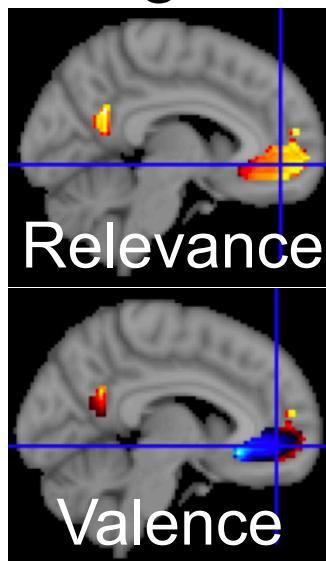


Relevance and valence maps differ in predicting message agreement



Summary

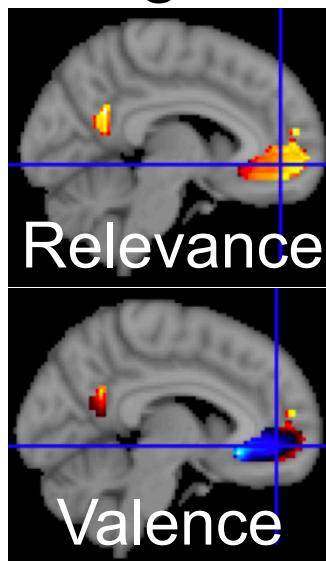
- Similarity to patterns reflecting judgments about relevance/valence showed opposing effects on message effectiveness



- Relevance → increased relevance/agreement
- Valence → decreased relevance/agreement

Summary

- Similarity to patterns reflecting judgments about relevance/valence showed opposing effects on message effectiveness



- Relevance → increased relevance/agreement
- Valence → decreased relevance/agreement

Aims: Self-relevance and valence



Theoretical (Wagner et al., 2018)

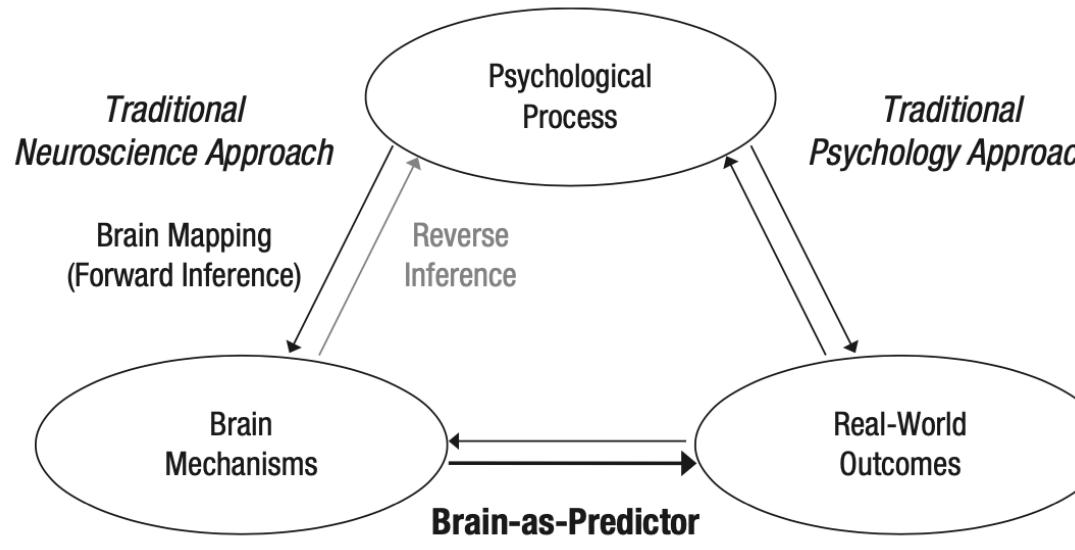
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Future directions



Berkman & Falk, 2013



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- Impression formation
- Decision making

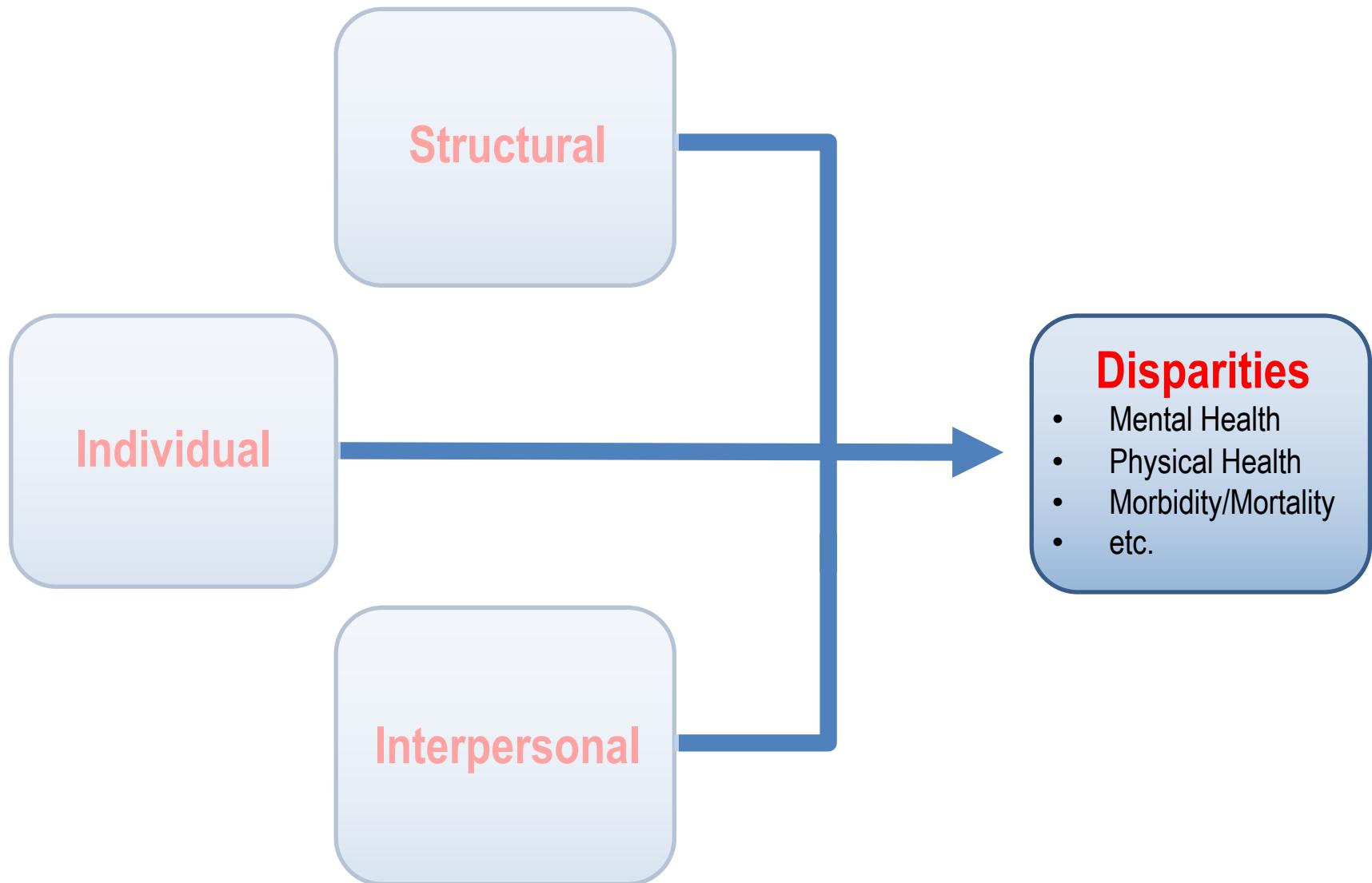
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- Poverty and smoking
- Status and immunity

Health Psychology & Neuroscience

- Physical activity
- Tobacco retailers
- COVID-19 messaging

Social determinants of health



Acknowledgements

Email: brad.mattan@gmail.com
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Emily Falk



Jennifer Kubota



Jasmin Cloutier



Kimberly Quinn



Pia Rotshtein



Collaborators

CN Lab (U Penn)
DDS Group (U Penn)
IFSN Lab (U Delaware)
mHealth Lab (NYU)
Michael Fichman (U Penn)