

Social status modulates the neural response to unfairness

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Abstract

Unfairness is a social phenomenon that is closely related to social status. The neural response to unfairness is modulated by social status. In this study, we used functional magnetic resonance imaging (fMRI) to investigate the neural response to unfairness in high and low social status individuals. We found that high social status individuals showed a stronger neural response to unfairness in the anterior cingulate cortex (ACC) and the dorsal striatum (DG) compared to low social status individuals. This modulation was mediated by the ACC and DG. These findings suggest that social status modulates the neural response to unfairness, and this modulation is mediated by the ACC and DG.

Key words: unfairness; social status; ACC; DG

Introduction

Unfairness is a social phenomenon that is closely related to social status. The neural response to unfairness is modulated by social status. In this study, we used functional magnetic resonance imaging (fMRI) to investigate the neural response to unfairness in high and low social status individuals. We found that high social status individuals showed a stronger neural response to unfairness in the anterior cingulate cortex (ACC) and the dorsal striatum (DG) compared to low social status individuals. This modulation was mediated by the ACC and DG. These findings suggest that social status modulates the neural response to unfairness, and this modulation is mediated by the ACC and DG.

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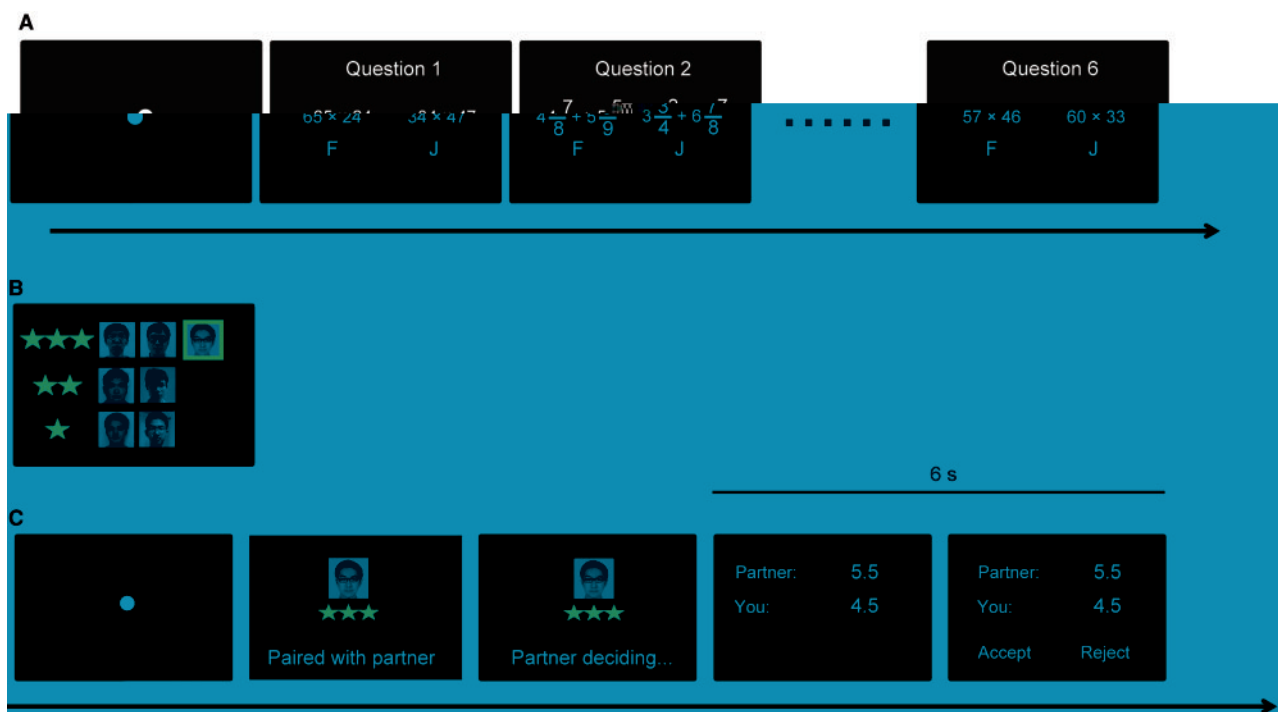


Fig. 1. (A) Sequence of math questions. (B) Partner selection screen. (C) Partner decision process.

1000 2000 3000
 3000 A 3000
 20
 1/9, 1.5/8.5, 2/8, 2.5/7.5, 3/7;
 4/6, 4.2/5.8, 4.5/5.5, 4.8/5.2, 5/5)
 (3.2/6.8, 3.8/6.2) 8
 24 G
 10 4
 24
 G A
 6
 10
 G
 7-

(1 = 0.5; 7 = 0.5)
 G
 (1 = 0.5; 7 = 0.5).
 (10.y)
 G.F y,
 (A, 2000),
 G y,
 F y, 10 G
 /.

MRI data acquisition

GE- 750 3.0
 C.
 (B D) 40
 AC C 3.1
 2000 30

3.1 × 3.1 × 3.1 90° 200 × 200

fMRI preprocessing

8 (),
 A AB (k). F
 3 × 3 × 3
 F H G . D y
 1/128H y

General linear model analyses

y
 k (G)
 (B D)
 B D G
 G ()
). F y
 A
 (H F). F
 y ()
 (> F ; F >

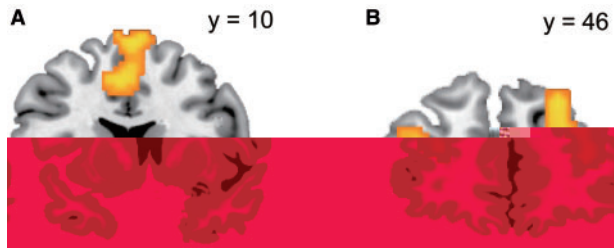


Fig. 3. ACC (A) and DFC (B). A: ACC, $P < 0.05$ ($P < 0.001$, $n = 23$). B: DFC, $P < 0.05$ ($P < 0.001$, $n = 23$).

$F(1, 22) = 97.59, P < 0.001, \eta^2 = 0.81$,
 (5.26 ± 0.15)
 (2.35 ± 0.15) . A
 $F(1, 22) = 12.58, P = 0.002, \eta^2 = 0.36$
 (3.4 ± 0.06) (3.0 ± 0.06) ,
 (5.73 ± 0.12) (4.94 ± 0.12) .
 $(r = 0.46, P = 0.028, d.f. = 21)$
 $G (r = 0.82, P < 0.001, d.f. = 21)$. A
 $(P = 0.6; P = 0.74)$.

fMRI results

Main effects of social status and fairness.

ACC, $P < 0.05$ ($P < 0.001$, $n = 23$),
 DFC ($F(1, 22) = 3.10, P = 0.087, \eta^2 = 0.12$),
 $(P < 0.005, \eta^2 = 0.46)$
 $(P < 0.05, \eta^2 = 0.46)$,
 $(x = -39, y = 11, z = -8, T = 3.10, k = 75)$.

Interaction between social status and fairness.

$(x = -21, y = -4, z = -11; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -15, y = -19, z = 4; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -36, y = -22, z = 64; F(1, 22) = 3.66, P = 0.067, \eta^2 = 0.14)$.

Table 1. BOLD signal changes in ACC and DFC regions. ACC/FC: ACC (A), DFC (B). $P < 0.05$ ($P < 0.001, n = 23$).

Region	Coordinates (x, y, z)			T-value	k
	x	y	z		
ACC/FC (A)	6	23	37	5.20	479
ACC/FC (B)	36	50	16	4.75	182
ACC/FC (C)	-36	50	22	4.12	45
ACC/FC (D)	-21	-4	-11	4.76	41
ACC/FC (E)	-15	-19	4	4.16	47
ACC/FC (F)	-36	-22	64	3.66	54

Note. ACC = ACC; FC = FC; A = ACC/FC (A); B = ACC/FC (B); C = ACC/FC (C); D = ACC/FC (D); E = ACC/FC (E); F = ACC/FC (F).

$(x = -21, y = -4, z = -11; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -15, y = -19, z = 4; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -36, y = -22, z = 64; F(1, 22) = 3.66, P = 0.067, \eta^2 = 0.14)$.
 (0.14 ± 0.02) $(0.07 \pm 0.02, P = 0.015)$,
 (0.08 ± 0.02)
 $(0.12 \pm 0.02, P = 0.140)$ ($F(1, 22) = 4B$).
 (0.04 ± 0.02) $(-0.04 \pm 0.02, P = 0.001)$,
 (-0.005 ± 0.02)
 $(-0.02 \pm 0.02, P = 0.469)$ ($F(1, 22) = 4D$).

Correlation analyses.

$(x = -21, y = -4, z = -11; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -15, y = -19, z = 4; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -36, y = -22, z = 64; F(1, 22) = 3.66, P = 0.067, \eta^2 = 0.14)$.

Functional connectivity analysis.

$(x = -21, y = -4, z = -11; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -15, y = -19, z = 4; F(1, 22) = 4.0, P = 0.05, \eta^2 = 0.15)$,
 $(x = -36, y = -22, z = 64; F(1, 22) = 3.66, P = 0.067, \eta^2 = 0.14)$.

Discussion

ACC/FC (A) ($x = -6, y = 23, z = 37; F(1, 22) = 5.20, P = 0.032, \eta^2 = 0.19$),
 ACC/FC (B) ($x = 36, y = 50, z = 16; F(1, 22) = 4.75, P = 0.037, \eta^2 = 0.18$),
 ACC/FC (C) ($x = -36, y = 50, z = 22; F(1, 22) = 4.12, P = 0.049, \eta^2 = 0.16$),
 ACC/FC (D) ($x = -21, y = -4, z = -11; F(1, 22) = 4.76, P = 0.036, \eta^2 = 0.18$),
 ACC/FC (E) ($x = -15, y = -19, z = 4; F(1, 22) = 4.16, P = 0.047, \eta^2 = 0.16$),
 ACC/FC (F) ($x = -36, y = -22, z = 64; F(1, 22) = 3.66, P = 0.067, \eta^2 = 0.14$).

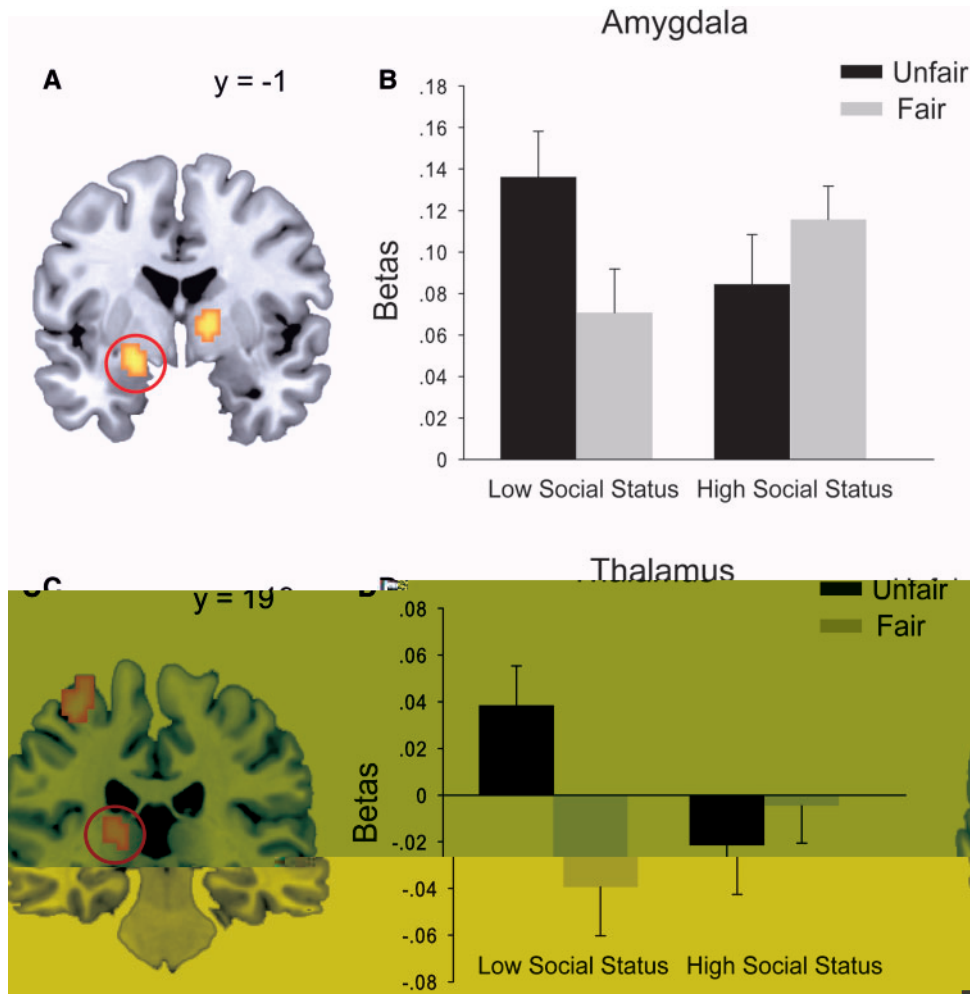


Fig. 4. (A) Coronal slice of the brain at $y = -1$ showing the amygdala. (B) Bar chart showing Beta weights for the amygdala. (C) Coronal slice of the brain at $y = 19$ showing the thalamus. (D) Bar chart showing Beta weights for the thalamus. Error bars represent standard error. $P < 0.05$ (corrected for multiple comparisons). $P < 0.001$ (corrected for multiple comparisons). $n = 23$.

He et al., 2014). The amygdala is a key region in the limbic system, involved in processing emotional information and social cues. The thalamus is a central hub for sensory and motor signals, and is also involved in social cognition. The present study shows that the amygdala and thalamus are involved in processing unfair and fair conditions, and that the amygdala shows greater activation for unfair conditions in the low social status group. This is consistent with previous research showing that the amygdala is involved in processing social information and that the thalamus is involved in social cognition. The present study also shows that the amygdala and thalamus are involved in processing unfair and fair conditions, and that the amygdala shows greater activation for unfair conditions in the low social status group. This is consistent with previous research showing that the amygdala is involved in processing social information and that the thalamus is involved in social cognition. The present study also shows that the amygdala and thalamus are involved in processing unfair and fair conditions, and that the amygdala shows greater activation for unfair conditions in the low social status group. This is consistent with previous research showing that the amygdala is involved in processing social information and that the thalamus is involved in social cognition.

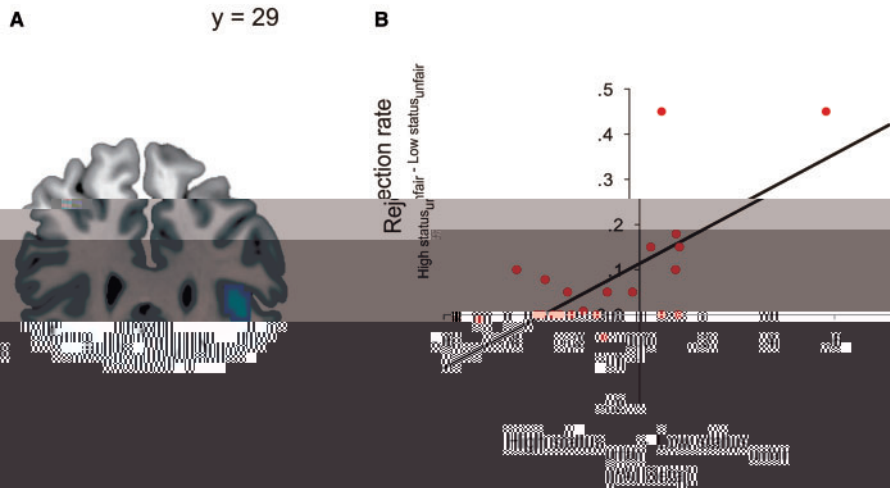


Fig. 5. G... (A) ... (B) ... (A) ... P < 0.05 (... P < 0.001 ... (A) ...

(C ... -D ... 'A ... et al., 2013) ... (... et al., 2009; ... et al., 2010). ... (... et al., 2008). ... (... et al., 2008; ... et al., 2012), ... (... et al., 2008; ... et al., 2012) ... (... et al., 2009; G ... et al., 2011; ... et al., 2014), ... (... et al., 2008). H ... (... et al., 2009). ... (... et al., 2003; ... et al., 2007; ... et al., 2014).

91232708, 31170972).

Supplementary data

SCAN

Conflict of interest.

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