最終賽局：
讓決策思考變得科學

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Strategic Motives Drive Proposers to Offer Fairly in Ultimatum Games: An fMRI Study

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ULTIMATUM GAME (UG)

- Two players interact with each other to divide a sum of money (Güth et al., 1982).

- The 1st player (proposer) proposes how to divide the sum between 2 players, and the 2nd player (recipient) can either accept or reject it.

- If the recipient accepts the offer, the money is divided as proposed. Otherwise, both players receive nothing.

STANDARD ECONOMIC THEORY VS. EXPERIMENTAL FINDINGS

- The recipient accepts any offer greater than zero, and the proposer offers the least amount possible (Rubienstein, 1982).

- The median offers are usually **50-50 split** of the sum (average about 30~40% of the sum), independent of stake size, in the standard version of UG (review see Thaler, 1988; Güth & Kocher, 2013).

- Low offers (less than 20% of the sum) are frequently rejected by responders (e.g., Cameron, 1999).

TWO HYPOTHESES OF UG FAIR OFFERS

- Altruistic motives (Camerer and Thaler, 1995; Kahneman et al., 1986; Rabin, 1993; Thaler, 1988)

  → Dictator games (DG) results did not support this hypothesis (Carpenter et al., 2005; Harrison and McCabe, 1996; Thaler, 1988; Zheng and Zhu, 2013)

- Strategic motives (Camerer and Thaler, 1995; Fehr and Schimidt, 1999; Forsythe et al., 1994)

  to avoid the possibility of rejection and receive money

WHY PREVIOUS REPORTS COULD NOT TEST THESE TWO HYPOTHESES?

Only the final proposal was observed: participants were asked to divide the money by

- indicating their preferred offer (e.g., Güth et al., 1982; Henrich et al., 2005; Roth et al., 1991) or

- choosing one preferred offer among several different share sizes (e.g., Brañas-Garza et al., 2014; Carpenter et al., 2005; Espín et al., 2015; Exadaktylos et al., 2013).

1. How proposers reached the final decision of offering fairly?

2. To what extent did they consider offering selfishly? How about in case of different stakes?

OUR DESIGN

$172

86   86   155 17

- Using a modified UG in which proposers had to choose between a fair and a selfish offer (Weiland et al, 2012)

- Manipulations:

1. Share size (offering 40%, 30%, 20%, or 10% of the sum)
2. Stake size (NT$200 or NT$2000)

- Choices, reaction time (RT), and the corresponding brain activations

PARTICIPANTS

- 45 participants (27 females and 18 males; 24.49 ± 2.70 years); they were matched with another 45 participants who acted as recipients to accept or reject their proposals.

- Two trials were selected randomly out of all testing trials and participants would receive money based on the matched recipients' answers to their proposed offer.

- The average amount of money that they received from the 2 selected trials was NT$901 ± NT$452 (NT$0 – NT$1740).

IMAGING DATA ACQUISITION

Simens Skyra 3T

- MRI images were collected using a 32-channel head coil in a 3T scanner (Skyra, Siemens Medical Solutions, Erlangen, Germany).

- A T2*-weighted gradient-echo echo planar imaging sequence: 3 mm slice thickness, 256×256 mm^2 field of view, 90° flip angle, 34 slices, 2000 ms repetition time (TR), and 30 ms echo time (TE).

- An anatomical, T1-weighted high-resolution image ($1 \times 1 \times 1$ mm^3): a standard MPRAGE sequence, with a 7° ip angle, 2530 ms TR, 3.3 ms TE and 1100 ms inversion time (TI).

TMBIC MR-COMPATIBLE INSTRUMENT

Ear phone (Sensimetric Model S14)

Head Coil
Head 32 Ch
Head/Neck 20 Ch
Head/Neck 64 Ch

Handwriting pad

Mouse & Response box (932 package)

Joystick (HHSC-JOY-5-UPG)

Eye tracker (SR eyelink 1000)

GENERAL VIEW OF DATA INCLUSION

▸ Behavioral data inclusion:

• Among 45 participants, sub 18 & 34 were excluded.

• Of the 43 participants (25 females; 25.23±2.75 years) , sub 24, 43, 45, 49, 59 were not included for RT data analysis because they did not have data in certain condition(s)

→ 38 (88%) participants were analyzed.

▸ fMRI data inclusion:

• Of the 43 participants, sub 38, 39, 55, 57, 60 were excluded due to too big head motion; sub 24, 43, 45, 46, 49, 59 were excluded due to not sufficient images per condition (n<5)

→ 32 (74%) participants (19 females; 24.97±2.69 years) were included

BEHAVIORAL RESULTS
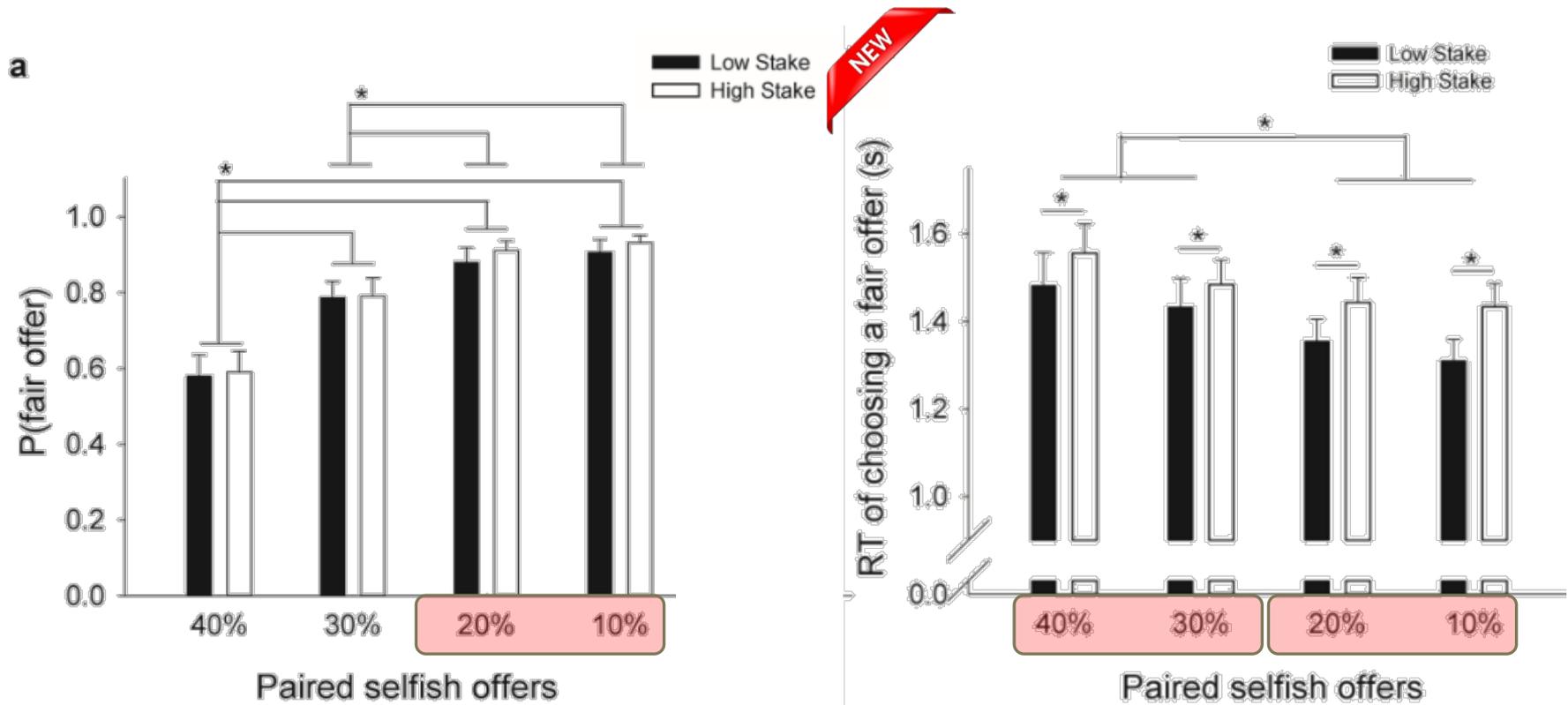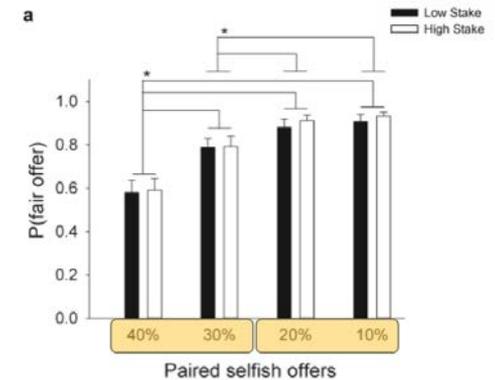
IMAGING RESULTS 1

- Fair offer over slightly selfish offer than very selfish offer
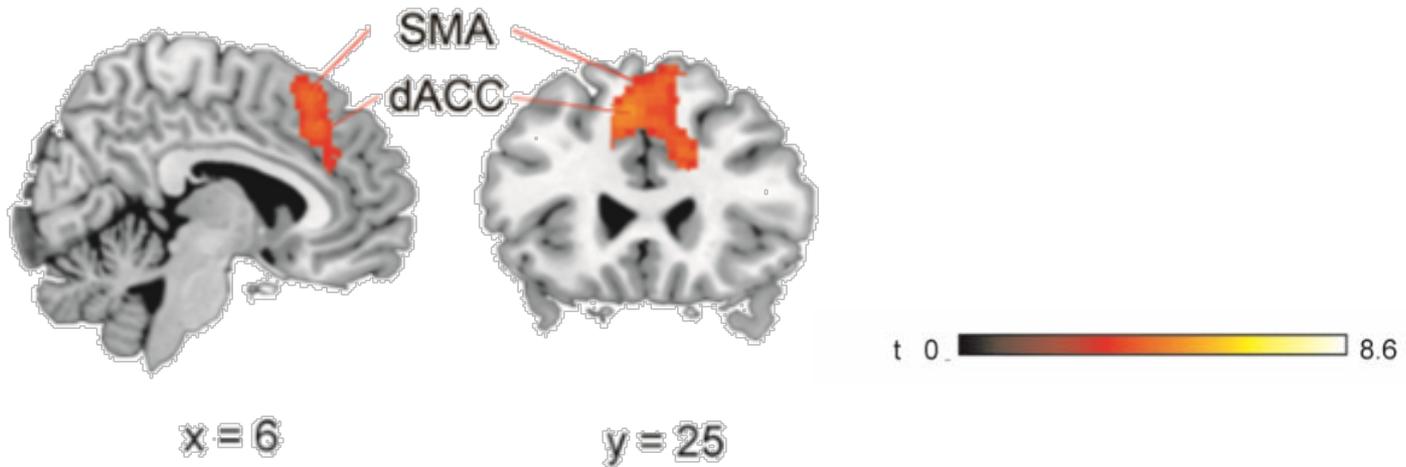
- Allocation of cognitive control for cost/benefit decision making (review see Shenhav et al., 2016)
- Motor control during selection process (Neubert et al., 2015)

IMAGING RESULTS 2

- Fair offer in high stake > low stake

$x = 8$
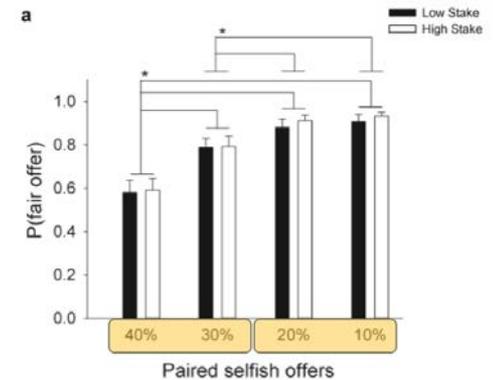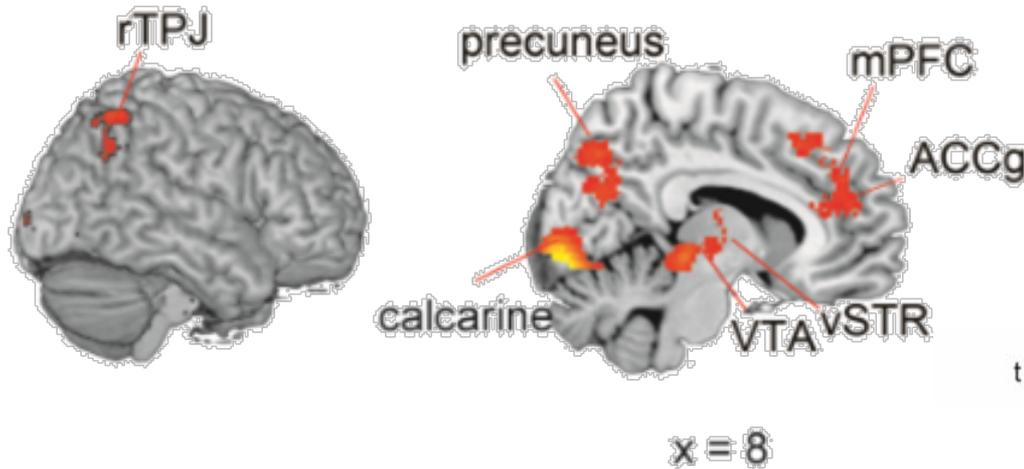
- Theory of mind (e.g., Saxe et al., 2003)
- Reward (e.g., Ernst and Paulus, 2005)
- Reward for others (Apps et al., 2016)

IMAGING RESULTS 3

- Slightly selfish offer > Fair offer

x = -8   y = 16
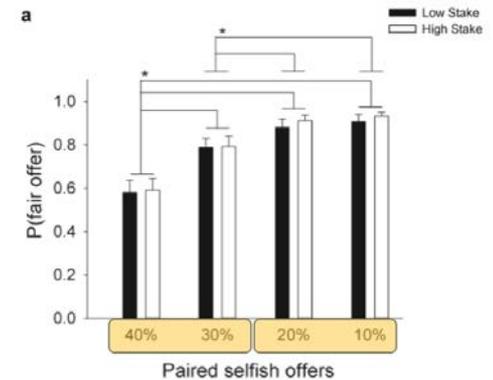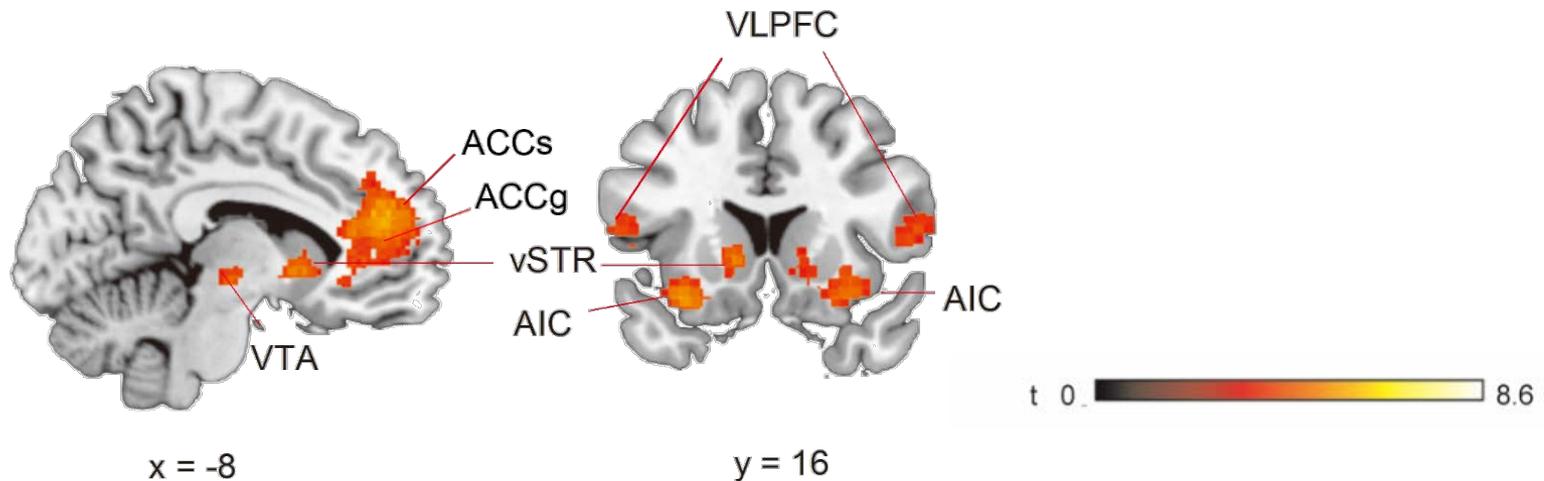
- Reward (e.g., Ernst and Paulus, 2005)
- Reward for self/others (Apps et al., 2016)
- Risk level & negative emotion (e.g., Critchley et al., 2001)

CONCLUSIONS -1

- Proposers showed lower rates and took longer to choose fair offer paired with slightly than extremely selfish offer.

- Meanwhile, they showed higher activations in mPFC (mostly dACC) representing higher requirement of cognitive control for a conflicting dilemma: a slightly selfish offer was more lucrative but somehow acceptable even though it was riskier than a fair offer.

CONCLUSIONS -2

- Proposers did not change the rate of fair offers with higher stakes. However, they took longer and were more active in reward- and theory-of-mind-circuits, representing the deliberation of recipients' answers.

- Proposers were more activated in the dopaminergic pathway and bilateral AIC, signaling the higher expected reward and risk in slightly selfish than fair offers.

- Overall, our findings favoured the hypothesis of strategic motives for fair UG offers.

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