

# Decision Making & Emotion: Experimental design

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Room C80 – Drop in hours Tuesday 2-4pm

# Today

## Aims:

- to discuss the neural response to fairness through 2 published studies
- to discuss the ways processes of interest have been isolated with the chosen contrasts (practical level)

## Objectives: At the end of the lecture

- you should have a better understanding of the (possible) functional roles of the reward system in response to fairness
- you should be able to critically examine the choice of contrasts in fMRI studies

- Part 1: Quick reminder
- Part 2: Paper 1
- Part 3: Paper 2

# Decision making situation

## EMOTIONAL PROCESSING (quick)

- **Amygdala** sensitive to salient emotional information (framing effect)
- **Insula** involved in pain, disgust (moral unfairness)
- **Striatum** involved in computing the reward value associated with a stimulus (including other people's reputation)
- **Ventromedial prefrontal cortex** involved in the emotional reaction to morally difficult situations and situations that involve risk

## NON-EMOTIONAL PROCESSING (more effortful)

- **Dorsolateral prefrontal cortex** involved in working memory, planning, retrieval and selection of information from memory

## INTEGRATION

- **orbitofrontal cortex** involved in regret (emotion is linked to counterfactual thinking) and in overriding the framing effect

# The Ultimatum Game

Andrew	£50 –	You £50
Steven	£55 –	You £45
Patrick	£60 –	You £40
Mike	£70 –	You £30

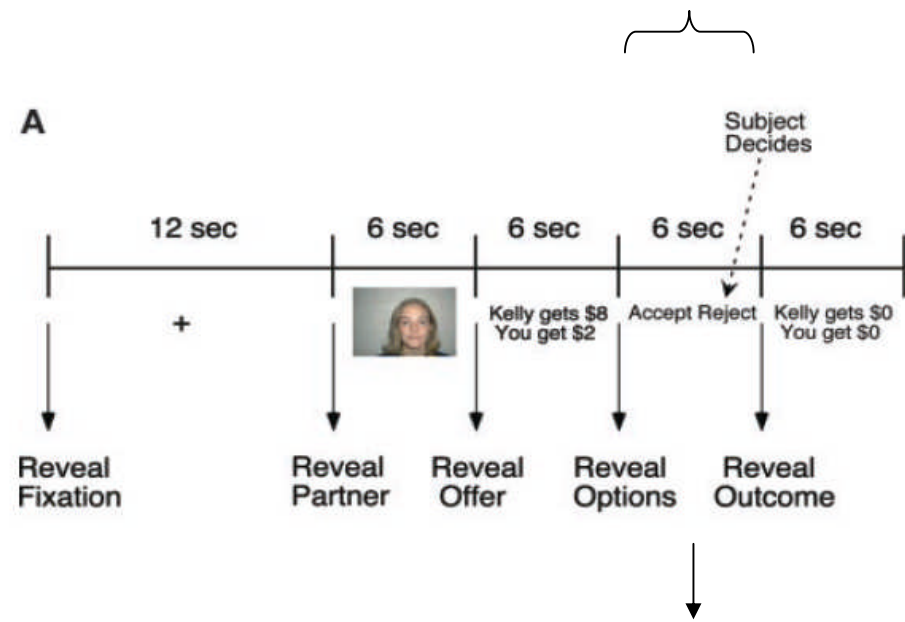
Tim	£80 –	You £20
Simon	£95 –	You £5
Oliver	£98 –	You £2
Henry	£99 –	You £1

Mark	£100 –	You £0
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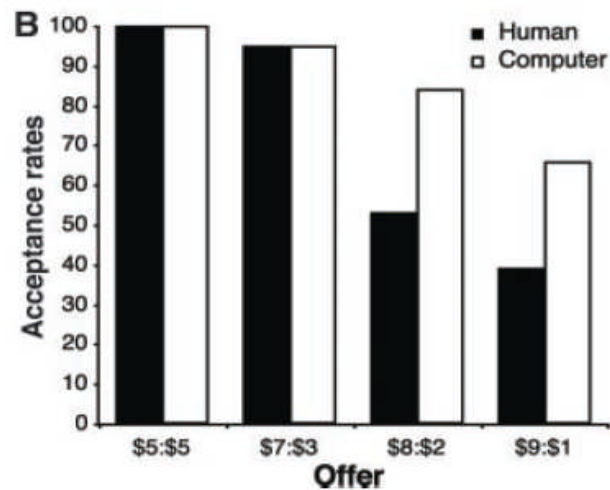
(Sanfey et al., 2003, Science)

	Human	Computer	Control
High	\$5 out of \$10	\$5 out of \$10	\$5
	\$3 out of \$10	\$3 out of \$10	\$3
Low	\$2 out of \$10	\$2 out of \$10	\$2
	\$1 out of \$10	\$1 out of \$10	\$1

BOLD measure



What's  
happening in  
participants'  
mind when they  
receive an unfair  
offer during that  
time window?



*(Sanfey et al., 2003, Science)*

- **(receiving) human unfair offer**
  - holding offer in mind
  - number processing
  - valuation of outcomes for self: self receives little or nothing
  - valuation of outcomes for other: other receives a lot or nothing
  - self/other comparison: other potentially more (jealousy/disgust?)
  - reject decision
  - anticipation of receiving no money because of decision

*(Sanfey et al., 2003, Science)*

- (receiving) human unfair offer MINUS (receiving) human fair offer
- (receiving) human unfair offer MINUS (receiving) computer unfair offer
- (receiving) human unfair offer MINUS (receiving) control low amount
- (receiving) human unfair 9/1 split MINUS (receiving) human unfair 8/2 split

➔ Insula is more activated in all 4 contrasts, what kind of processing can the insula be associated with?

(Sanfey et al., 2003, Science)

- **(receiving) human unfair offer MINUS (receiving) human fair offer**

- holding offer in mind
- number processing
- valuation of outcomes for self: self receives little or nothing
- valuation of outcomes for other: other receives a lot or nothing
- self/other comparison: other potentially more (jealousy/disgust?)
- reject decision
- anticipation of receiving no money because of decision

- similar
- similar
- self receives good amount or nothing
- other receives good amount or nothing
- self and other same: no jealousy
- accept decision
- anticipation of receiving some money

(Sanfey et al., 2003, Science)

- **(receiving) human unfair offer MINUS (receiving) human fair offer**

→ ~~holding offer in mind~~

→ ~~number processing~~

→ valuation of outcomes for self: self receives little or nothing

→ valuation of outcomes for other: other receives a lot or nothing

→ self/other comparison: other potentially more (jealousy/disgust?)

→ reject decision

→ anticipation of receiving no money because of decision

→ similar

→ similar

→ self receives good amount or nothing

→ other receives good amount or nothing

→ self and other same: no jealousy

→ accept decision

→ anticipation of receiving some money

(Sanfey et al., 2003, Science)

• **(receiving) human unfair offer MINUS (receiving) computer unfair offer**

→ ~~holding offer in mind~~

→ similar

→ ~~number processing~~

→ similar

→ valuation of outcomes for self: self receives little or nothing

→ similar

→ valuation of outcomes for other: other receives a lot or nothing

→ similar?

→ self/other comparison: other potentially more (jealousy/disgust?)

→ self and other same: probably no jealousy

→ reject decision

→ less reject decision

→ anticipation of receiving no money because of decision

→ less anticipation of receiving no money

(Sanfey et al., 2003, Science)

• **(receiving) human unfair offer MINUS (receiving) computer unfair offer**

→ ~~holding offer in mind~~

→ similar

→ ~~number processing~~

→ similar

→ ~~valuation of outcomes for~~

→ similar

~~self: self receives little or  
nothing~~

→ ~~valuation of outcomes for~~

→ similar?

~~other: other receives a lot or  
nothing~~

→ self/other comparison: other  
potentially more

→ self and other same: probably  
no jealousy

(jealousy/disgust?)

→ reject decision

→ less reject decision

→ anticipation of receiving no  
money because of decision

→ less anticipation of receiving  
no money

(Sanfey et al., 2003, Science)

- **(receiving) human unfair offer MINUS (receiving) control low amount**

→ ~~holding offer in mind~~

→ similar

→ ~~number processing~~

→ similar

→ ~~valuation of outcomes for~~

→ no option valuation

~~self: self receives little or  
nothing~~

→ ~~valuation of outcomes for~~

→ no option valuation

~~other: other receives a lot or  
nothing~~

→ self/other comparison: other  
potentially more

→ no self/other comparison

(jealousy/disgust?)

→ reject decision

→ no decision

→ anticipation of receiving no  
money because of decision

→ anticipation of receiving some  
money

(Sanfey et al., 2003, Science)

- **(receiving) human unfair offer MINUS (receiving) control low amount**

→ ~~holding offer in mind~~

→ similar

→ ~~number processing~~

→ similar

→ ~~valuation of outcomes for~~

→ no option valuation

~~self: self receives little or  
nothing~~

→ ~~valuation of outcomes for~~

→ no option valuation

~~other: other receives a lot or  
nothing~~

→ self/other comparison: other  
potentially more

→ no self/other comparison

(jealousy/disgust?)

→ reject decision

→ no decision

→ anticipation of receiving no  
money because of decision

→ anticipation of receiving some  
money

(Sanfey et al., 2003, Science)

• **(receiving) human unfair 9/1 split MINUS (receiving) human unfair 8/2 split**

→ ~~holding offer in mind~~

→ similar

→ ~~number processing~~

→ similar

→ valuation of outcomes for self: self receives little or nothing

→ self receives a little more or nothing

→ valuation of outcomes for other: other receives a lot or nothing

→ possibly slightly less jealousy

→ self/other comparison: other potentially more (jealousy/disgust?)

→ slightly less jealousy?

→ reject decision

→ reject decision (slightly less)

→ anticipation of receiving no money because of decision

→ (slightly less) anticipation of receiving no money because of decision

(Sanfey et al., 2003, Science)

- **overall insula could be associated with:**

→ ~~holding offer in mind~~

→ ~~number processing~~

→ ~~valuation of outcomes for~~

~~self: self receives little or  
nothing~~

→ ~~valuation of outcomes for~~

~~other: other receives a lot or  
nothing~~

→ self/other comparison: other  
potentially more

(jealousy/disgust?)

→ reject decision

→ anticipation of receiving no  
money because of decision

How could you  
improve the design to  
narrow down the  
possibilities?

(Tabibnia et al., 2008, *Psychological Science*)

		Material Utility	
		High	Low
Fairness	High	\$7.00 out of \$15	\$0.50 out of \$1
	Low	\$7.00 out of \$23	\$0.50 out of \$10

→ only considered paired of trials with same material utility but where in one case the participant “rejects” and in the other s/he “accepts”.

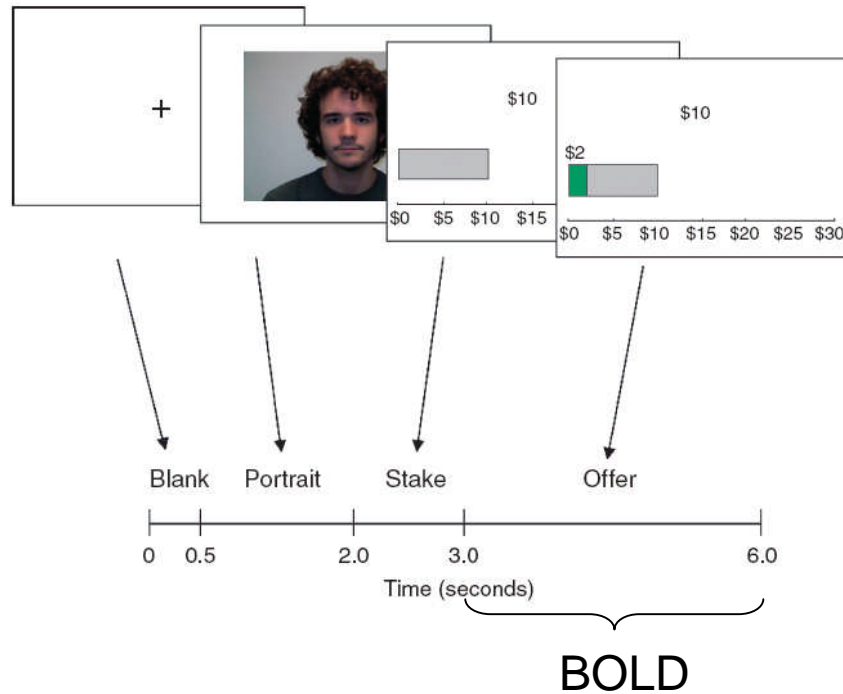


TABLE 1

*Likelihood of an Offer Being Accepted as a Function of the Ratio of the Offer to the Stake Size*

Ratio of offer to stake	Acceptance rate
50%	97.9%
40–49%	92.3%
30–39%	75.8%
20–29%	44.7%
10–19%	30.8%
<10%	1.4%

Unfortunately no details by utility...

*(Tabibnia et al., 2008, Psychological Science)*

- Reject unfair offer – rest → Insula activation
- Reject unfair offer – accept fair offer → Unlike previous study: Insula not more activated

→ any ideas why?

## Reject unfair

- holding offer in mind
- number processing
- valuation of outcomes for self: self receives something (a little or a lot) or nothing
- valuation of outcomes for other: other receives something (a little or a lot) or nothing
- self/other comparison: other potentially more (jealousy/disgust?)
- reject decision
- anticipation of receiving no money because of decision

## Accept fair

- similar
- similar
- similar
  
- other receives same amount
  
- no jealousy
  
- accept decision
- anticipation of receiving some money

## Reject unfair

- holding offer in mind
- number processing
- valuation of outcomes for self: self receives something (a little or a lot) or nothing

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- similar
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- other receives same amount
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- anticipation of receiving some money

Insula seem to have been activated equally in both cases!

## Reject unfair

- ~~holding offer in mind~~
- ~~number processing~~
- ~~valuation of outcomes for self: self receives something (a little or a lot) or nothing~~

- ~~valuation of outcomes for other: other receives something (a little or a lot) or nothing~~
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## Accept fair

- similar
- similar
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- other receives same amount
- no jealousy
- accept decision
- anticipation of receiving some money

Insula seem to have been activated equally in both cases!

## Reject unfair

- ~~holding offer in mind~~
- ~~number processing~~
- ~~valuation of outcome~~
- ~~self: self receives something (a little or a lot) or nothing~~

## Accept fair

- ~~valuation of outcomes for other: other receives something (a little or a lot) or nothing~~
- self/other comparison: other potentially more (jealousy/disgust?)
- reject decision
- anticipation of receiving no money because of decision

Check differences in method...

- other receives same amount
- no jealousy
- accept decision
- anticipation of receiving some money

Insula seem to have been activated equally in both cases!

*(Tabibnia et al., 2008, Psychological Science)*

- **Accept fair offers – reject unfair offers (for pairs with matched utilities only)**

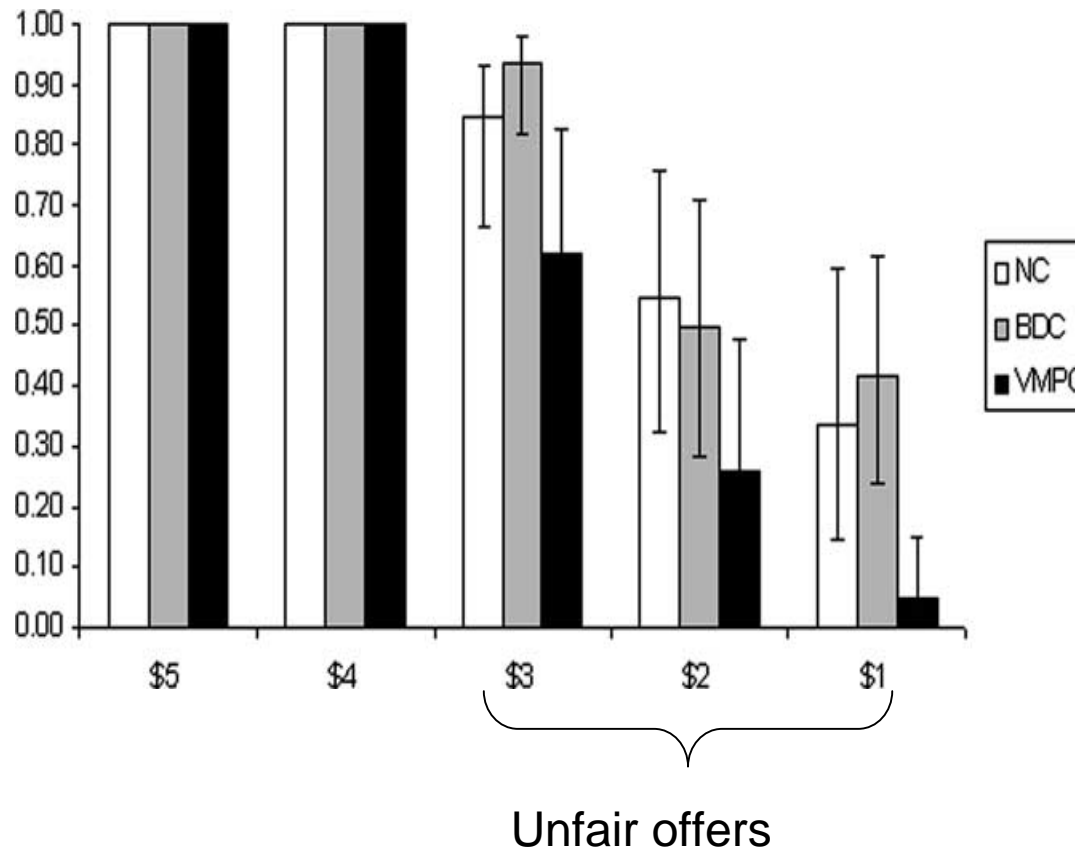
→ Increased striatum activation when accepting a fair offer (reward)

- **Accept unfair offer – rest**
- **Accept unfair offer – reject unfair offer**

→ Increased right VMPFC (overcoming negative feeling of unfairness)

# Bonus discussion

→ VMPFC patients are more likely to reject unfair offers?  
Better reason for why?



# Food for thoughts...

→ Nice story: VMPFC helps overcome feeling of unfairness, so if patients have a deficit to this area there will indeed reject even more unfair offers

BUT! Why do these patients become more utilitarian in moral reasoning? i.e. more able to overcome negative feelings in that situation?

