Virtual bargaining: A micro-foundation for social decision making and interaction

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OVERVIEW

1. Three thought experiments

Part I: Virtual Bargaining

2. Nash equilibrium
3. Virtual bargaining I: Possible equilibria
4. Virtual bargaining II: Choosing an equilibrium

Part II: Applications

5. Fairness through virtual bargaining
6. Joint action and attention
7. Communication as virtual bargaining
8. Future directions

1. THREE THOUGHT EXPERIMENTS

1. X and Y have to bargain to share £10

- They are only given three options; no-one gets anything if they don't agree

X

Y

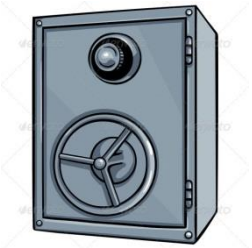
Now with no bargaining or communication of any kind

- But if **X** and **Y** don't spontaneous 'agree' on a split, both get nothing…

- Now a conventional coordination game

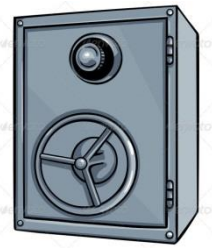
X \ **Y**	A	B	C
A	9,1	-	-
B	-	1,9	-
C	-	-	5,5

2. Bargaining gangsters



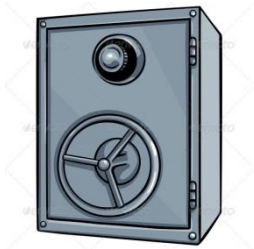
- **Do nothing?**
- **Buy boobytrap** for own safe?
- **Steal?** (will inevitably lose/damage some of the ‘stolen treasure’)

- What do they agree?
- (nb. They may not trust each other…)



The Boobytrap Game:

now, no bargaining or communication allowed



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* Buy boobytrap for own safe?
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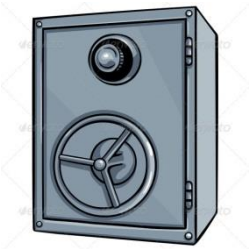
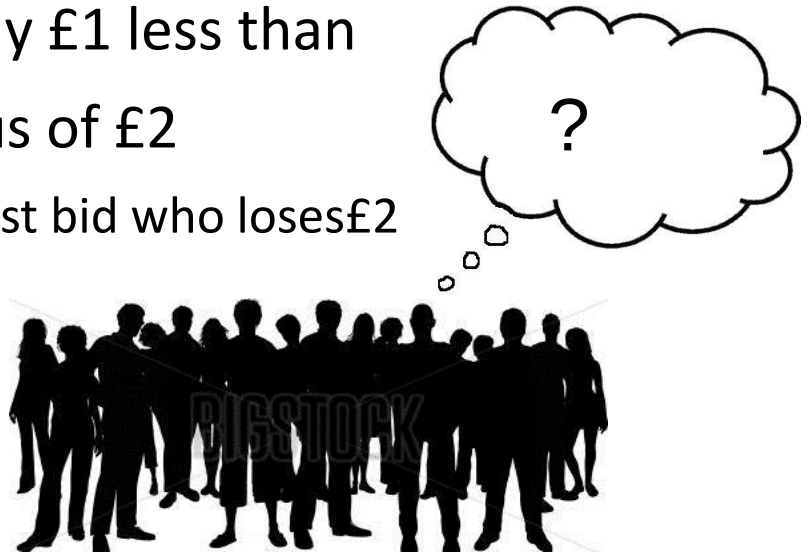


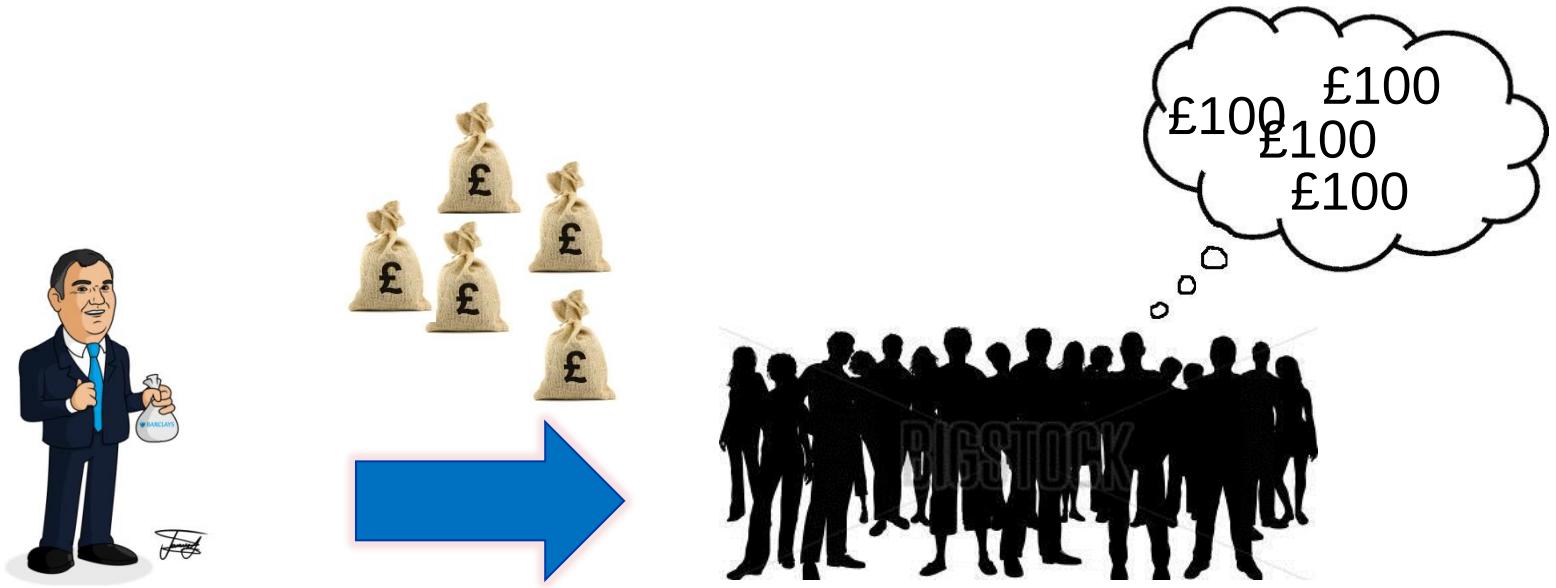
3. Agreeing how to take money from a bizarrely generous ‘banker’

- Each of n players chooses a sum of money between £-100 and £100
- The banker gives the second largest sum **to all**
  - 100, 99, 84, 3, -97
  - 100, 100, 100, 1, -12
- If one player’s number is precisely £1 less than this award, this player get a bonus of £2
  - taken from the player with the highest bid who loses£2



And now we can't actually communicate…
(super-Traveller's Dilemma, Basu, 1994)

- This seems too easy!



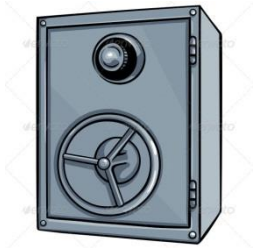
Part I: Virtual Bargaining

2. GAME THEORY: STANDARD VERSION

Nash equilibrium

- A pair of strategies such that each player's strategy is the best response to the other
- Game theory: model self and other(s) as rational individuals, not objects
- 2 problems
  - Too many Nash equilibria (**much discussed**)
  - Problem of too few Nash equilibria (***not* much discussed**)
    - The boobytrap game (Misyak & Chater, in press)
    - Traveller's Dilemma (Basu, 1994)

The Boobytrap Game



* Do nothing?
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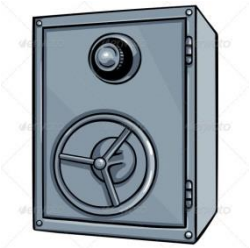


A part of the boobytrap game…

	C	D
C	30, 30	10, 40
D	40, 10	20, 20

This is Prisoner's Dilemma, with its demoralizing D,D Nash equilibrium

The Boobytrap Game

	C	D	B
C	30, 30	10, 40	30, 29
D	40, 10	20, 20	-100, 9
B	29, 30	9, -100	29, 29

i.e., Prisoner's Dilemma – but now with an extra move

The Boobytrap Game

	C	D	B
C	30, 30	10, 40	30, 29
D	40, 10	20, 20	-100, 9
B	29, 30	9, -100	29, 29

According to standard game theory, B is dominated by C; so Nash equilibrium is still DD

The Boobytrap Game

	C	D	B
C	30, 30	10, 40	30, 29
D	40, 10	20, 20	-100, 9
B	29, 30	9, -100	29, 29

But if people buy the boobytrap (or even better, buy it sometimes) shouldn't 29, 29 be attainable?

The (standard) Traveller's Dilemma (Basu, 1994)

- Each of two players chooses a sum of money between $1 and $100
- Both get the payoff, in $, associated with the lowest number
- If one player's number is strictly lower, then transfer $2 from the 'greedy' to the 'modest' player

The (standard) Traveller's Dilemma (Basu, 1994)

- E.g.,

  $100, $100 → $100, $100

  $100, $99 → $99-$2=$97, $99+$2=$101

  $1, $100 → $1+$2=$3, $1-$2=-$1

- Unique Nash equilibrium (!)

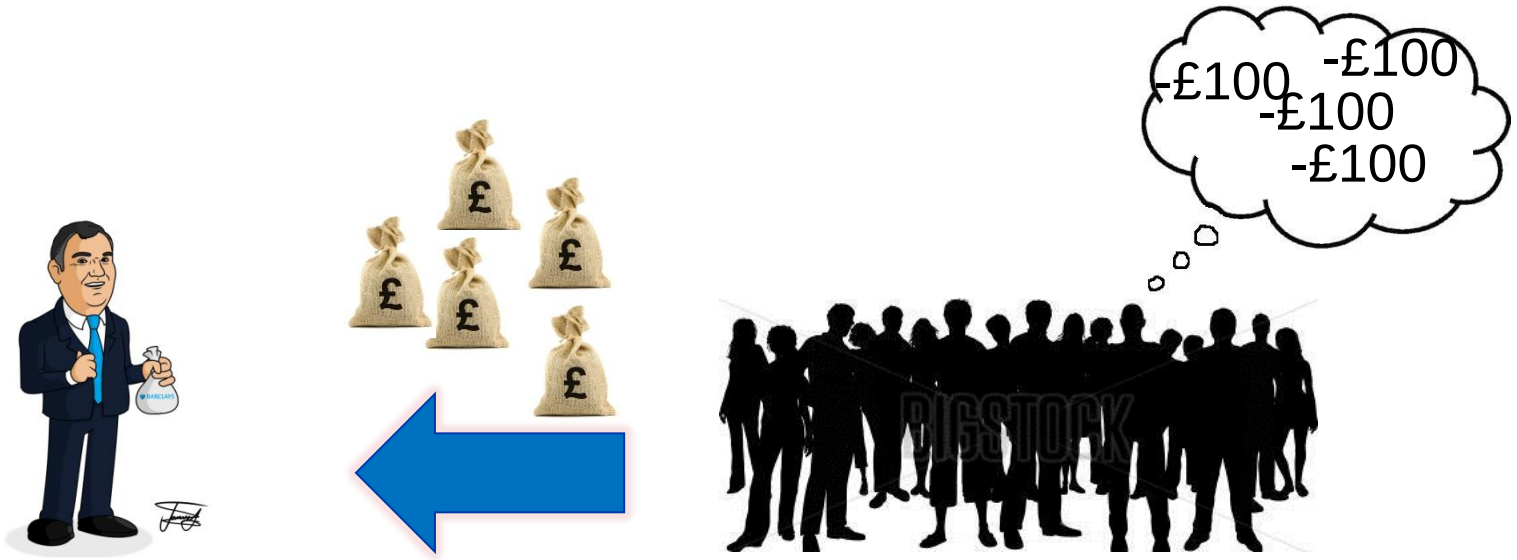
  $1, $1 → $1, $1

But this seems like a terribly bad outcome!

Shouldn't something near $100, $100 be attainable?

And the super-Traveller's Dilemma??

- If the players are all Nash Players, then the Banker does well after all - unique Nash equilibrium is:



3. VIRTUAL BARGAINING I: POSSIBLE EQUILIBRIA

The key shift:

- Don't ask: what shall I do in response to your move? (I don't know your move, anyway)
- Do ask: what could we agree to do?
- Key idea of team reasoning (Sugden, Bacharach, Colman, et al).

Two differences from standard team reasoning

1. What is the mechanism for 'creating' the team 'will' from the wills of its individual members?

    suggestion: virtual bargaining:

    i.e., the agreement they would have reached

2. Bargaining applies even for sworn enemies, and even with low/no trust

    No assumption that the 'team' is 'on the same side' (cf the gangsters!): so no assumption of goodwill or trust, or shared objectives

Who do we trust?

- Nash assumes (implicitly) that we don't trust ourselves (we may violate our side of the bargain, and best respond)

vs

- In making a bargain, we trust ourselves, but we don't (necessarily) trust the other player (the other may violate their side of the bargain and best respond)

Each player is *cautious*

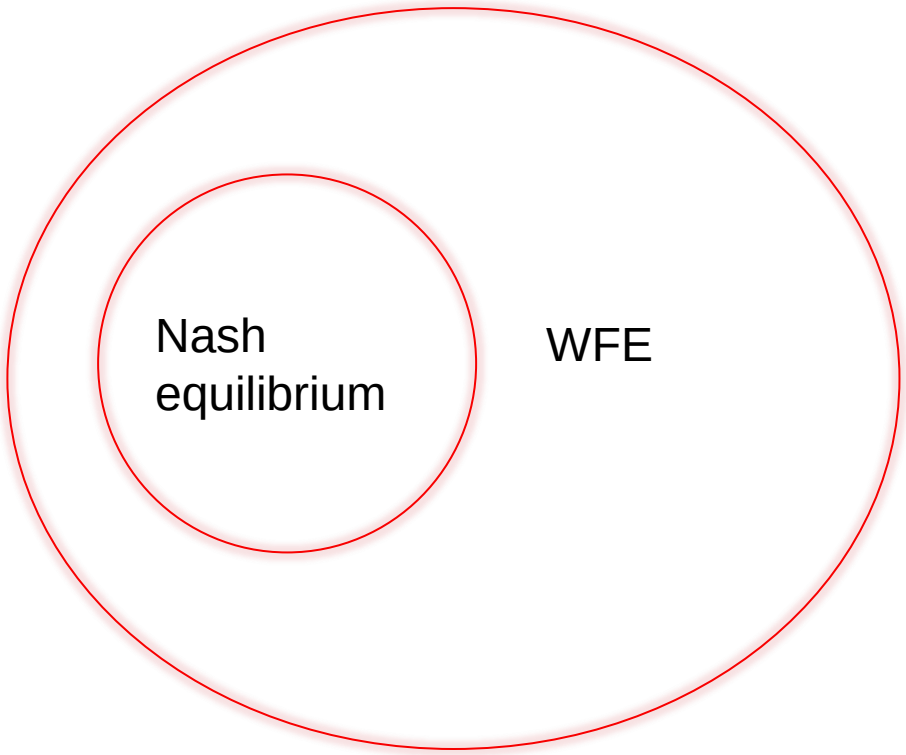
- Neither knows whether the other will
  - "Go through" with the 'bargain'
  - Best-respond (if different)
- Call the 'sure thing' payoff the minimum of these
- Suppose each player aims to maximize the 'sure thing'

Weakly feasible equilibrium (WFE)

- A pair of strategies, (σ_1^W, σ_2^W) is a WFE if:

  - Player 1 can't obtain a better "sure thing," by shifting to some other strategy, given that player 2 plays σ_2^W
  - Player 2 can't obtain a better "sure thing," by shifting to some other strategy, given that player 1 plays σ_1^W

WFE extends Nash



But the extra equilibria are ones that seem very natural to play…

Application to the Boobytrap Game

	C	D	B
C	30, 30	10, 40	30, 29
D	40, 10	20, 20	-100, 9
B	29, 30	9, -100	29, 29

B, B is (nearly) a WFE: if I buy the boobytrap, you can either best respond (C) or go through with the bargain (B). Either way, I get 29.

Actually, I only need to buy the boobytrap *enough* to deter D…

	C	D	B
C	30, 30	10, 40	30, 29
D	40, 10	20, 20	-100, 9
B	29, 30	9, -100	29, 29

…so a mixed strategy of C and B is best

But notice this is a dominated by C (and hence not a Nash equilibrium)

The (normal) Traveller's Dilemma (Basu, 1994)

- Each player chooses a sum of money between $1 and $100
- Both get the payoff, in $, associated with the lowest number
- If one player's number is strictly lower, then transfer $2 from the 'greedy' to the 'modest' player

- Then, many WFE: ($1, $1), ($2, $2)… ($100, $100)

The Traveller's Dilemma (Basu, 1994)

($100, $100)

Has a Sure Thing for Player 1: Min($98, $100) = $98

Can the first player get a better Sure Thing? No! For any other n<100, the pair of strategies:

($*n*, $100)

Has a Sure Thing for Player 1: Min($*n*-2, $*n*) = $*n*-2 < $98… i.e., is worse.

So ($100, $100) is indeed a WFE

4. VIRTUAL BARGAINING II: CHOOSING AN EQUILIBRIUM

How do we *coordinate* on the same equilibrium?

- Virtual bargaining asks...
  - Which equilibrium would we agree on?
  - And we then follow this agreement
- If
  - there is an obvious winning agreement
- Then
  - coordination can be achieved

So *coordination* is not mere *cooperation*; and nothing to do with altruism

The link between virtual bargaining and 'real' bargaining is a general psychological claim

- Whatever factors influence 'real' bargaining should influence virtual bargaining
  - Personality
  - Reputation
  - Past history
  - Background wealth
  - Status, etc, etc

Formal challenge: choose a specific model of bargaining

- E.g., Nash bargaining

  - Maximize product of utility gains for the bargain, in comparison with some default
    - Not always obvious what the default should be…

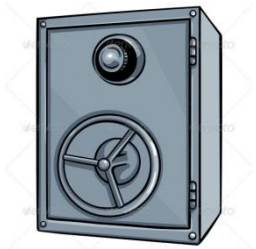
(And, assuming cautious players, we'll consider the utility of the "sure thing" outcome in the worst case scenario)

Back to our coin sharing game…

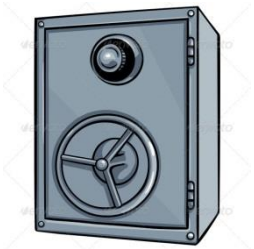
Y / X	A	B	C
A	9,1	-	-
B	-	1,9	-
C	-	-	5,5

The Boobytrap Game:

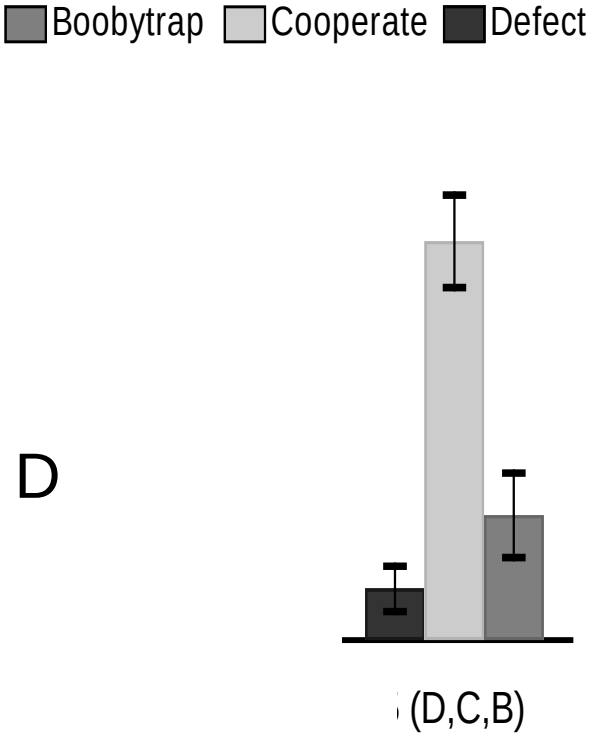
now, no bargaining or communication allowed



Possible WF equilibria:
B, B **good**
(or mixed C/B, mixed C/B) **v. good**
D, D **bad**



Experimental result
(Misyak & Chater, in press)



And people play a B, C mix; rarely D;

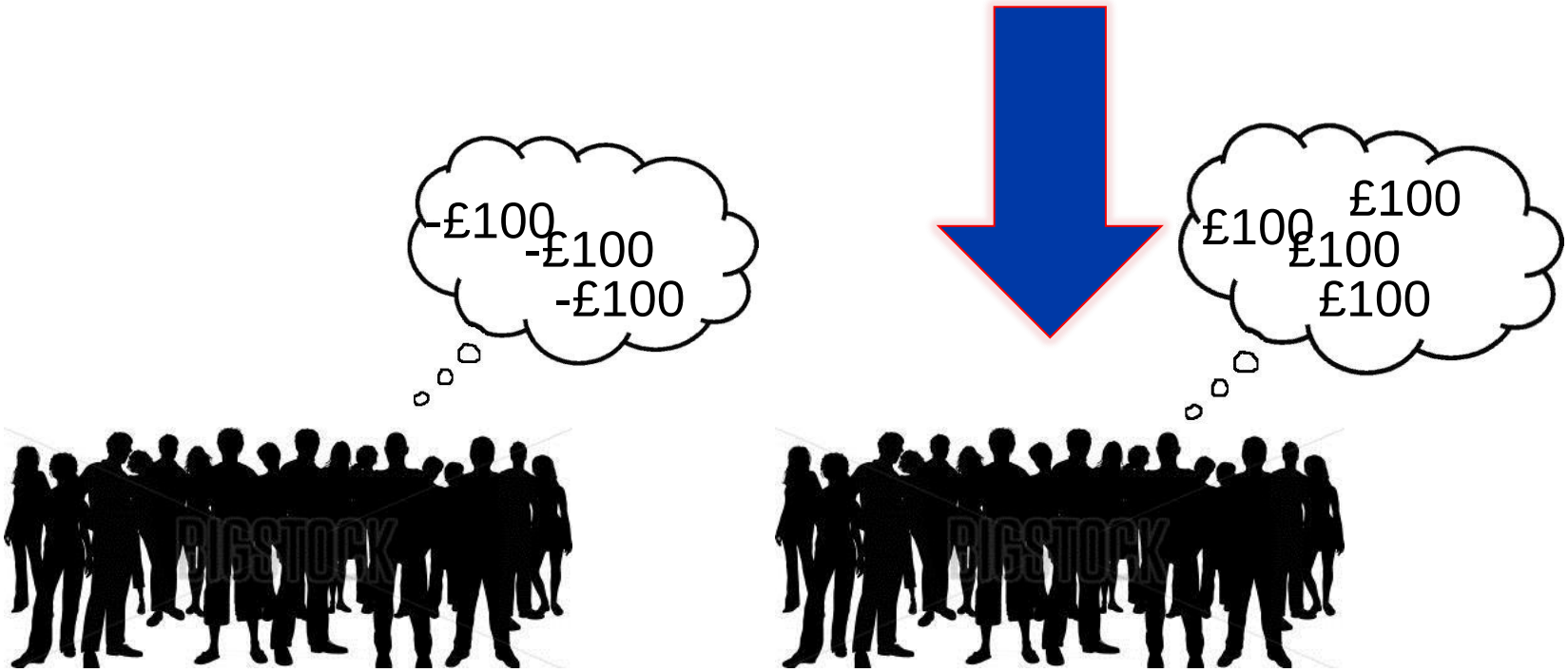
And do better than Nash: D, D

And no reliance on altruism, common interests

Even antagonistic players will ‘virtually bargain’

Super-traveller's dilemma

- The best bargain is obvious!



But not all cases will be ‘easy’

- Recall: General claim is that the challenges for virtual bargaining will be the same as for a theory of bargaining
  - When there is no obvious winning agreement, virtual bargaining can lead to poor coordination
  - And predicts people should do badly
  - Can be tested experimentally
    - comparing cases where players can or can’t communicate

Part II: Applications

5. FAIRNESS THROUGH VIRTUAL BARGAINING

A new perspective on ‘fairness’

- Perhaps what matters is not fair allocation of resources
- But a fair bargain
- Experiment (Güth & Van Damme, 1998)

  3-person ultimatum game

  - A: makes the ultimatum (an ‘offer’ to B and C)
  - B: accepts or rejects
  - C: does nothing

Sharply contrasting predictions

- (Subgame perfect) Nash would favour

  99%, 1%, 0%

- Fairness of outcome would favour

  1/3, 1/3, 1/3

- Fairness of bargaining would favour

  ½, ½, 0

roughly

C is ignored as no role in the bargaining process; 'fairness' = what virtual bargaining yields

But when a bargain is violated, we may feel **outrage**

- We've seen that fair bargains may be more important than fair outcomes
- Wild claim:
  - (Many) moral emotions are primarily about (**virtual or real**) ***bargains*** **not** ***actions***
  - They can be generalized via notion a social contract (Hobbes, Rousseau, Rawls)
- Hence, inappropriate to feel angry at a shark—sharks and people can't make bargains!

6. JOINT ACTION AND JOINT ATTENTION

Joint action is ubiquitous in human activity

What is joint action?

- Sebanz, Bekkering and Knoblich: coupled perception/action systems
- Bratman: action carried out with a shared intention
- Sugden: result of “team reasoning” (what is best for ‘us’)
- Virtual bargaining viewpoint is:
  - A joint action A is the result of a virtual bargain
  - An implicit agreement “Let’s do A!”

Joint attention is also ubiquitous

And, of course, joint action often presupposes joint attention

What is joint attention?

- Shared gaze 
- Dyadic joint attention 
- Triadic joint attention 
- Virtual bargaining viewpoint is:
  - Joint attention = joint action where the action involves information processing (i.e., directing attentional resources)
  - A joint action A is the result of a virtual bargain
  - An implicit agreement “Let’s look at/attend to/remember X!”

7. COMMUNICATION AS VIRTUAL BARGAINING

Implication: Real agreements are built on virtual bargains

Communication through Nash equilibrium?

- The informational bankruptcy of “cheap talk” (Farrell, J.; Rabin, M. (1996). "Cheap Talk". *Journal of Economic Perspectives* **10** (3): 103–118)
- So signalling via action must be costly : e.g., “stotting” http://en.wikipedia.org/wiki/Stotting
- No joint attention/action required---but little can be communicated

But if ‘talk is cheap’

- how does
  - Language
  - Facial expression
  - Gesture
  - …

…successfully carry information between people??

- Why aren’t we limited to:

= “I’m fast!”

Communication involves joint action and joint attention---and is solved by virtual bargaining over mappings between signal and message

- Joint action:

- Joint attention:

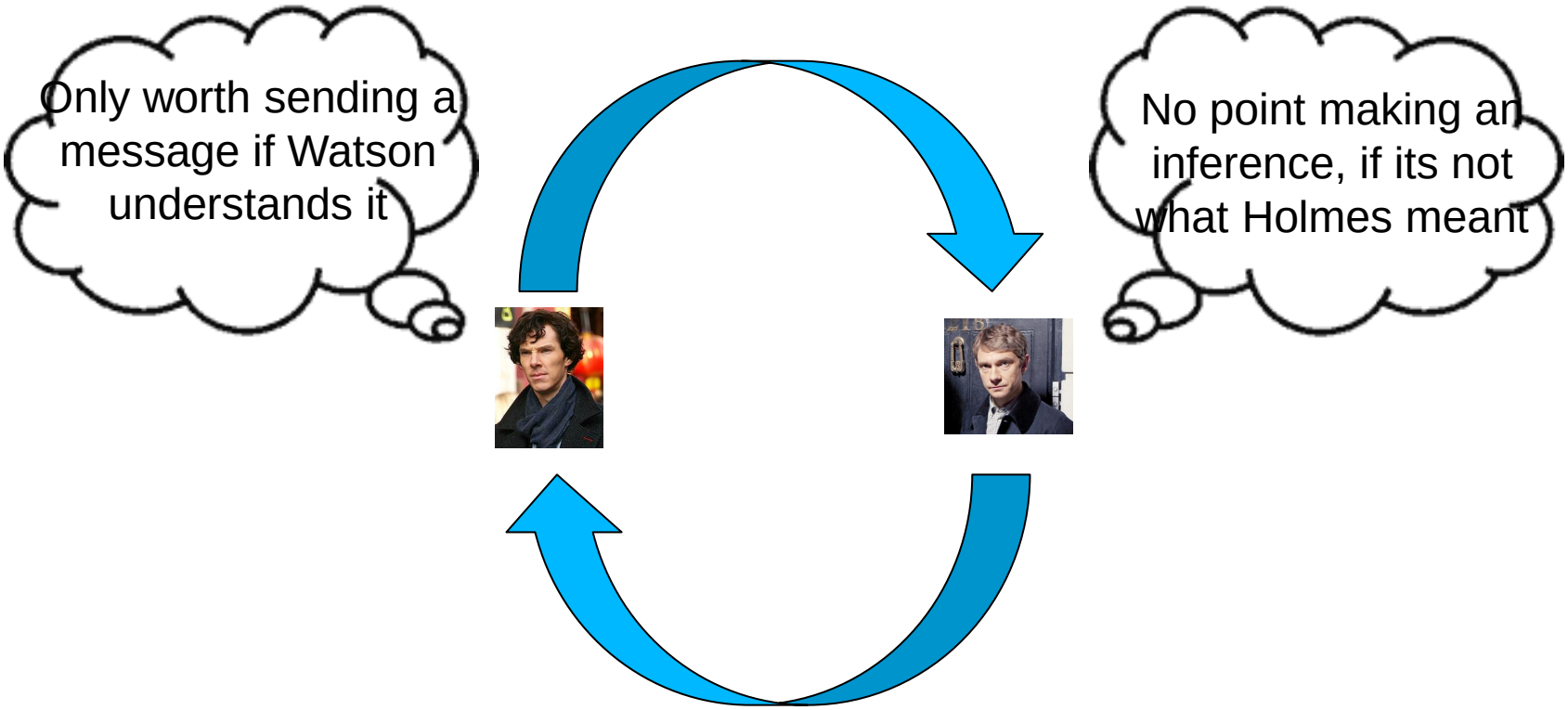
But communicative signals are notoriously vastly underspecified/context specific

- Virtual bargaining sees communication as joint action/attention
  - If we could 'bargain' about which mapping to use, in a local context,
    - we'd choose a 'good' mapping
  - But what is 'good'? –
    - something like maximizing:

$$\frac{\text{communicative content}}{\text{cognitive effort}}$$

(cf Sperber and Wilson, Relevance Theory)

Communication has “symmetrical” pay-offs... And miscommunication is bad for both of us



So communication is a ‘coordination game’

But communicative signals are notoriously vastly underspecified/ambiguous/context specific

Holmes

"The cup…"

?

Watson

But communicative signals are notoriously vastly underspecified/ambiguous/context specific

Holmes

"The cup…"

?

Watson

And which item is more ‘cup-like’ is not the whole story…

Holmes

“The cup…”

?

Watson

And which item is more ‘cup-like’ is not the whole story…

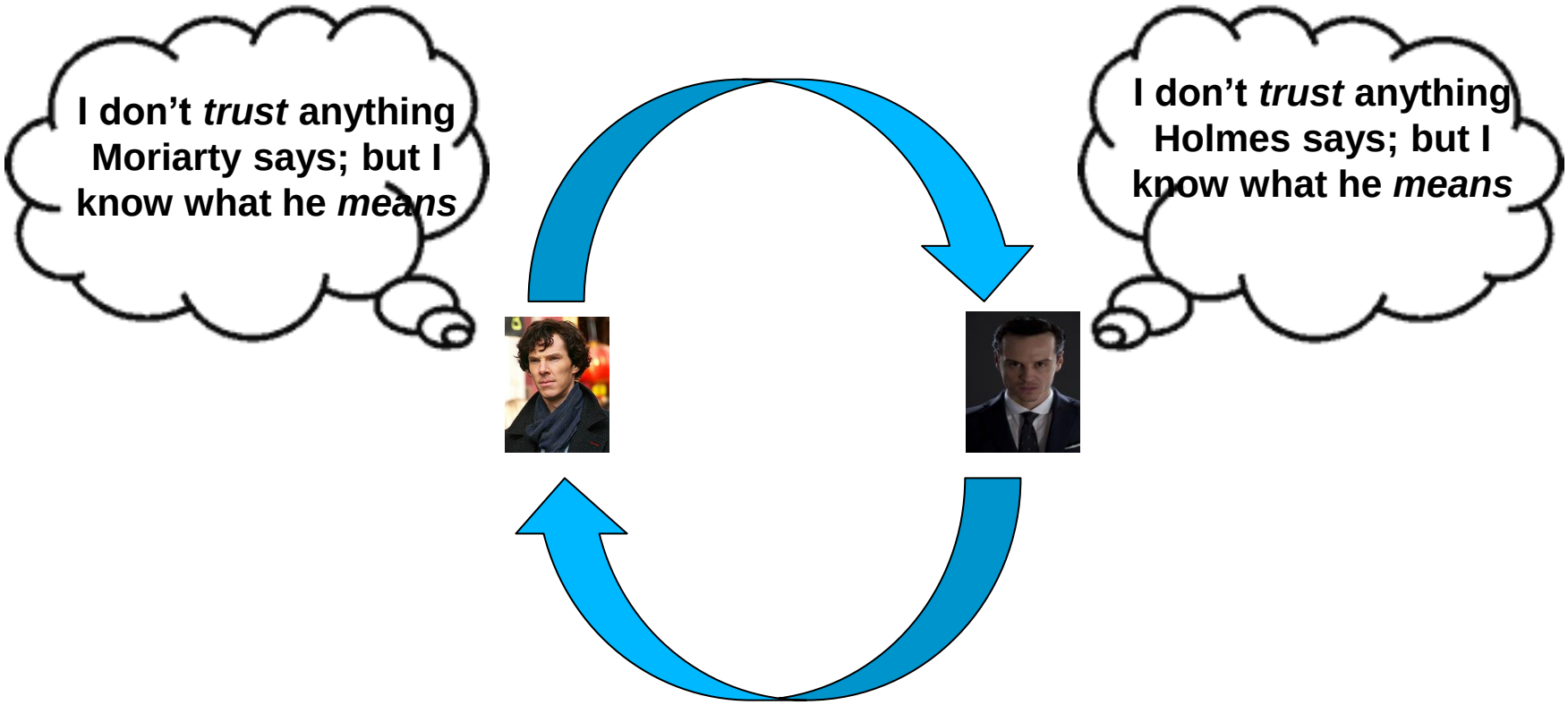
Holmes

“The cup…”

?

Watson

Communication does *not* presuppose cooperativeness (cf Grice) (arch-enemies can communicate)



Holmes and Moriarty both know what *would* result from a virtual bargain about how best to communicate

8. FUTURE DIRECTIONS

Future directions

- If each new virtual bargain can be based on past precedent…
- …may supports language, customs, conventions...
- And perhaps explicit cultural forms are often codifications of earlier virtual bargains
  - (case law, sports, joint stock companies, insurance...)
- Suggests an incremental theory of culture as layers of virtual agreements (cf Buchanan and Tulloch, 1962; Sugden, 2013)
- Uniquely human?