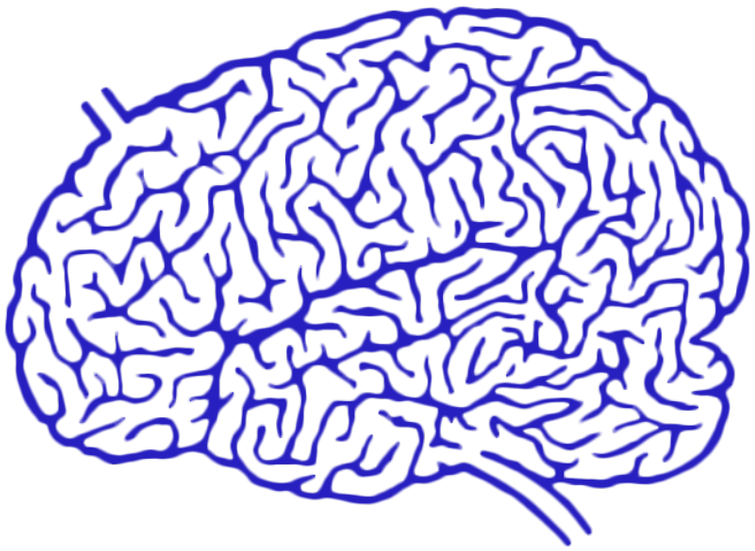

Cheap talk with multiple audiences: An experimental analysis

Andy Fang
Artemis Han

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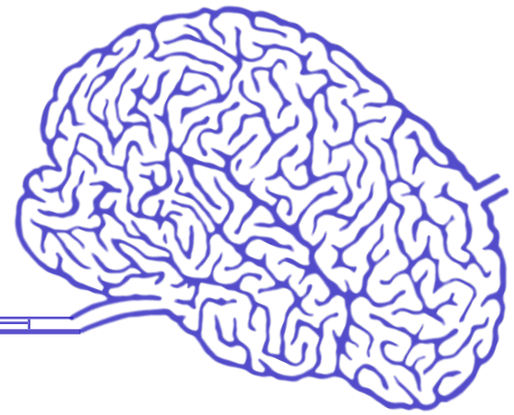


In many economic environments with communication of private information, the message sent by an informed sender may simultaneously influence the actions of many uninformed receivers with potentially conflicting interests.

Example

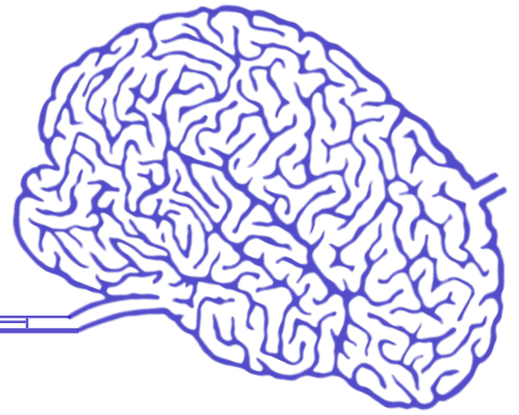
- **Firm financial statements**
- **Political speech**

Public? **Private?**

1 sender vs 1 receiver?

1 sender vs multiple receiver?

Experimental Design

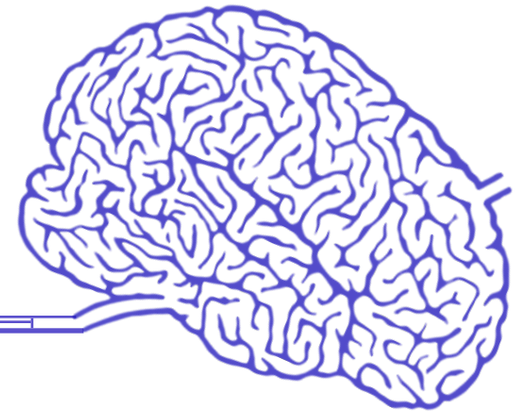


Cheap Talk with Multiple Audiences

- Princeton Laboratory for Experimental Social Science PLESS
- z-Tree software
- 8 sessions, 12 subjects → 96 subjects
- 1.5 hour per hour
- $10 show up fee, $24.40-$33.80 earnings according to payoff

PRINCETON UNIVERSITY

Cheap Talk



What is cheap talk?

In game theory, cheap talk is communication between players that does not directly affect the payoffs of the game. Providing and receiving information is free.

One actor has information and the other has ability to act. The informed player can choose strategically what to say and what not to say.

- costless to transmit and receive
- non-binding (i.e. does not limit strategic choices by either party)
- unverifiable (i.e. cannot be verified by a third party like a court)

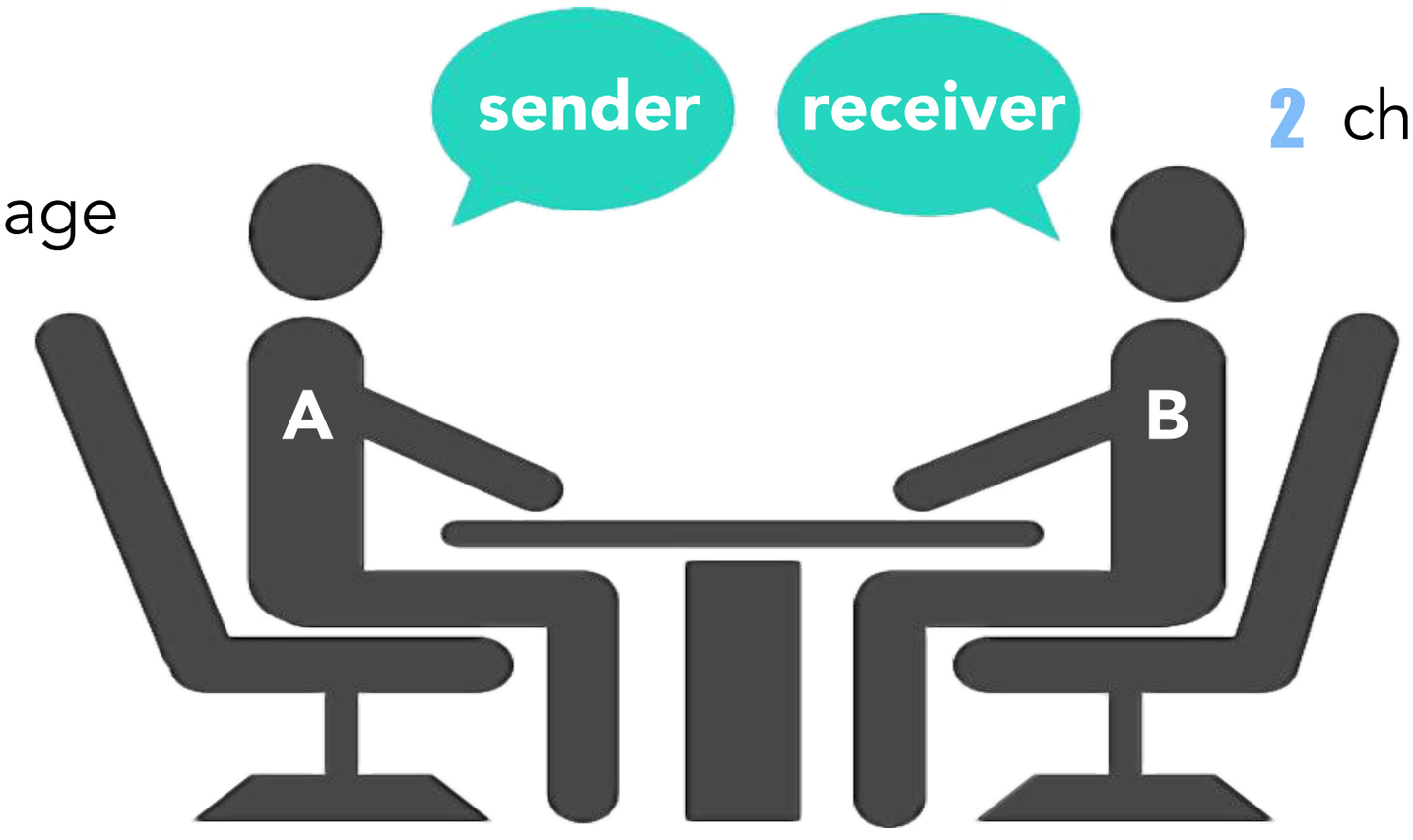
Part A

- Session 1-6
- 6 games, repeated 3 times
- pairs: sender & receiver

heads tails

1 observe the state of the world

2 send a message to B



1 see the message

2 choose an action

Game 1:
Sender's payoff

	Heads	Tails
Action A	10	0
Action B	0	10

Receiver's payoff

	Heads	Tails
Action A	10	0
Action B	0	10

Game 2:
Sender's payoff

	Heads	Tails
Action A	25	0
Action B	0	25

Receiver's payoff

	Heads	Tails
Action A	10	0
Action B	0	10

Game 3:
Sender's payoff

	Heads	Tails
Action A	15	0
Action B	0	15

Receiver's payoff

	Heads	Tails
Action A	0	15
Action B	15	0

Game 4:
Sender's payoff

	Heads	Tails
Action A	20	0
Action B	0	20

Receiver's payoff

	Heads	Tails
Action A	0	20
Action B	20	0

Game 5:
Sender's payoff

	Heads	Tails
Action A	0	10
Action B	10	30

Receiver's payoff

	Heads	Tails
Action A	10	0
Action B	0	10

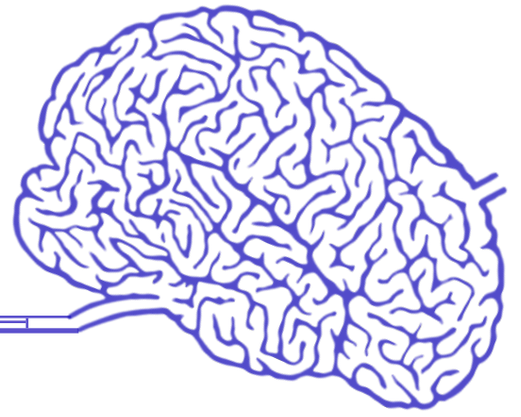
Game 6:
Sender's payoff

	Heads	Tails
Action A	30	10
Action B	10	0

Receiver's payoff

	Heads	Tails
Action A	10	0
Action B	0	10

Payoff



Game 1:
Sender's payoff

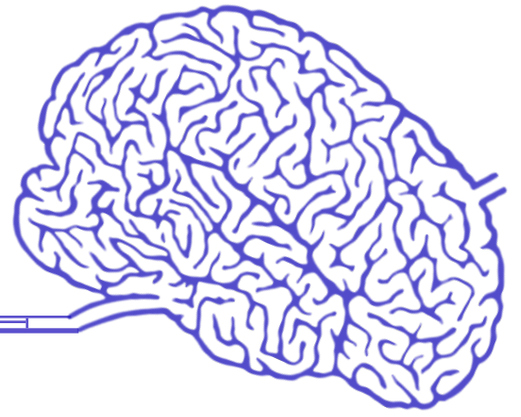
	Heads	Tails
Action A	10	0
Action B	0	10

Receiver's payoff

	Heads	Tails
Action A	10	0
Action B	0	10

? → A should say? → B should act?

Payoff



Game 4:
Sender's payoff

	Heads	Tails
Action A	20	0
Action B	0	20

Receiver's payoff

	Heads	Tails
Action A	0	20
Action B	20	0

? → A should say? → B should act?

Payoff

Game 6:
Sender's payoff

	Heads	Tails
Action A	30	10
Action B	10	0

Receiver's payoff

	Heads	Tails
Action A	10	0
Action B	0	10

?

?

→ A should say? → B should act?

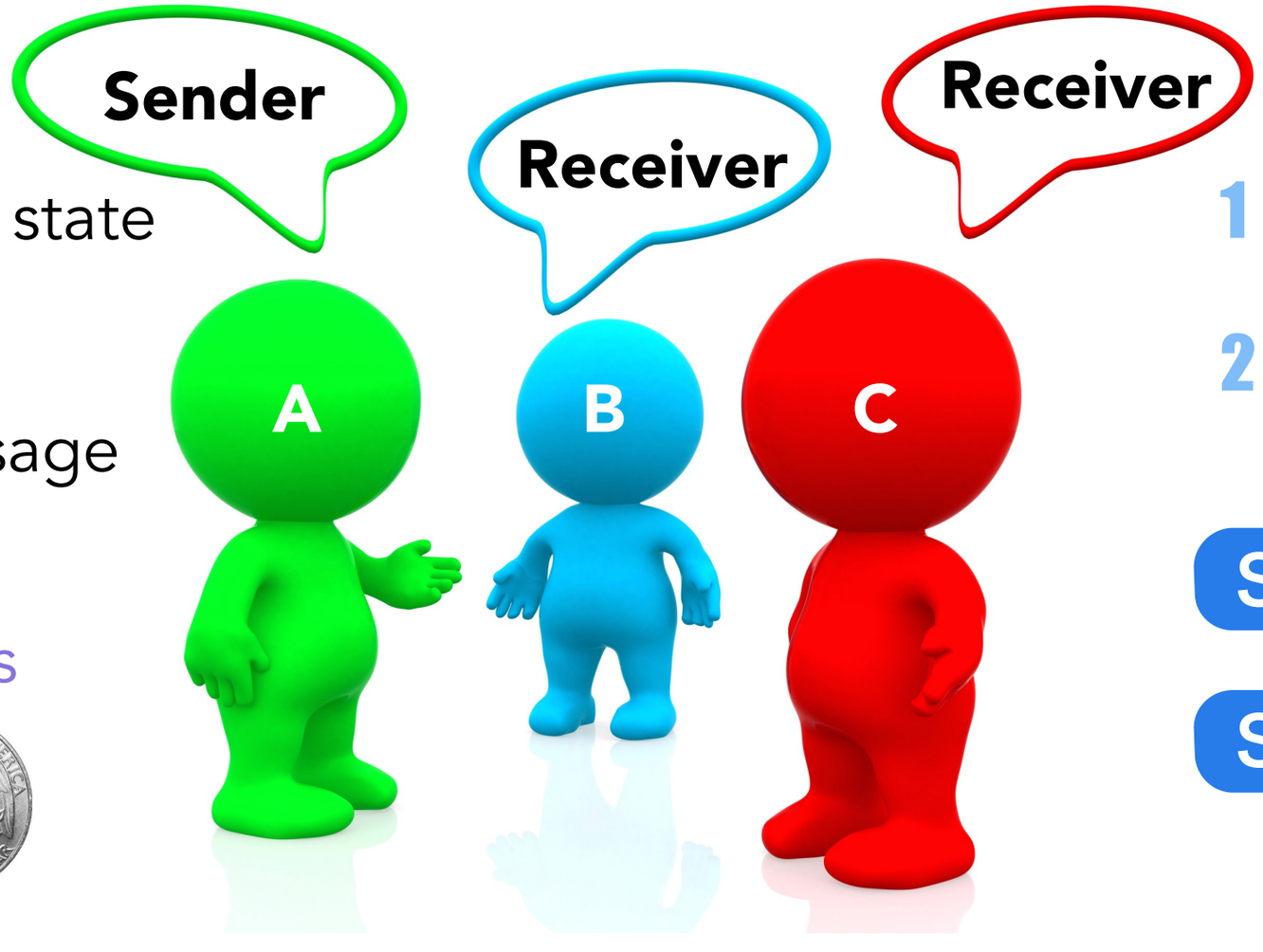
Part B

- Session 7-12
- 5 games, repeated 4 times
- groups of 3: 1 sender & 2 receivers

1 observe the state of the world

2 send a message to B and C

heads tails



1 see the message

2 choose an action

Same message

Simultaneously

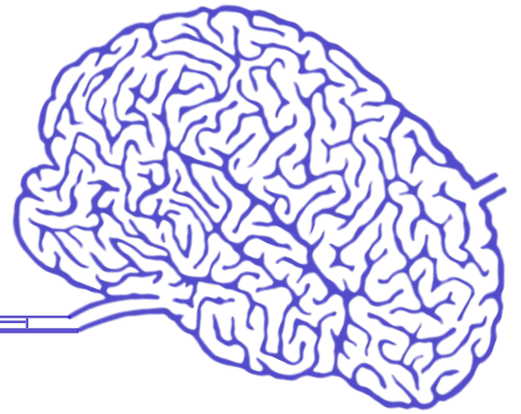
Table 3
Types of private vs. public communication.

	Separating equilibrium in *private*	Separating equilibrium in *public*
No communication	No	No
Mutual discipline	No	Yes
Subversion	With one receiver, but not with the other	No
One-sided discipline	With one receiver, but not with the other	Yes
Full communication	Yes, with both receivers	Yes

Five Types of Game

- No communication
- Mutual Discipline
- Subversion
- One-sided Discipline
- Full Communication

Payoff



Game 12 – Full communication

Sender's payoff

	Heads	Tails
Action A1	10	0
Action B1	0	10

Sender's payoff

	Heads	Tails
Action A2	25	0
Action B2	0	25

Receiver 1's payoff

	Heads	Tails
Action A1	10	0
Action B1	0	10

Receiver 2's payoff

	Heads	Tails
Action A2	10	0
Action B2	0	10

Game 13 – Subversion

Sender's payoff

	Heads	Tails
Action A1	10	0
Action B1	0	10

Sender's payoff

	Heads	Tails
Action A2	15	0
Action B2	0	15

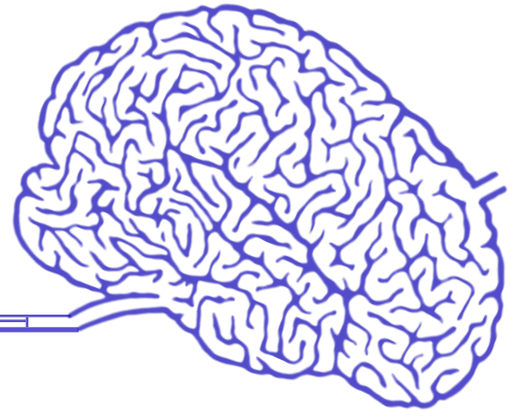
Receiver 1's payoff

	Heads	Tails
Action A1	10	0
Action B1	0	10

Receiver 2's payoff

	Heads	Tails
Action A2	0	15
Action B2	15	0

Payoff



Game 23 – One-sided discipline

Sender's payoff

	Heads	Tails
Action A1	25	0
Action B1	0	25

Sender's payoff

	Heads	Tails
Action A2	15	0
Action B2	0	15

Receiver 1's payoff

	Heads	Tails
Action A1	10	0
Action B1	0	10

Receiver 2's payoff

	Heads	Tails
Action A2	0	15
Action B2	15	0

Game 56 – Mutual discipline

Sender's payoff

	Heads	Tails
Action A1	0	10
Action B1	10	30

Sender's payoff

	Heads	Tails
Action A2	30	10
Action B2	10	0

Receiver 1's payoff

	Heads	Tails
Action A1	10	0
Action B1	0	10

Receiver 2's payoff

	Heads	Tails
Action A2	10	0
Action B2	0	10

Payoff

Game 34 – No communication

Sender's payoff

	Heads	Tails
Action A1	15	0
Action B1	0	15

Receiver 1's payoff

	Heads	Tails
Action A1	0	15
Action B1	15	0

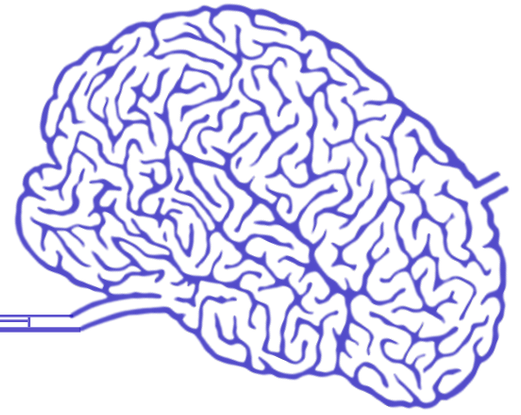
Sender's payoff

	Heads	Tails
Action A2	20	0
Action B2	0	20

Receiver 2's payoff

	Heads	Tails
Action A2	0	20
Action B2	20	0

Hypothesis



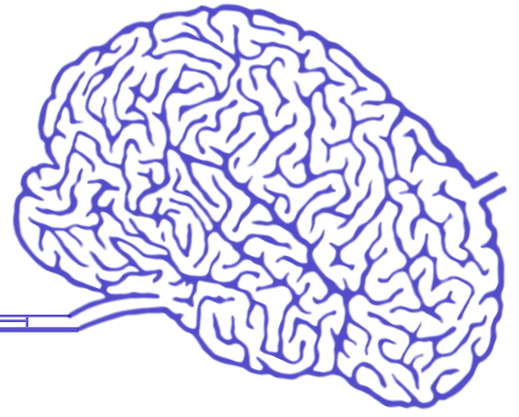
1 Hypothesis 1

Both in 2-person and in 3-person games, the sender's strategy is less informative in games of conflict than in games of no conflict. Similarly, the receivers' actions are more correlated to the sender's message in games of no conflict than in games of conflict.

2 Hypothesis 2

Adding a second receiver to a 2-person game has a positive effect in games of One-Sided Discipline and Mutual Discipline, a negative effect in a game of Subversion, and a neutral effect in games of No Communication and Full Communication.

Experiment Result



Two-person games – summaries of the means.

	telling_truth		*believing_sender*	
	Mean	St. dev.	Mean	St. dev.
No conflict	0.976 (1.0)	0.154	0.979 (1.0)	0.143
Conflict	0.628 (0.5)	0.484	0.714 (0.5)	0.452

Theoretical values are in parentheses.

Two-person games – means by game.

Game	*telling_truth*		*believing_sender*	
	Mean	St. dev.	Mean	St. dev.
1	0.986 (1.0)	0.117	0.986 (1.0)	0.117
2	0.965 (1.0)	0.184	0.972 (1.0)	0.165
3	0.701 (0.5)	0.459	0.556 (0.5)	0.499
4	0.653 (0.5)	0.478	0.576 (0.5)	0.496
5	0.507 (0.5)	0.502	0.861 (0.5)	0.347
6	0.653 (0.5)	0.478	0.861 (0.5)	0.347

Experiment Result

Two-person games – individual strategy profiles (out of the total of 96 subjects).

telling_truth

No conflict	Truth			Mix			Lie
Conflict	Truth	Mix	Lie	Truth	Mix	Lie	Truth
	18.8%	**69.8%**	4.2%	2.1%	5.2%	0.0%	0.0%

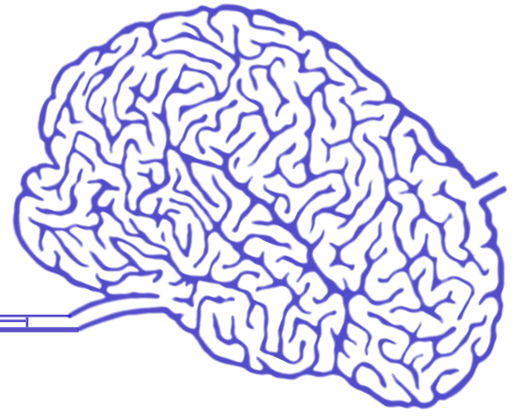
believing_sender

No conflict	Trust			Mix			Deny
Conflict	Trust	Mix	Deny	Trust	Mix	Deny	Trust
	30.2%	**61.5%**	1.0%	4.2%	3.1%	0.0%	0.0%

18.8% → Under conflict, revealing the truth too frequently.

30.2% → Under conflict, trusting senders too much.

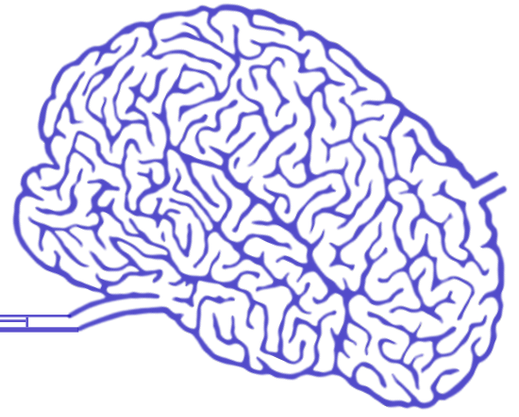
Experiment Result



telling_truth		*receiver 1 – believing*		*receiver 2 – believing*	
Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
0.930 (1.0)	0.256	0.964 (1.0)	0.188	0.919 (1.0)	0.273
0.660 (0.5)	0.475	0.617 (0.5)	0.487	0.648 (0.5)	0.478

telling_truth		*receiver 1 – believing*		*receiver 2 – believing*	
Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
0.969 (1.0)	0.175	0.977 (1.0)	0.152	0.977 (1.0)	0.152
0.688 (0.5)	0.465	0.734 (0.5)	0.443	0.688 (0.5)	0.465
0.883 (1.0)	0.323	0.969 (1.0)	0.175	0.867 (1.0)	0.341
0.633 (0.5)	0.484	0.500 (0.5)	0.502	0.609 (0.5)	0.490
0.938 (1.0)	0.243	0.945 (1.0)	0.228	0.914 (1.0)	0.281

Experiment Result



Three-person games – individual strategy profiles.

telling_truth

No conflict	Truth			Mix			Lie
Conflict	Truth	Mix	Lie	Truth	Mix	Lie	Truth
	32.3%	**38.5%**	11.5%	4.2%	10.4%	2.1%	0.0%

% out of the total of 96 subjects.

believing_sender1

No conflict	Trust			Mix			Deny
Conflict	Trust	Mix	Deny	Trust	Mix	Deny	Trust
	29.2%	**45.8%**	15.6%	3.1%	4.2%	0.0%	1.0%

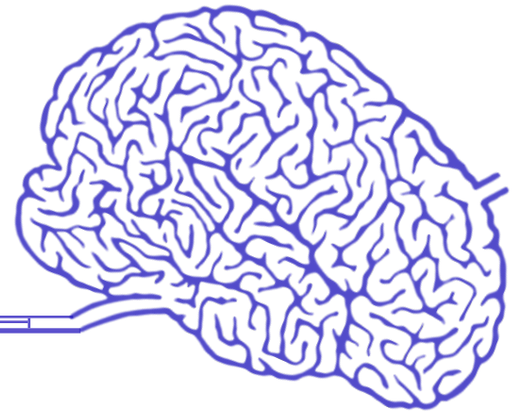
% out of the total of 96 subjects.

believing_sender2

No conflict	Trust			Mix			Deny
Conflict	Trust	Mix	Deny	Trust	Mix	Deny	Trust
	31.3%	**35.4%**	14.6%	6.3%	8.3%	4.2%	0.0%

We find support in the data for our hypothesis.

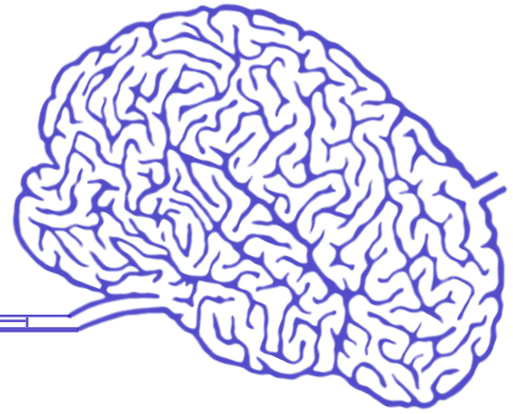
Intuition



What does the addition of a second receiver affect the result?

1. Does the sender's strategy change?
2. Do the receivers recognize the change?

Intuition



Differences of the means between 2-person games and 3-person games.

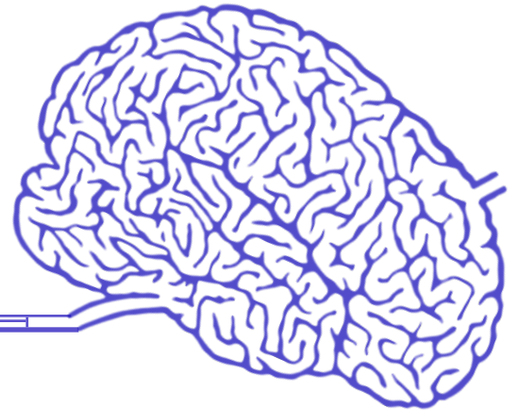
Telling_truth						
	1	2	3	4	5	6
1	–	**−0.0174**	**−0.2986****	–	–	–
2	**0.0035**	–	−0.0825**	–	–	–
3	**−0.0139**	**0.1814****	–	**−0.0686**	–	–
4	–	–	**−0.0200**	–	–	–
5	–	–	–	–	–	**0.4306****
6	–	–	–	–	**0.2847****	–

Believing_sender						
	1	2	3	4	5	6
1	–	**−0.0095**	**−0.2517****	–	–	–
2	**0.0043**	–	**−0.0035**	–	–	–
3	0.1319**	**0.3116****	–	**−0.0556**	–	–
4	–	–	**0.0330**	–	–	–
5	–	–	–	–	–	**0.0842****
6	–	–	–	–	**0.0530***	–

Results in bold are consistent with the theoretical predictions. Results not in bold show a statistically significant difference when there is no difference according to the theory.

We find significant support in the data for our hypothesis.

Intuition



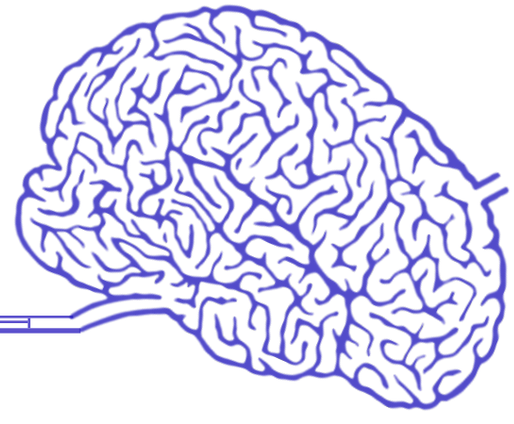
Behavioral predictions of the level-k model for 2-person games.

	Games 1 & 2		Games 3 & 4		Game 5		Game 6	
	Sender	Receiver	Sender	Receiver	Sender	Receiver	Sender	Receiver
L_0	Truth	Trust	Truth	Trust	Truth	Trust	Truth	Trust
L_1	Truth	Trust	Lie	Deny	"Tails"	Mix	"Heads"	Mix
L_2	Truth	Trust	Truth	Trust	Mix	Mix	Mix	Mix
L_3	Truth	Trust	Lie	Deny	Mix	Mix	Mix	Mix
L_4	Truth	Trust	Truth	Trust	Mix	Mix	Mix	Mix
…	…	…	…	…	…	…	…	…
L_∞	Truth	Trust	…	…	Mix	Mix	Mix	Mix
NE	Truth	Trust	Mix	Mix	Mix	Mix	Mix	Mix

Behavioral predictions of the level-k model for 3-person games.

	Games 12, 23 & 56			Games 13 & 34		
	Sender	Receiver 1	Receiver 2	Sender	Receiver 1	Receiver 2
L_0	Truth	Trust	Trust	Truth	Trust	Trust
L_1	Truth	Trust	Trust	Lie	Deny	Deny
L_2	Truth	Trust	Trust	Truth	Trust	Trust
L_3	Truth	Trust	Trust	Lie	Deny	Deny
L_4	Truth	Trust	Trust	Truth	Trust	Trust
…	…	…	…	…	…	…
L_∞	Truth	Trust	Trust	…	…	…
NE	Truth	Trust	Trust	Mix	Mix	Mix

Conclusion



1. Additional audience is in line with theoretical predictions.
2. Mistakes made from complexity decrease from learning.
3. A combination of level-k and Nash is best for explanation.

Thank you for your attention !