Competition, preference uncertainty, and jamming: A strategic communication experiment

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Agenda

- An example
- Experiment introduction
- Predictions
- Results
- Conclusion

Experiment introduction

- Two message senders
- One message receiver
- A Target T [-100, 100]
- A shift for right sender S_R [0, 50]
- A shift for left sender S_L [-50, 0]
- Maximum payoff point for receiver is T
- Maximum payoff point for senders are T+S_i

PLAYER A INSTRUCTIONS

Drag the WHITE tab to select a MESSAGE to send to Player C. When you are ready to send your message, click on the "Send Message" button.

If you have a question, please raise your hand and wait for the experimenter.

PAYOFF FORMULA

Payoff = 100 - |Target - Action|

A player earns 100 points if the action is equal to his or her own target and 1 point less for each unit of difference between the action and the target.

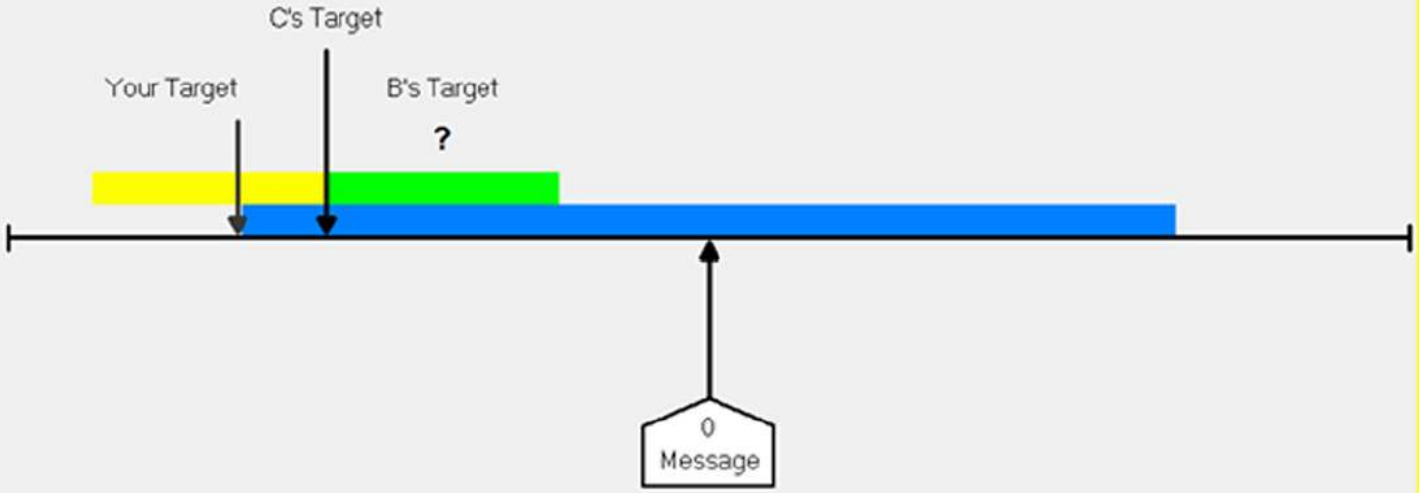
PAYOFF CALCULATOR

Click on the buttons below to show or hide the payoff calculator.

Show | Hide

Possible values for C's target | Possible values for your target | Possible values for B's target

C's Target: -82 | **Your Target: -101** | **B's Target: Between -82 and -32**



Send Message

Three predictions

- Babbling
- Partition
- Jamming

Babbling Predictions

- Messages are unrelated to the target

- $c \sim U[-100,100]$
- $E(m_i) = 0$
- $E(c) = 0$

Partition Predictions

- Messages only reveals whether the T is high or low
- Using K to communicate T is bigger or smaller than K

$$m_L(T, S_L) \sim \begin{cases} \mathrm{U}[K^*, 100] \; if \; T + S_L > K^* \\ \mathrm{U}[-100, K^*] \; if \; T + S_L < K^* \end{cases}$$

$$m_R(T, S_R) \sim \begin{cases} \mathrm{U}[-K^*, 100] \; if \; T + S_R > -K^* \\ \mathrm{U}[-100, -K^*] \; if \; T + S_R < -K^* \end{cases}$$

$$c(m_L, m_R) = \begin{cases} 2K^* \; if \; m_L > K^* \; and \; m_R > -K^* \\ -2K^* \; if \; m_L < K^* \; and \; m_R < -K^* \\ 0 \; otherwise, \end{cases}$$

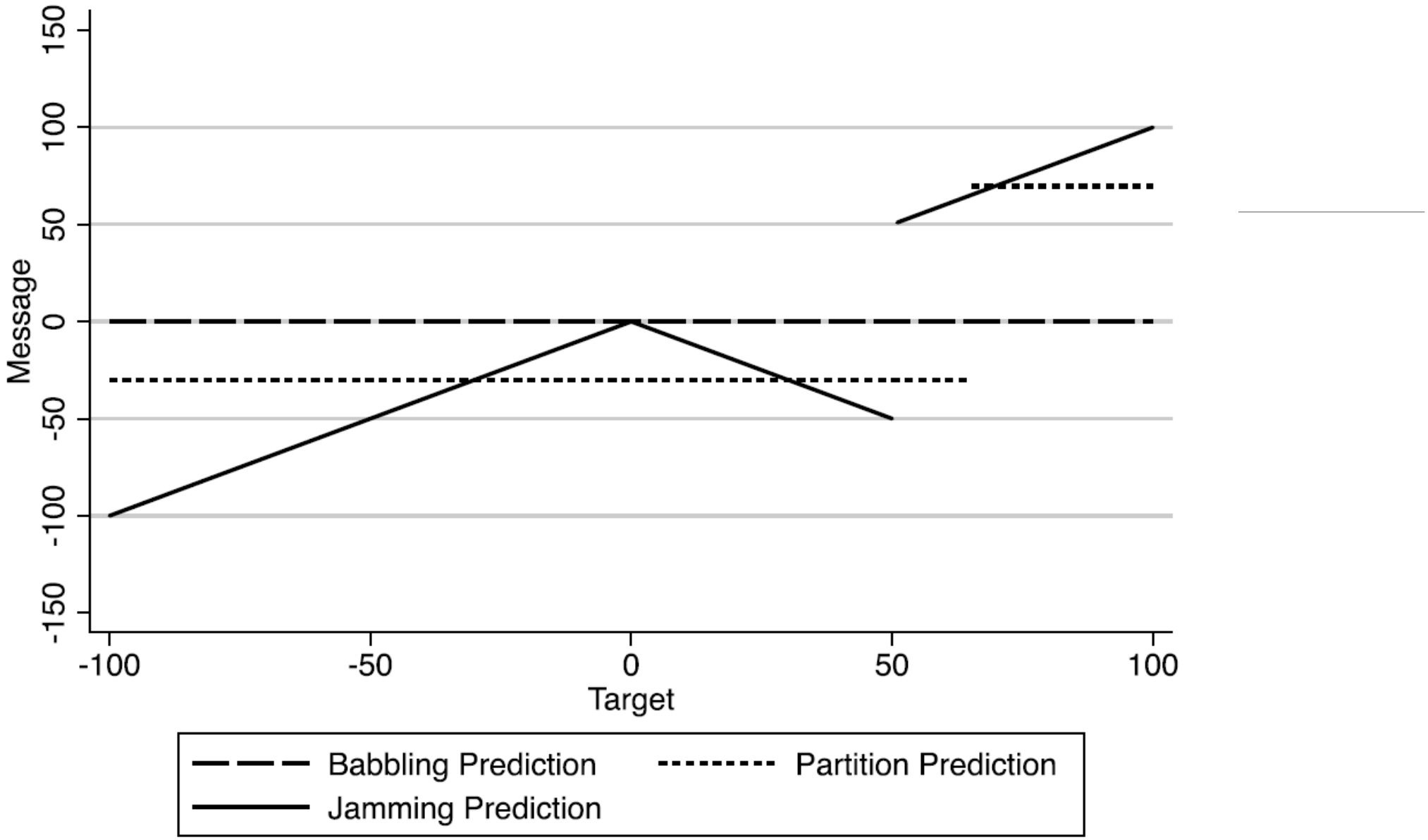
Jamming Prediction

- Sometimes tell the truth by sending T
- Incentive to jam the message by sending -T

$$m_L(T, S_L) = \begin{cases} -T \text{ if } T \in [0, -2S_L] \\ T \text{ otherwise} \end{cases}$$

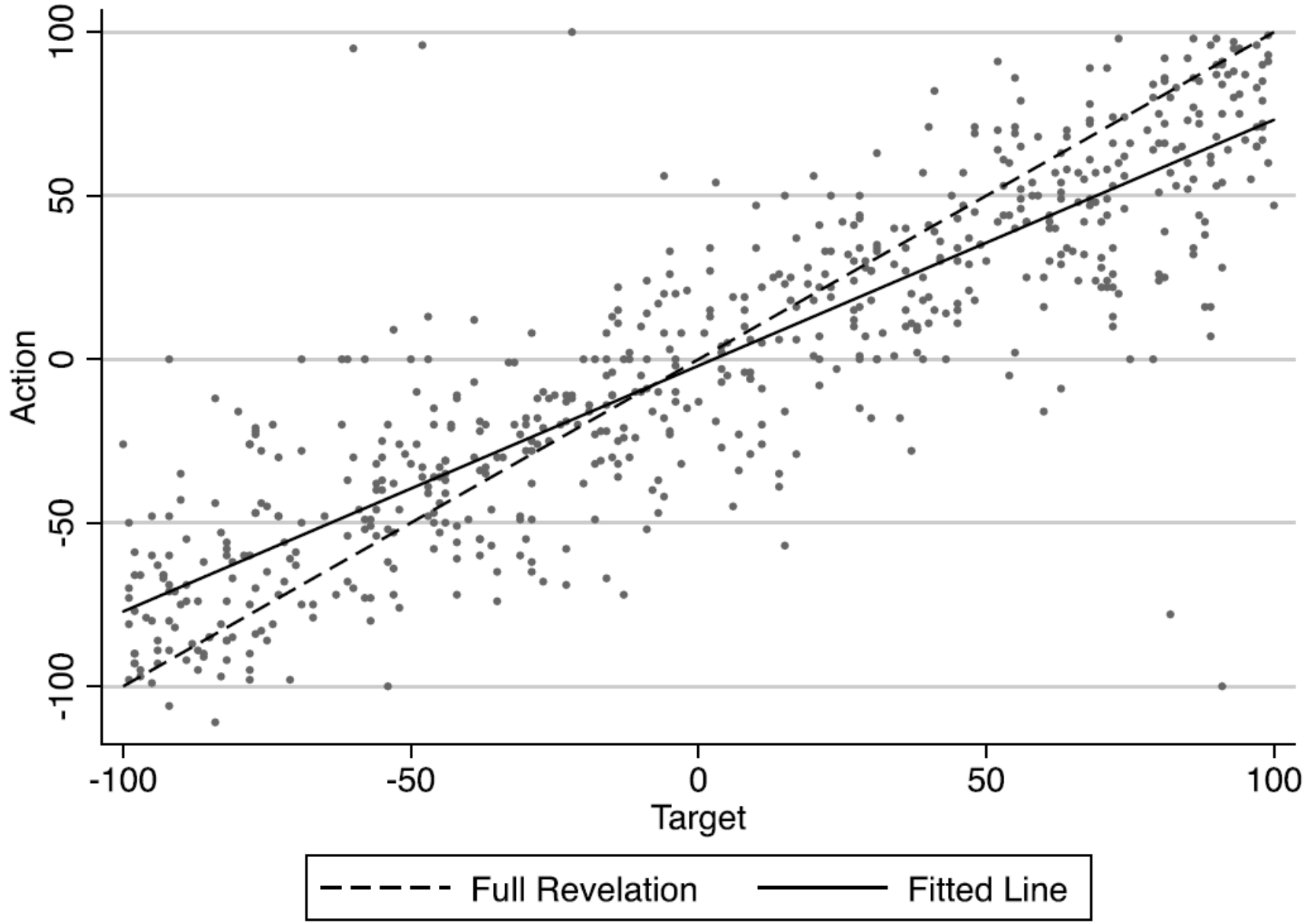
$$m_R(T, S_R) = \begin{cases} -T \text{ if } T \in [-2S_R, 0] \\ T \text{ otherwise} \end{cases}$$

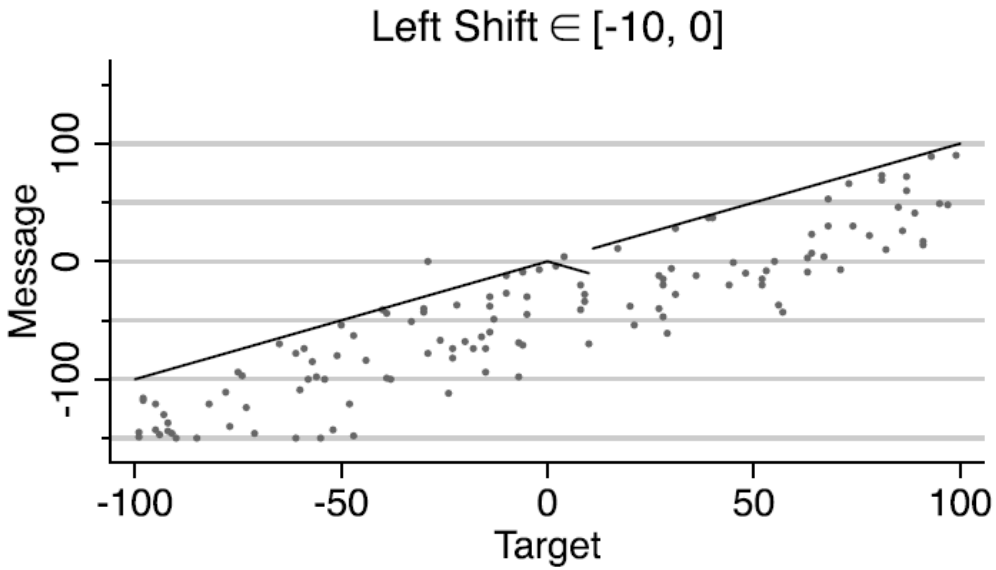
$$c(m_L, m_R) = \begin{cases} m_L \text{ if } m_L = m_R \\ 0 \text{ otherwise.} \end{cases}$$


Message
150
100
50
0
-50
-100
-150
-100
-50
0
50
100
Target
Babbling Prediction
Partition Prediction
Jamming Prediction

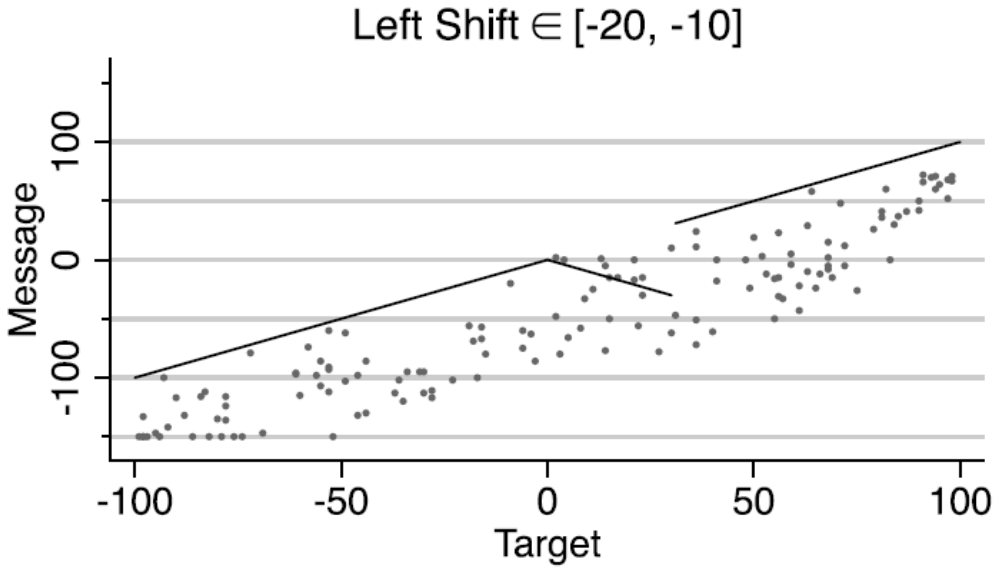
Result - overview

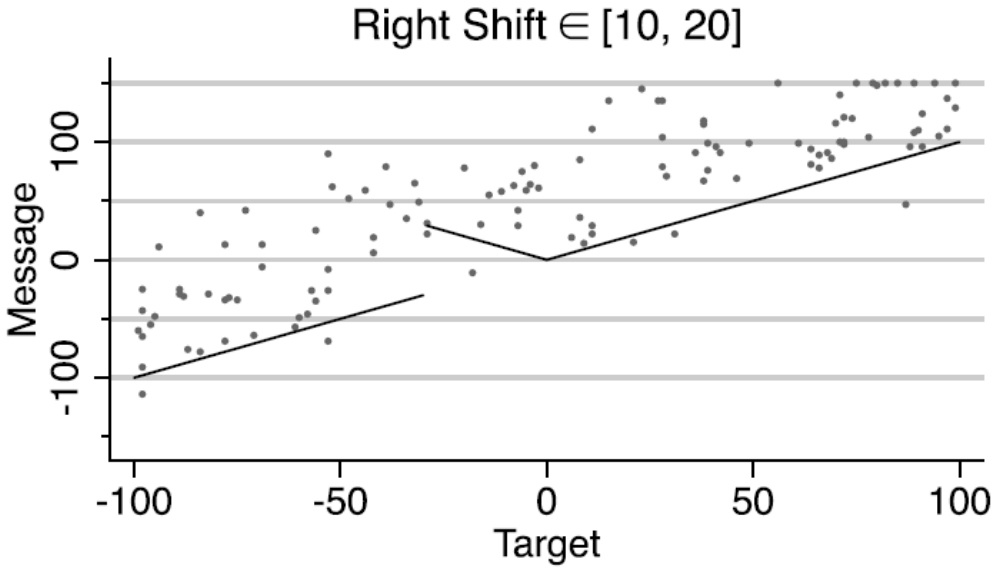
- Senders tends to exaggerate the message overtime
- Receivers tends to split the senders’s messages


Action
100
50
0
-50
-100
-100
-50
0
50
100
Target
Full Revelation
Fitted Line

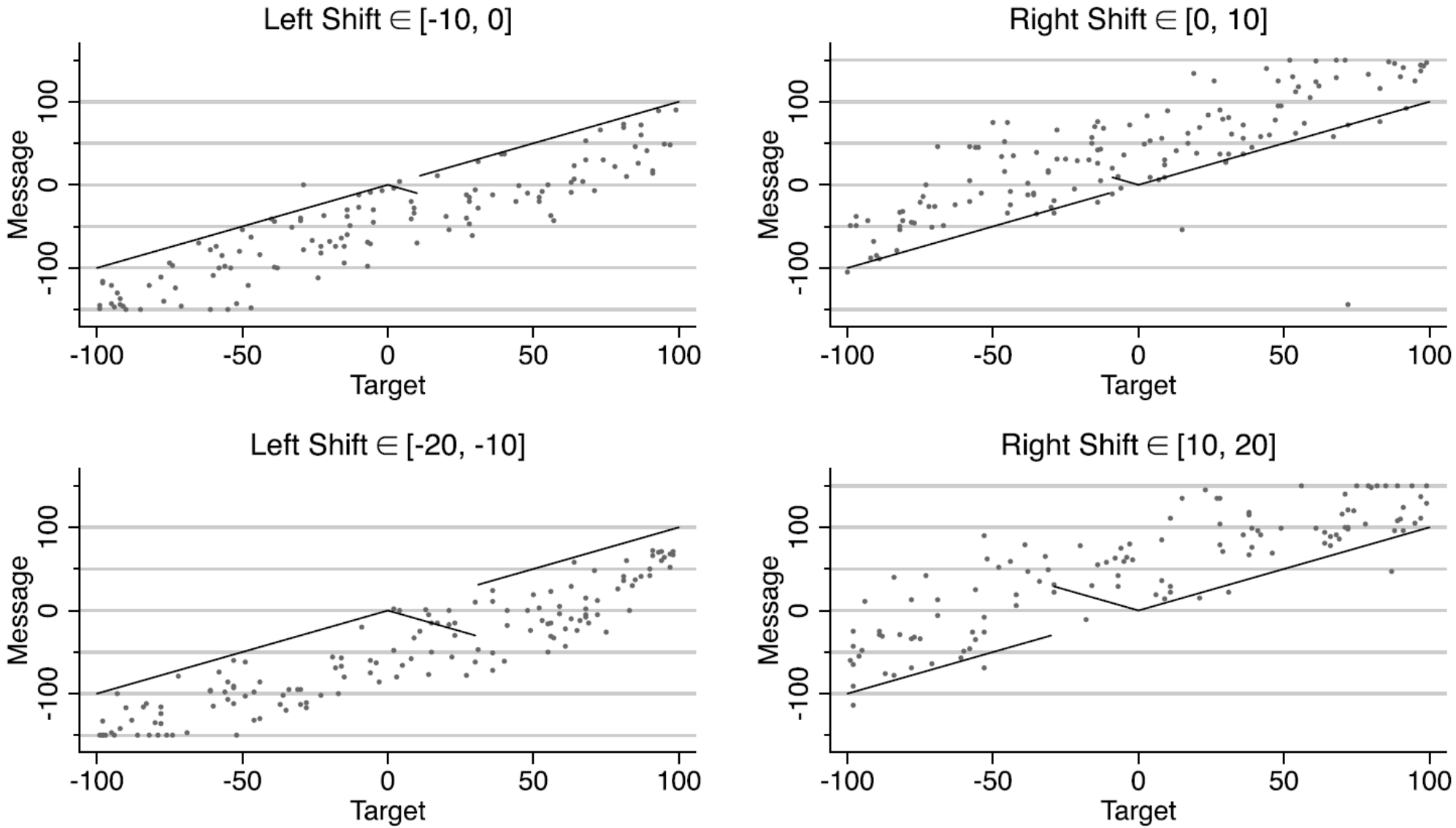

Left Shift ∈ [-10, 0]
Message
100
0
-100
-100
-50
0
50
100
Target

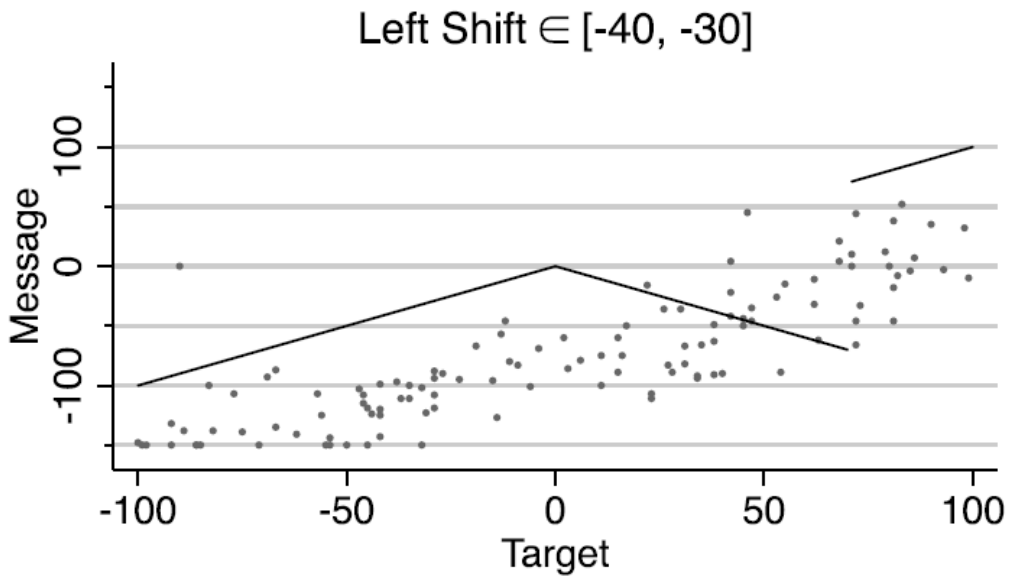

Right Shift ∈ [0, 10]
Message
100
0
-100
-100
-50
0
50
100
Target

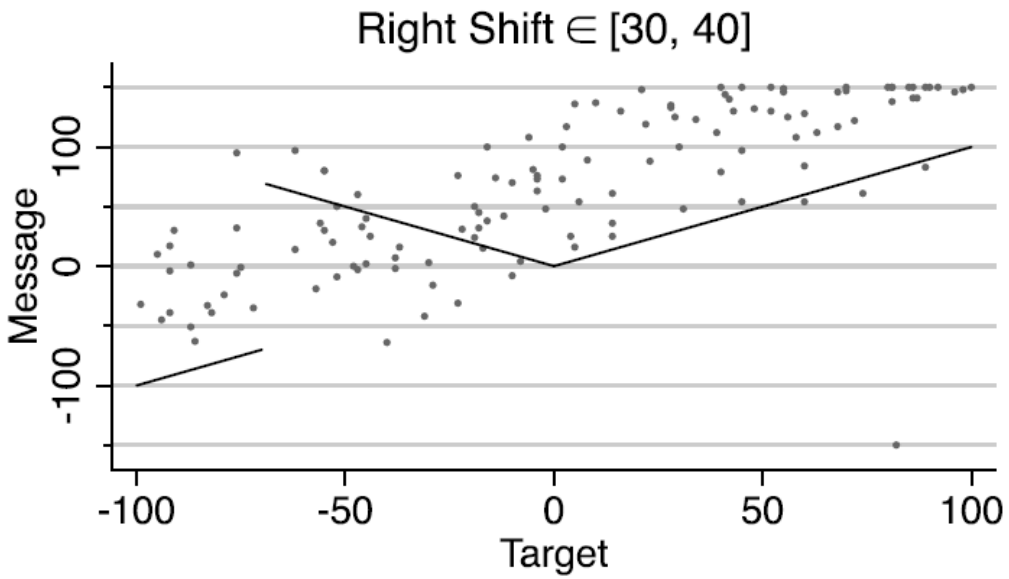

Left Shift ∈ [-20, -10]
Message
100
0
-100
-100
-50
0
50
100
Target

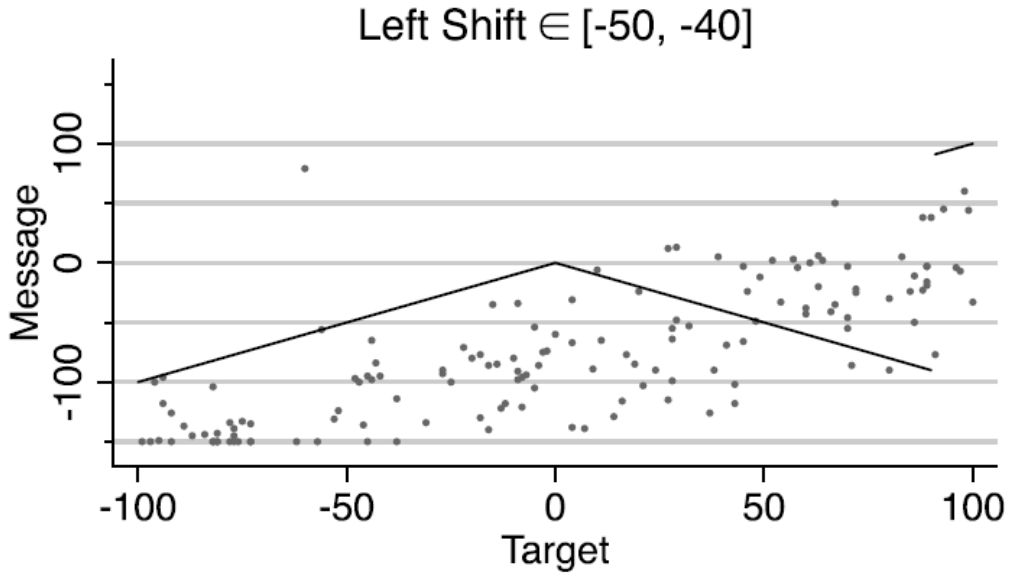

Right Shift ∈ [10, 20]
Message
100
0
-100
-100
-50
0
50
100
Target

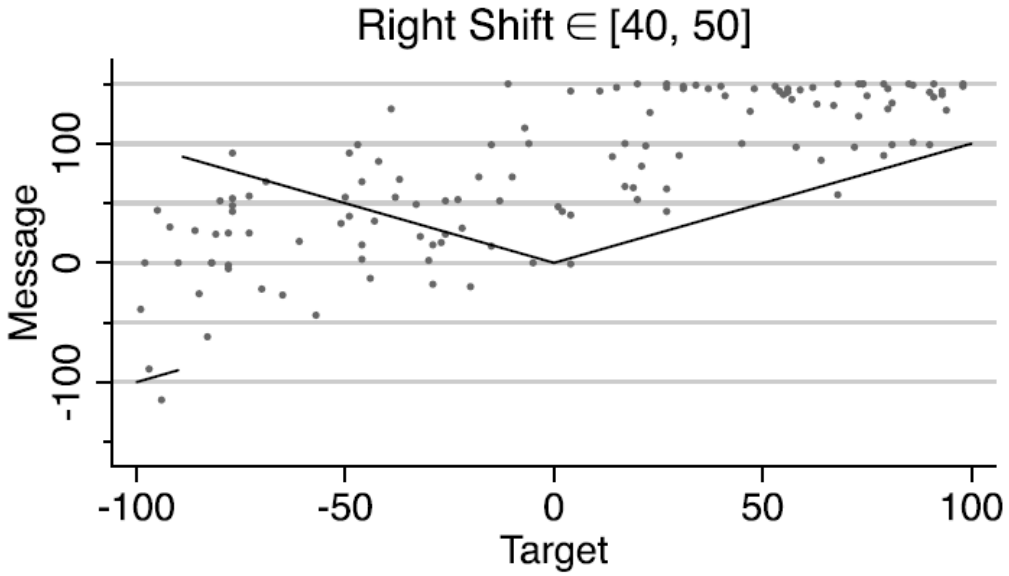
	Babbling	Partition	Jamming
Target	0.75** (0.03)	0.66** (0.04)	0.81** (0.03)
Target x Left High		-0.16 (0.12)	
Target x Right Low		-0.05 (0.14)	
Left High		23.08* (9.05)	
Right Low		-14.81 (12.28)	
Target x Jam			-0.22** (0.04)
Constant	-1.97 (1.51)	-2.10 (1.57)	-2.11 (1.52)
R^2	0.75	0.76	0.76
N	640	640	640

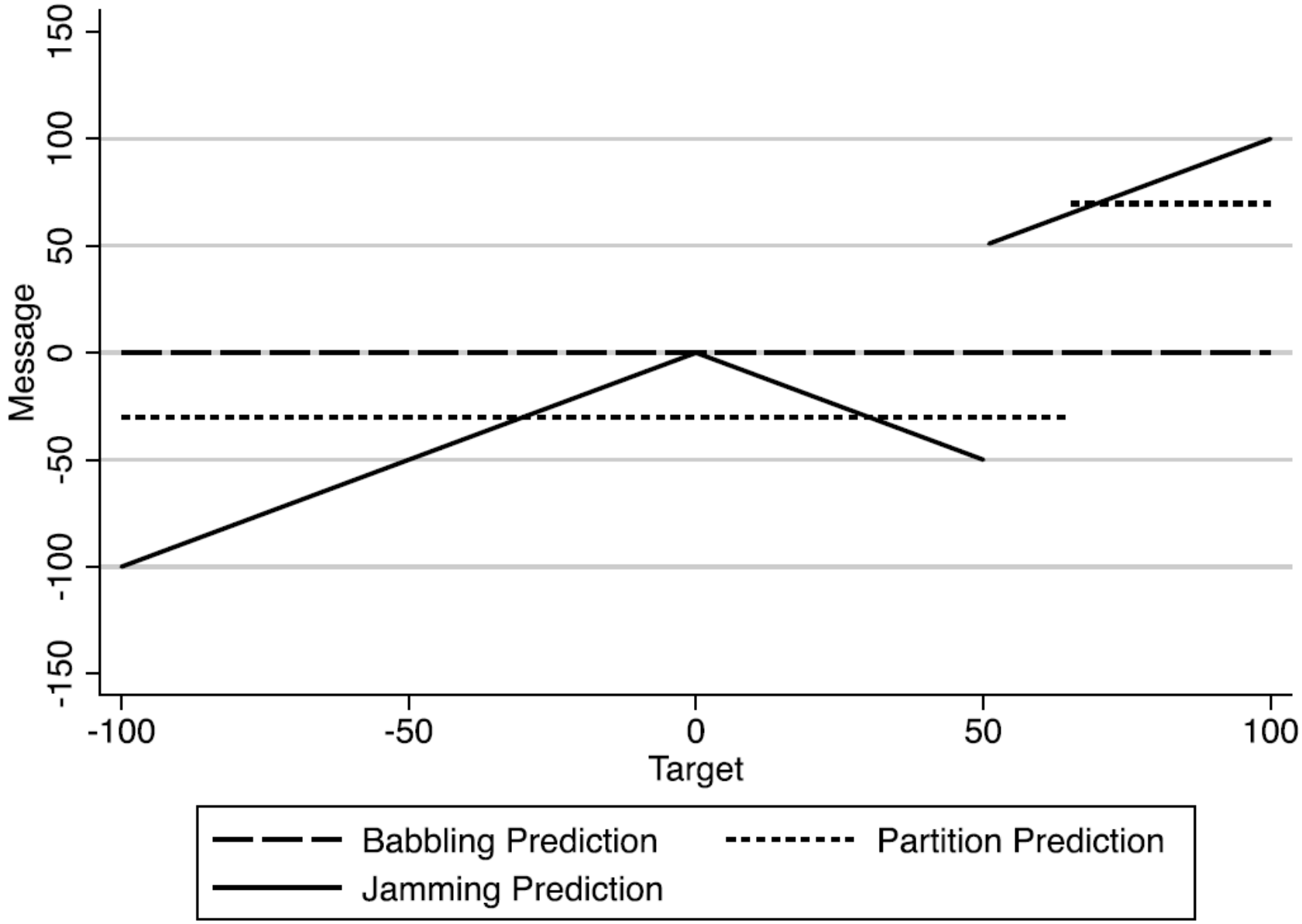

Left Shift ∈ [-10, 0]
Right Shift ∈ [0, 10]
Left Shift ∈ [-20, -10]
Right Shift ∈ [10, 20]
Message
Target
-100
-50
0
50
100


Left Shift ∈ [-40, -30]
Message
100
0
-100
-100
-50
0
50
100
Target


Right Shift ∈ [30, 40]
Message
100
0
-100
-100
-50
0
50
100
Target


Left Shift ∈ [-50, -40]
Message
100
0
-100
-100
-50
0
50
100
Target


Right Shift ∈ [40, 50]
Message
100
0
-100
-100
-50
0
50
100
Target


Message
150
100
50
0
-50
-100
-150
-100
-50
0
50
100
Target
Babbling Prediction
Partition Prediction
Jamming Prediction

Summary of equilibrium predictions

- Fail
- Other explanations and models

Receiver's strategy

- Split the difference

  -Averaging senders' messages

- Which is unrelated to sender's exaggeration. Only depend on believing S_L and S_R are symmetry.

T = 90
S_L = -10
S_R = 15

Sender L
message: 80

Receiver:
Where is the target = ?

$$\frac{80 + 130}{2} = 105$$

Sender R
message : 130

	(1)	(2)	(3)
Average Message	0.85** (0.02)	0.82** (0.05)	0.84** (0.05)
Target		0.04 (0.04)	0.04 (0.04)
Left Shift		0.01 (0.06)	0.01 (0.06)
Right Shift		0.01 (0.05)	0.01 (0.05)
Avg. Message * Round			-0.002 (0.003)
Round			-0.04 (0.11)
Constant	0.33 (0.98)	0.38 (1.66)	0.94 (1.54)
R^2	0.89	0.89	0.89
N	640	640	640

Receiver's strategy

- Adding target , S_L and S_R to the model does not add any additional explanatory power.
- This strategy does not change much over the experimental session.

Sender's strategy: Level-k

- Level-k reasoning: truthful (t-k) and selfish (s-k)
- t-1 subject believes he is playing with a truthful opponent. With this belief, the receiver will choose $c = \frac{1}{2}(\mathrm{T} + m_{t-1})$ and his best response is $m_{t-1} = T + 2S$.

Type	Left Sender Message	Right Sender Message
t-0	T	T
t-1	T+2S	T+2S
t-2	T+2S-50	T+2S+50
t-3	T+2S-100	T+2S+100
s-0	T+S	T+S
s-1	T+2S-25	T+2S+25
s-2	T+2S-75	T+2S+75

Level-k message strategies

	(1)	(2)	(3)	(4)
Target	0.87** (0.02)	0.98** (0.03)	0.85** (0.02)	1.00** (0.03)
Shift	0.88** (0.08)	0.85** (0.12)	1.00** (0.07)	0.97** (0.13)
Left Shift	-40.22** (3.55)	-19.62** (4.41)	-41.34** (3.22)	-21.31** (5.34)
Right Shift	34.85** (4.75)	19.23** (5.29)	44.64** (3.36)	22.43** (6.26)
Target * Round		-0.01* (0.00)		-0.01** (0.00)
Shift * Round		0.00 (0.01)		-0.00 (0.01)
Left Sender * Round		-1.53** (0.36)		-1.53** (0.39)
Right Sender * Round		1.17** (0.42)		1.66** (0.44)
R^2	0.84	0.86	0.88	0.90
N	1280	1280	1280	1280

Sender's strategy

- Level-k reasoning:
- Generalized form : $m = T + 2S + \alpha$,
  where $\alpha = 50(k-1)$ or $\alpha = 50(k-1) + 25$
- Predictions:
  target = 1
  shift = 2
  intercepts = 25x
  - First half session vs. second half session
  - The average subject's level is around s-1 or t-2.

Sender's strategy-
Experimental best responses

- Experimental best responses (past experience)
- Opposing sender's past exaggeration: $\bar{e}_t = \sum_{\tau=1}^{t-1}(m_{opp}^{\tau} - T^{\tau})$
- Opposing sender's current message: $E[m_{opp}] = T + \bar{e}_t$
- Sender's best response: $m = T + 2S - \bar{e}_t$

	(1)	(2)	(3)	(4)
Target	0.88** (0.02)	0.99** (0.03)	0.85** (0.02)	1.00** (0.03)
Shift	0.87** (0.08)	0.93** (0.14)	0.85** (0.08)	0.94** (0.14)
Exaggeration (last 5)	-0.56** (0.07)	-0.33* (0.13)		
Exaggeration (all)			-0.68** (0.14)	-0.24 (0.18)
Left Sender	-12.19* (5.30)	-10.45 (6.24)	-11.25 (7.71)	-14.92 (7.49)
Right Sender	3.61 (5.67)	9.83 (6.58)	3.51 (6.67)	15.30* (7.38)
Target * Round		-0.01** (0.003)		-0.01** (0.0003)
Shift * Round		-0.01 (0.01)		-0.01 (0.01)
Exag. (last 5) * Round		-0.01 (0.01)		
Exag. (all) * Round				-0.02 (0.01)
Left Sender * Round		-0.46 (0.50)		0.03 (0.65)
Right Sender * Round		-0.08 (0.66)		-0.63 (0.80)
R^2	0.87	0.88	0.86	0.87
N	1234	1234	1234	1234

Sender's strategy

- Experimental best responses
- Sender's best response: $m = T + 2S - \bar{e}_t$
  - Predictions:
    target = 1
    shift = 2
    past exaggeration = -1
    left (right) sender = 0
  - Senders under-exaggerate relative to the predicted experiential best response.
  - The level of under-exaggeration decreases over time and is much closer to the predicted messages by the last round of play.

Conclusion

- Experiment recall
- The result does not follow the predicted equilibrium
  - Divergence over period
- Receiver's spilit strategy
- Sender's exaggerate strategies
- Theory in the real world
  - Policy issues

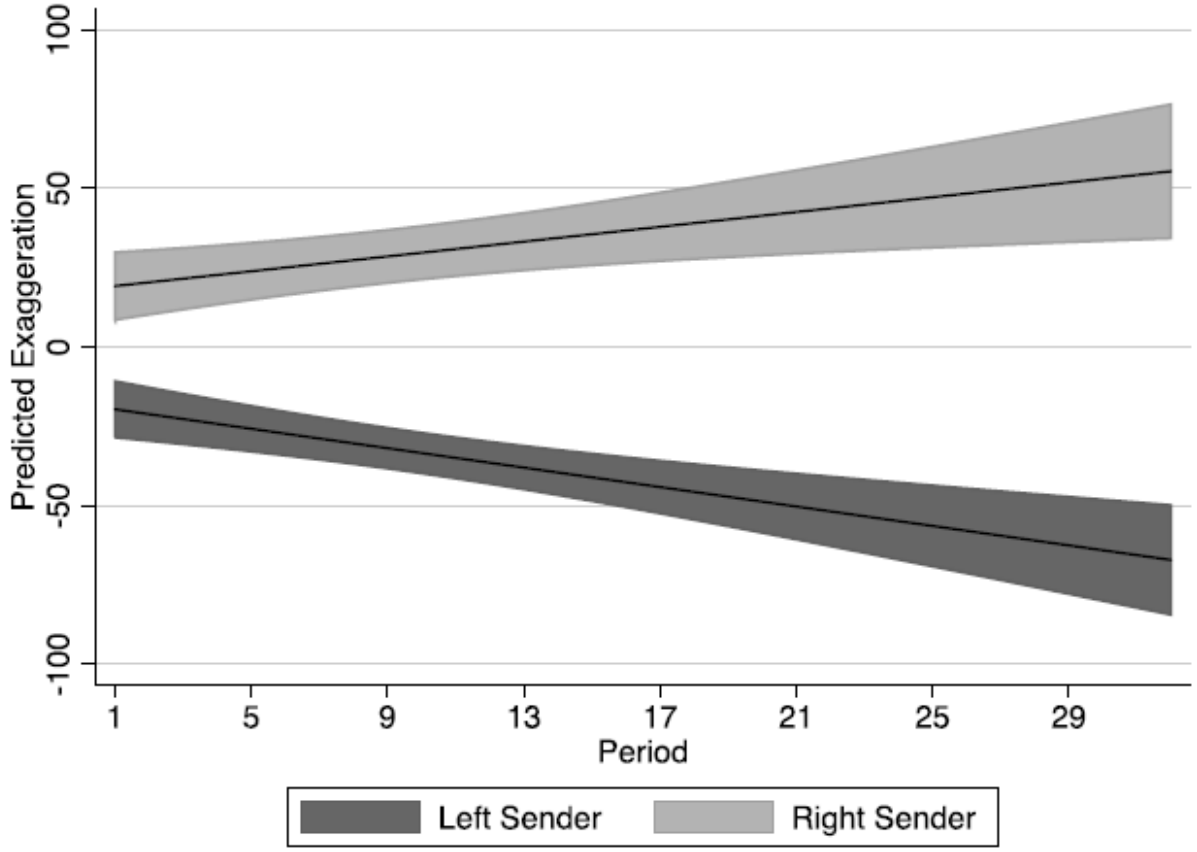


Fig. 5. Exaggeration and unraveling: predicted sender intercepts over time.