The Selective Disclosure of Evidence: An Experiment

A. Farina G. R. Fréchette A. Lizzeri J. Perego

September 2023

Introduction

Introduction

Core economic environment:

- Sender has private information about a state of the world.
- Receiver wants to learn the state.
- Sender wants to pretend the state is high.
- Sender can send a message about the state.
- How much **communication** can be achieved?

It depends on whether messages are verifiable or not.

Introduction

Often **verifiability is partial** and **evidence is noisy**

- Sender has multiple verifiable signals about the state.
- Signals can be selected for disclosure.

  e.g. SAT, news about political candidate, oil fields...

Signals have both **intrinsic** and **context-dependent** meanings:

- SAT may have been taken multiple times.
- There are many stories about the candidate.
- There are reports from many geologists.

This Paper

- Considers a **modified communication game**.
  - Sender has noisy signals and can selectively disclose.
- Studies how **information transmission** is affected by:
  - Variations in the number of signals available (**selection**)
  - Changes in sender's communication capacity (**verifiability**)
- Derives a theory based **experimental design** to test the main predictions.
  - Selective disclosure in equilibrium.
  - Witholding information and selectively disclosing possible.
  - Deception (rather than lying) possible.

Overview: Theory

Cheap Talk e.g., Crawford-Sobel ’82

- “Soft” information—Messages are Unverifiable.
- Large frictions in information transmission.

Disclosure e.g., Milgrom ’81

- “Hard” information—Messages are Verifiable.
- No frictions in information transmission (*unravelling*).

Our Framework

- Flexible verifiability.
- Spans cheap-talk and disclosure results.

Overview: Experiments

Cheap Talk e.g., Cai-Wang ’06

- Over-communication (with misaligned preferences).
- Some information transmission.

Disclosure e.g., Jin-Luca-Martin ’20

- Incomplete unravelling (*failure to account for selection*).
- Frictions in information transmission.

Our Framework

- Both over and under communication are possible.
- What dominates?

Some Literature

Disclosure: Jin, Luca and Martin (2022, AEJ: Micro)

Cheap talk: Blume, Lai and Lim (2020, Handbook of Experimental GT)

Partially verifiable disclosure: Penczynski, Koch and Zhang (2021)

Theory: Milgrom (1981, Bell), Fishman and Hagerty (1990, QJE), Di Tillio, Ottaviani and Sorensen (2021, Ecma)

Model

The Communication Game—Milgrom (1981)

Sender

1. Privately observes state $\theta \in \Theta$, with:
    - Θ finite.
    - Prior $p \in \Delta(\Theta)$.
2. Given θ, draws N i.i.d. signals, $s_i \in S \subseteq \mathbb{R}$.
    - An exogenous information structure $f : \Theta \to \Delta(S)$, MLRP.
    - Notation: $\bar{s} = (s_1, ..., s_N) \in S^N$.
3. Can disclose up to K of the N drawn signals:
    - N, the number of available signals.
    - K, the number of reportable signals.

The Communication Game—Milgrom (1981)

Receiver

4. Observes the message.
5. Takes an action ($a \in A$) to maximize the expected payoff.

The Communication Game—Milgrom (1981)

Receiver

4. Observes the message.
5. Takes an action ($a \in A$) to maximize the expected payoff.

Payoffs

6. $u_S(\theta, a) = a$.
7. $u_R(\theta, a) = c - (a - \theta)^2$, where $c \in \mathbb{R}$

Example

Let $\Theta = \{\theta_H, \theta_L\}$, $S = \{A, B, C, D\}$ and f be

	Signal			
State	A	B	C	D
θ_L	10%	20%	25%	45%
θ_H	45%	25%	20%	10%

Example

Let $\Theta = \{\theta_H, \theta_L\}$, $S = \{A, B, C, D\}$ and f be

	Signal			
State	A	B	C	D
θ_L	10%	20%	25%	45%
θ_H	45%	25%	20%	10%

Let $N = 3$ and $\theta = \theta_L$.

Example

Let $\Theta = \{\theta_H, \theta_L\}$, $S = \{A, B, C, D\}$ and f be

	Signal			
State	A	B	C	D
θ_L	10%	20%	25%	45%
θ_H	45%	25%	20%	10%

Let $N = 3$ and $\theta = \theta_L$.

Assume signals are $\{B, D, D\}$.

Example

Let $\Theta = \{\theta_H, \theta_L\}$, $S = \{A, B, C, D\}$ and f be

	Signal			
State	A	B	C	D
θ_L	10%	20%	25%	45%
θ_H	45%	25%	20%	10%

Let $N = 3$ and $\theta = \theta_L$.

Assume signals are $\{B, D, D\}$.

If $K = 1$

Sender can send message from $\{\varnothing, B, D\}$.

Example

Let $\Theta = \{\theta_H, \theta_L\}$, $S = \{A, B, C, D\}$ and f be

	Signal			
State	A	B	C	D
θ_L	10%	20%	25%	45%
θ_H	45%	25%	20%	10%

Let $N = 3$ and $\theta = \theta_L$.

Assume signals are $\{B, D, D\}$.

If $K = 3$

Sender can send message from $\{\varnothing, B, D, BD, BDD\}$.

Role of K and N

When $K = N$, information is **fully verifiable**.

- Can disclose all signals $\rightsquigarrow$ unraveling $\rightsquigarrow$ no frictions

When $K < N$, information is **partially verifiable**.

- Can't disclose all signals $\rightsquigarrow$ unraveling is unfeasible.
- Scope for imitation via **selective disclosure**.
- Messages verifiable, but selection $\rightarrow$ meaning **context dependent**.

Hybrid framework b/w cheap-talk games and disclosure games.

Equilibrium

Proposition **Milgrom (1981)**

Fix any (N, K), there exists a Sequential Equilibrium with maximal selective disclosure: Sender reports the K most favorable signals.

Equilibrium

Proposition **Milgrom (1981)**

Fix any (N, K), there exists a Sequential Equilibrium with maximal selective disclosure: Sender reports the K most favorable signals.

Observable Implications

Sender

- $\uparrow K$: disclosed signals increases.
- $\uparrow N$: most favorable signal sent more often.

Receiver

- $\uparrow N$: most favorable signals become less persuasive.

Equilibrium: Refinements

Unlike classic disclosure games, the sequential equilibrium outcome is **not unique** when $K < N$.

- Off-path beliefs can support other equilibrium outcome.
- Refinements for signalling games (e.g., Cho-Kreps ’87, Banks-Sobel ’87) have no force here.
- Refinements for cheap talk games: Farrel (1993)’s **Neologism Proofness**.

⏩ Example

Equilibrium: Uniqueness

Proposition

The equilibrium with maximal selective disclosure is Neologism Proof.

Equilibrium: Uniqueness

Proposition

The equilibrium with maximal selective disclosure is Neologism Proof.

Neologism Proofness delivers outcome uniqueness

An equilibrium (σ, μ) induces an outcome $x : S^N \to A$,

$$x(\bar{s}) = \sum_{\bar{s}'} \mu(\bar{s}' | \sigma(\bar{s})) \mathbb{E}(\theta | \bar{s}') \qquad \forall\, \bar{s}.$$

Equilibrium: Uniqueness

Proposition

The equilibrium with maximal selective disclosure is Neologism Proof.

Proposition

Let (σ^*, μ^*) be the equilibrium with maximal selective disclosure and (σ, μ) be any other Neologism Proof equilibrium. Let x^* and x their respective outcomes. Then, $x^* = x$.

Example

Main Outcome Variable

We study the effects of changing (N, K).

Our main outcome of interest is **equilibrium informativeness**.

- How effectively the receiver learns the state θ.

Informativeness can be measured in several ways:

- Correlation between θ and a.
- **Receiver's expected payoff**.

Increasing K (Verifiability)

Fix $N \geq 1$.

Proposition

Equilibrium informativeness increases in K.

Intuition

- Easier to send messages that others cannot imitate.

$\Rightarrow$ Less pooling.

$\Rightarrow$ More information transmitted.

Increasing N (Selection)

Fix $K \geq 1$.

Proposition

When $N \to \infty$, equilibrium informativeness converges to zero.

<u>Intuition</u>

- When N grows, “highest" message available to every θ.

$\Rightarrow$ All types pool.

Increasing N

Increase in N (for small N) generates two contrasting effects:

1. **Information Effect**
    - Sender has more evidence to prove her type.
    - Selection contains information about undisclosed signals: "bad" messages are more informative.
2. **Selection Effect**
    - Sender is more selective, making "higher" signals less informative.

$(1) + (2) \implies$ informativeness may be non monotonic in N

EXPERIMENT

Experimental Design

- Two urns: Yellow (low) and Red (high).
- Four balls: A, B, C, or D.
- f is

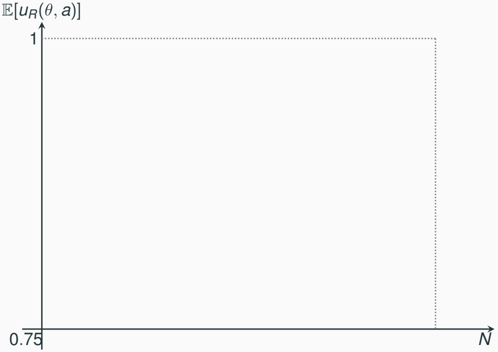
	Signal			
State	A	B	C	D
Yellow (θ_L)	10%	20%	25%	45%
Red (θ_H)	45%	25%	20%	10%

Experimental Design: Treatments

	N=1	N=3	N=10	N=50
$K = 1$	*i*	·	*ii*	*iii*
$K = 3$	·	*iv*	*v*	*vi*

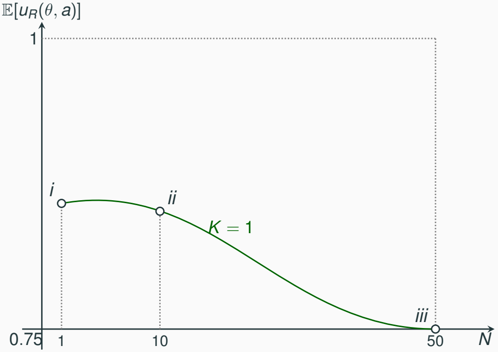
Experimental Design: Treatments

	N=1	N=3	N=10	N=50
$K = 1$	*i*	·	*ii*	*iii*
$K = 3$	·	*iv*	*v*	*vi*



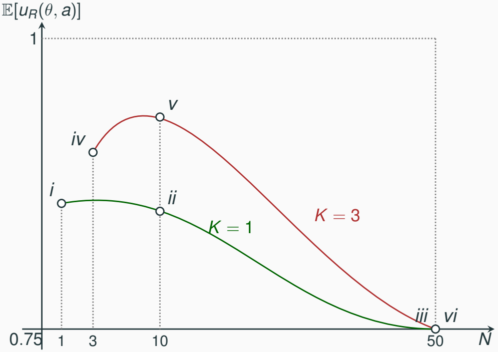
Experimental Design: Treatments

	N=1	N=3	N=10	N=50
$K=1$	*i*	·	*ii*	*iii*
$K=3$	·	*iv*	*v*	*vi*

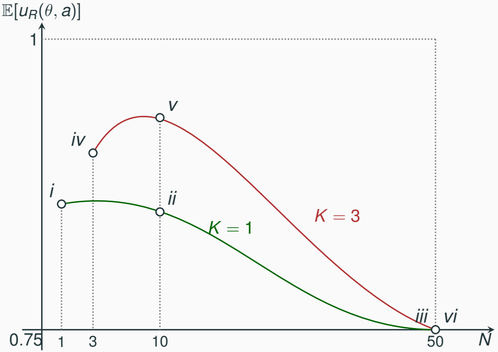


Experimental Design: Treatments

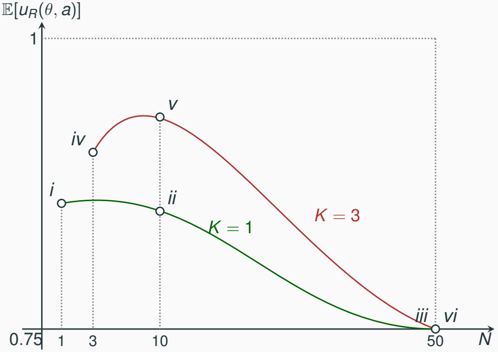
	N=1	N=3	N=10	N=50
$K = 1$	*i*	·	*ii*	*iii*
$K = 3$	·	*iv*	*v*	*vi*



Experimental Design: Testable Implications



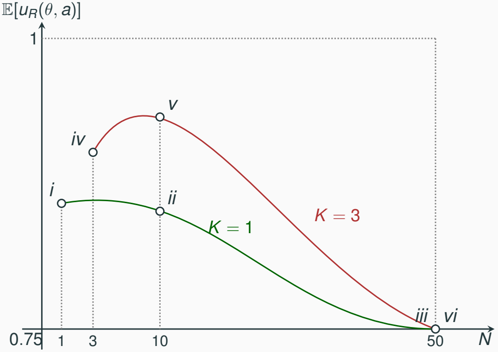
Experimental Design: Testable Implications



Test 1. If $K = N$, informativeness increases with N (more info)

$$iv > i$$

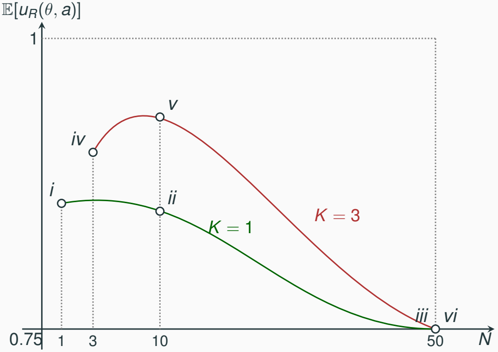
Experimental Design: Testable Implications



Test 2. $\uparrow K$: informativeness increases (more verifiability)

$$v > ii$$

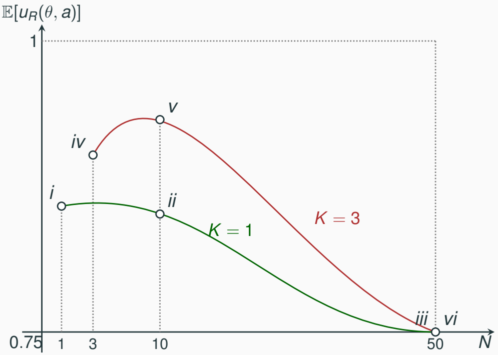
Experimental Design: Testable Implications



Test 3. $\uparrow N$: informativeness decreases (selection effect)

$$ii > iii \qquad v > vi$$

Experimental Design: Testable Implications



Test 4. $\uparrow N$: informativeness increases (information effect)

$$v > iv$$

Experimental Design: Sender Interface

Round 7 of 30: Communication Stage | **You are the Sender**

Reminder:

If the secret Urn is **Yellow**, this is the probability of each ball being drawn:

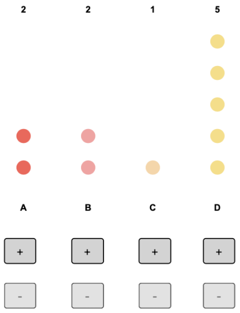
A	B	C	D
10 %	20 %	25 %	45 %

If the secret Urn is **Red**, this is the probability of each ball being drawn:

A	B	C	D
45 %	25 %	20 %	10 %

The secret Urn is Yellow

Available Balls



Your message to the Receiver is:

Experimental Design: Sender Interface

Round 7 of 30: Communication Stage — **You are the Sender**

Reminder:

If the secret Urn is **Yellow**, this is the probability of each ball being drawn:

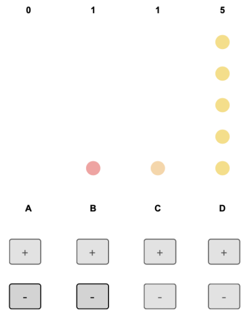
A	B	C	D
10 %	20 %	25 %	45 %

If the secret Urn is **Red**, this is the probability of each ball being drawn:

A	B	C	D
45 %	25 %	20 %	10 %

The secret Urn is Yellow

Available Balls



Your message to the Receiver is:

A A B

Send

Experimental Design: Receiver Interface

Round 7 of 30: Guessing Stage **You are the Receiver**

Reminder:

If the secret Urn is **Yellow**, this is the probability of each ball being drawn:

A	B	C	D
10 %	20 %	25 %	45 %

If the secret Urn is **Red**, this is the probability of each ball being drawn:

A	B	C	D
45 %	25 %	20 %	10 %

The Sender had 10 available balls and they could disclose 3 or less. This is the Sender's message:

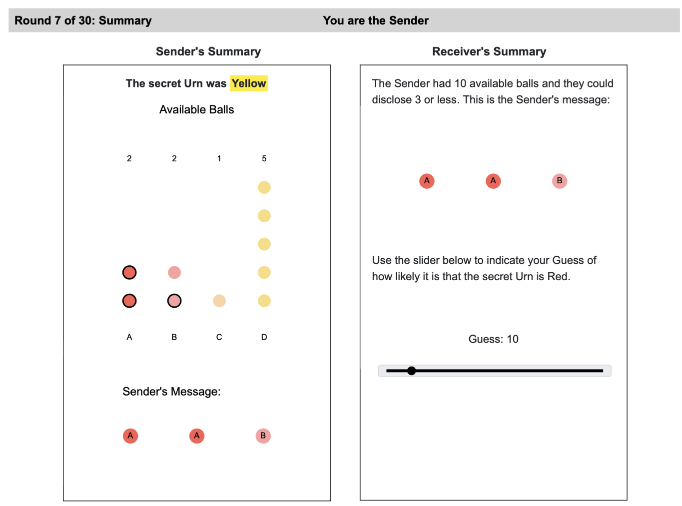
A A B

Use the slider below to indicate your Guess of how likely it is that the secret Urn is Red.

Your Guess: 10

Submit

Experimental Design: Summary



Experimental Design: History

Round 7 of 30: History **You are the Sender**

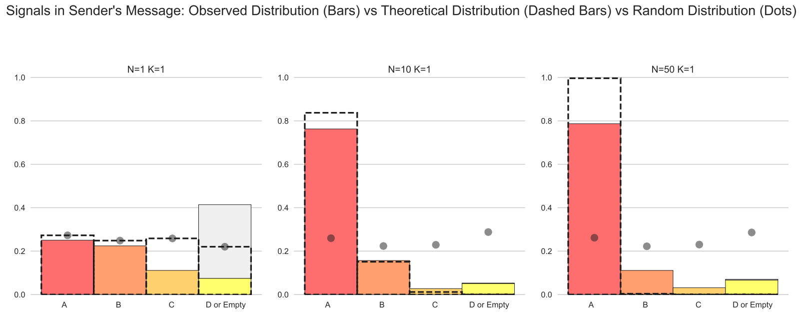
Round	Secret Urn	Message	Guess
7	Yellow	A A B	10
6	Red	A A ◯	77
5	Red	A B B	77
4	Red	A A A	97
3	Red	A A ◯	87
2	Yellow	C C ◯	52
1	Red	◯ ◯ ◯	0

Next

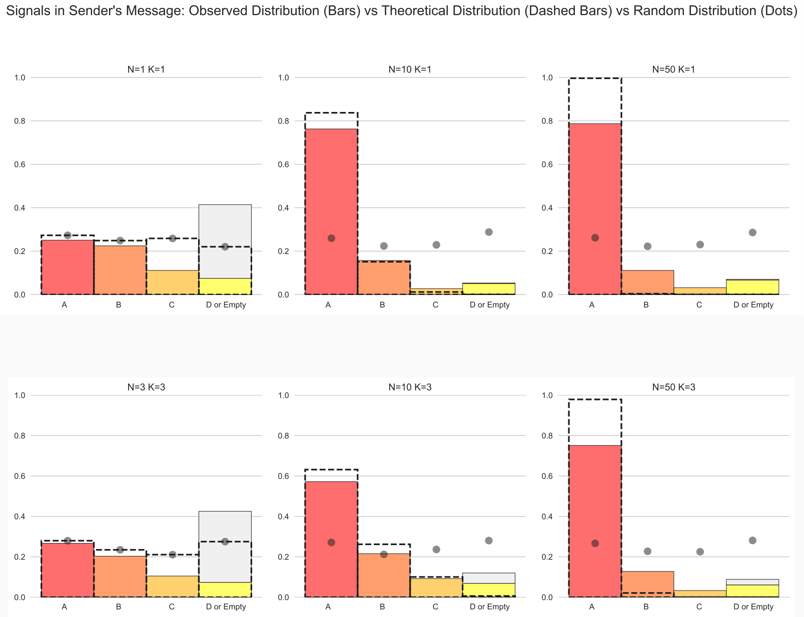
Results

Sender's Aggregate Behavior

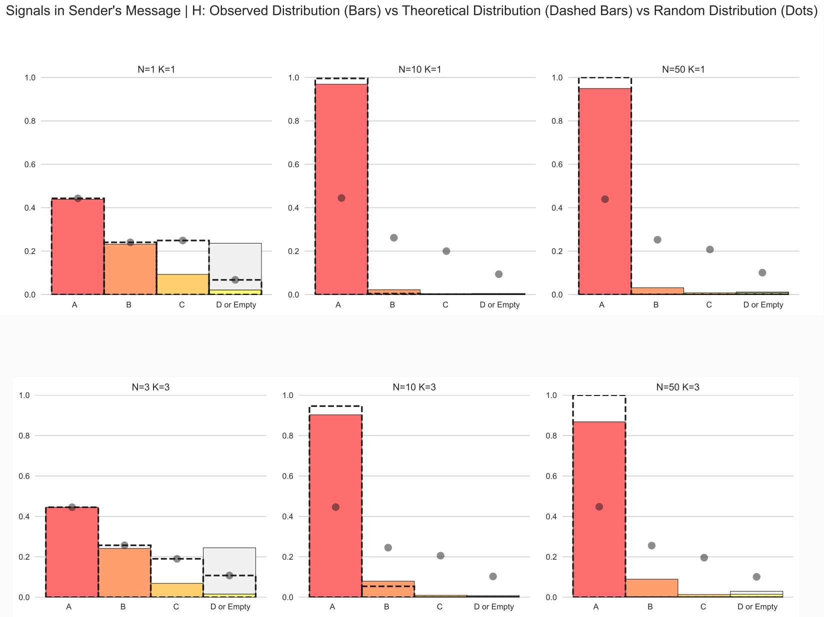
Sender's Disclosure Choices



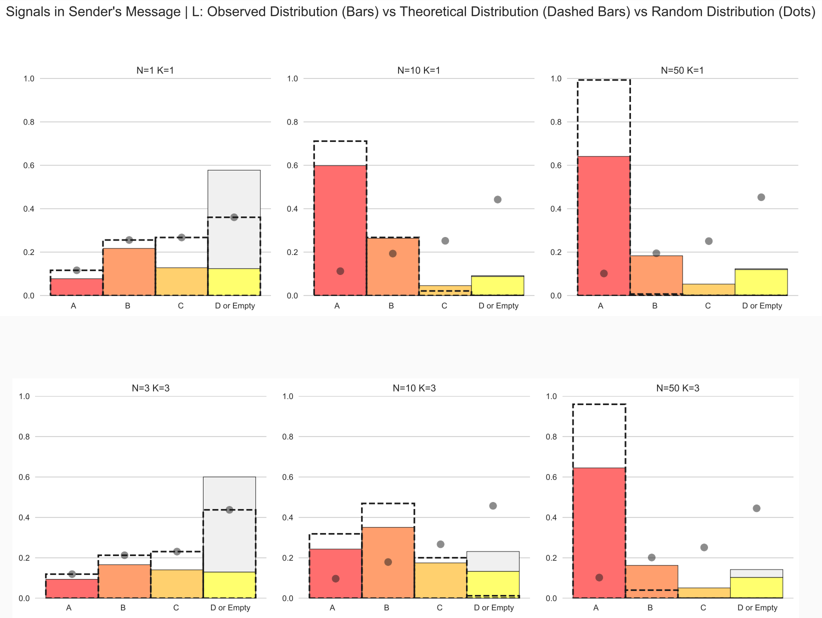
Sender’s Disclosure Choices



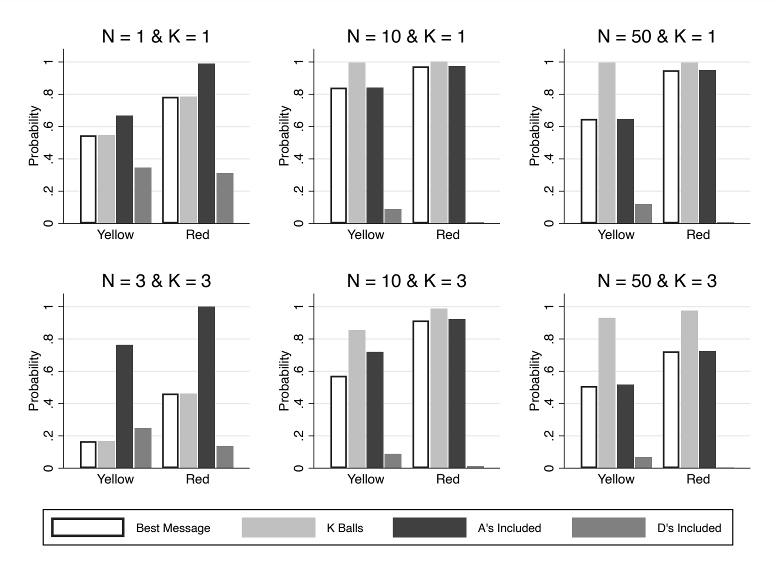
High Type Sender’s Disclosure Choices



Low Type Sender’s Disclosure Choices



Sender's Messages



Result 1 (Senders)

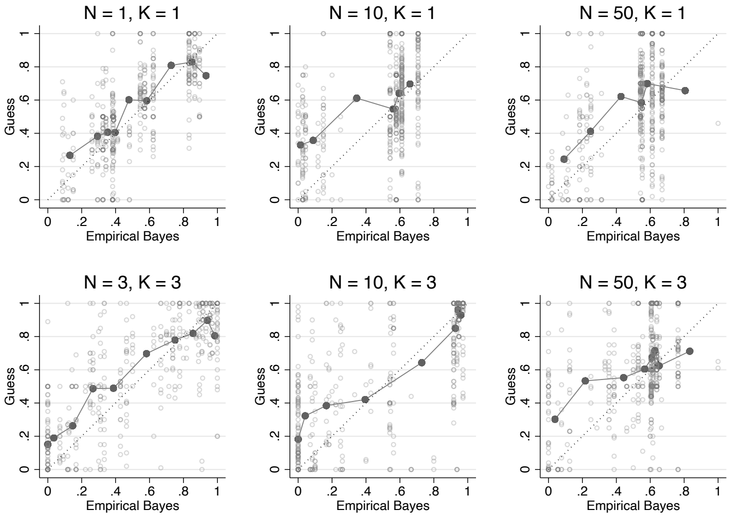
Result: The distribution of balls in messages is “close” to equilibrium.

Main Deviation:

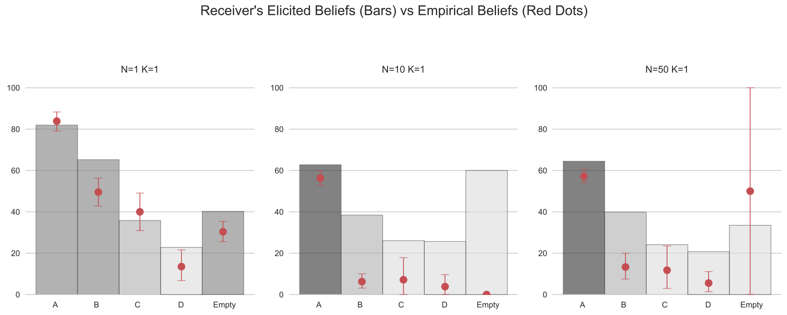
- Not disclosing bad balls when $N = K$.
- Not disclosing good balls as often as predicted when the type of the sender is low.
- Overall, more information transmitted than predicted.

Receiver's Aggregate Behavior

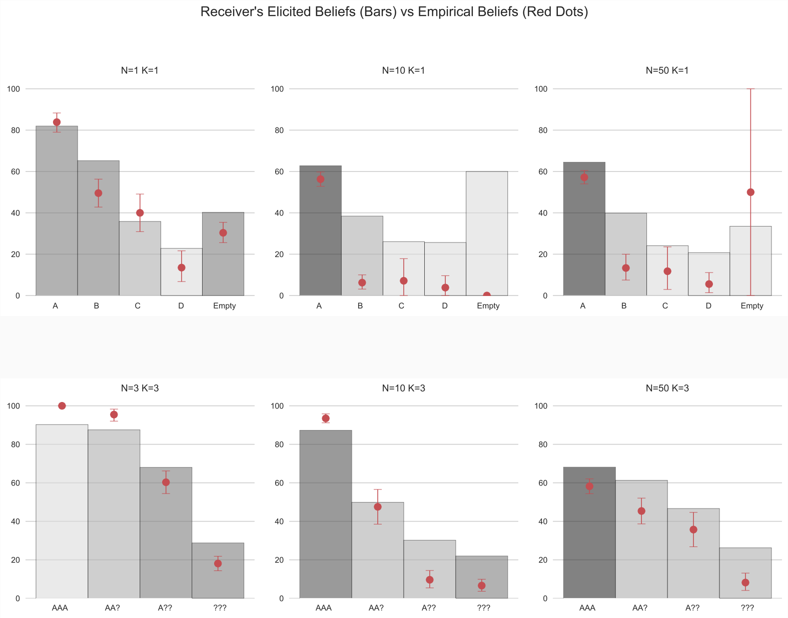
Receiver's Updating



Receiver’s Beliefs



Receiver’s Beliefs



Result 2 (Receivers)

Result: Receivers overestimate the probability of an high type sender when it is less likely, more so when selection is more acute.

Sender's Heterogeneity

Heterogeneity: Senders

Challenge

- Large number of urn / balls / message combinations.
- Specific behavior of interest varies across treatments.
  - Number of balls sent ($K = 1$ vs $K = 3$).
  - Balls sent vs balls available ($N = K$ vs $N > K$).

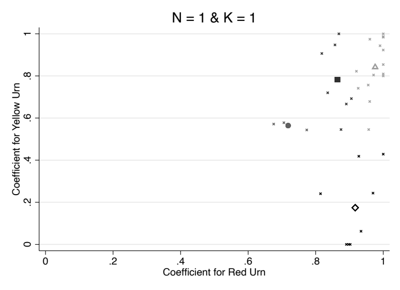
$\rightarrow$ Precludes a unified approach using those variables.

Heterogeneity: Senders

Solution

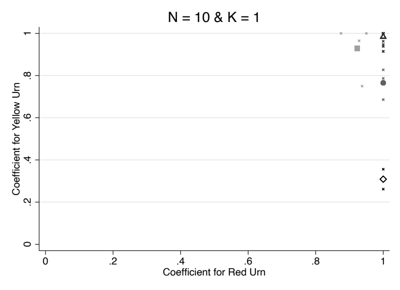
- Transform balls and messages to numbers ($B^{\#}$ and $M^{\#}$).
- Regress $M^{\#}$ on $B^{\#}|$yellow urn and $B^{\#}|$red urn.
- Cluster the coefficient estimates.
- Describe behavior along key dimensions of interest.

Heterogeneity: Senders



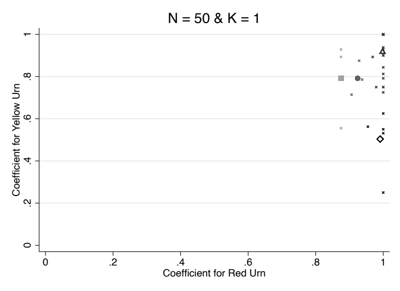
Cluster	Obs (33)	Urn	*K*	A	D
Triangle	15				
		Red	0.91	1	0.38
		Yellow	0.64	1	0.27
Square	7				
		Red	0.73	1	0.25
		Yellow	0.51	1	0.21
Circle	3				
		Red	0.5	0.92	n/a
		Yellow	0.54	0.67	0.49
Diamond	8				
		Red	0.71	1	0.20
		Yellow	0.30	0	0.46

Heterogeneity: Senders



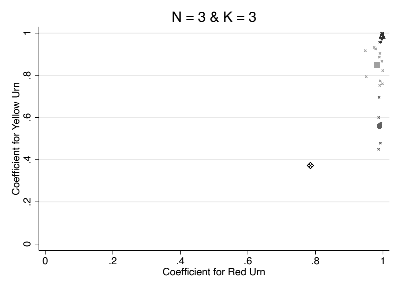
Cluster	Obs (34)	Urn	K	A	D
Triangle	24				
		Red	1	1	0
		Yellow	1	0.97	0.02
Square	4				
		Red	1	0.81	0.08
		Yellow	1	0.88	0.07
Circle	4				
		Red	1	1	0
		Yellow	1	0.46	0.14
Diamond	2				
		Red	1	1	0
		Yellow	1	0	0.89

Heterogeneity: Senders



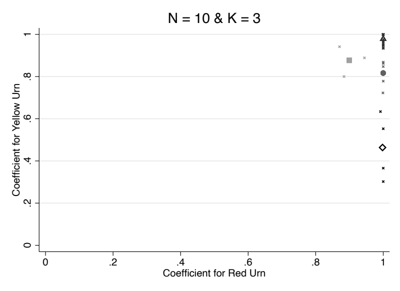
Cluster	Obs (36)	Urn	*K*	A	D
Triangle	25				
		Red	1	0.99	0
		Yellow	1	0.74	0.03
Square	3				
		Red	1	0.04	0.82
		Yellow	1	0	0.51
Circle	3				
		Red	1	0.78	0
		Yellow	1	0.63	0.18
Diamond	5				
		Red	1	0.96	0
		Yellow	0.95	0.26	0.46

Heterogeneity: Senders



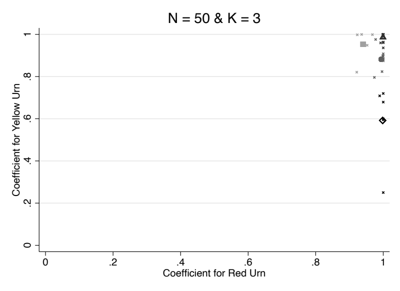
Cluster	Obs (29)	Urn	*K*	A	D
Triangle	12				
		Red	0.64	1	0.23
		Yellow	0.25	1	0.17
Square	11				
		Red	0.34	1	0.05
		Yellow	0.12	0.80	0.18
Circle	5				
		Red	0.26	1	0
		Yellow	0.12	0	0.80
Diamond	1				
		Red	0	1	0
		Yellow	0	0.50	0

Heterogeneity: Senders



Cluster	Obs (33)	Urn	*K*	A	D
Triangle	19				
		Red	0.99	0.99	0
		Yellow	0.88	0.96	0.01
Square	3				
		Red	1	0.46	0.17
		Yellow	1	0.43	0.04
Circle	7				
		Red	1	0.94	0
		Yellow	0.74	0.66	0.10
Diamond	4				
		Red	0.92	0.83	0
		Yellow	0.76	0.28	0.43

Heterogeneity: Senders



Cluster	Obs (35)	Urn	*K*	A	D
Triangle	15				
		Red	1	0.88	0
		Yellow	0.94	0.80	0
Square	5				
		Red	0.89	0.17	0
		Yellow	0.87	0.32	0
Circle	9				
		Red	0.97	0.70	0
		Yellow	0.94	0.31	0.04
Diamond	6				
		Red	1	0.86	0.03
		Yellow	0.95	0.31	0.41

Heterogeneity: Senders

Equilibrium type (55%)

- Most common.
- $N > K$: Mostly report best balls independently of the type.
- $N = K$: Disclose fewer than K balls.

Deception Averse Type (15%)

- A's reported more often when the type is high.
- D's reported more often when the type is low.
- $N = K$: Disclose fewer than K balls.

Others (30%)

- Similar to *equilibrium types* when the type is high.
- Report A's less but do not report D's when the type is low.
- Some low rates of A's when the type is high [confusion].

Receiver's Heterogeneity

Heterogeneity: Receivers

Challenge

- Large number of messages.
- Different messages across treatments.
- Some messages have very few observations.

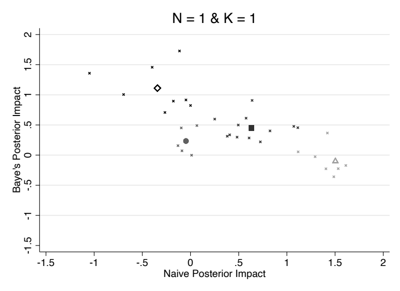
$\rightarrow$ Precludes a unified approach using that variable.

Heterogeneity: Receivers

Solution

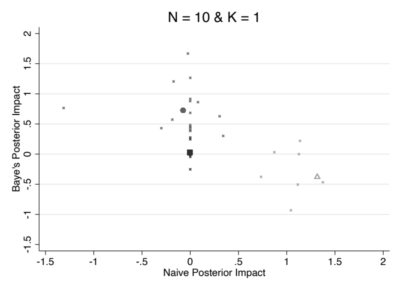
- Compute *equilibrium update* following each message.
- Compute the update of someone who ignores selection: *naive update*.
- Regress guesses on a constant (α) and the equilibrium and naive updates.
- Cluster the coefficient estimates.
- Describe behavior along key dimensions of interest.

Heterogeneity: Receivers



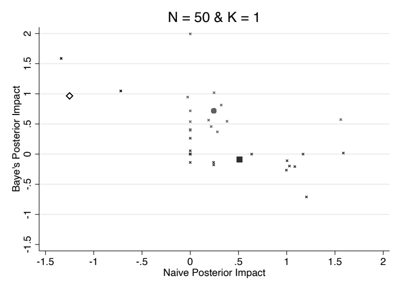
Cluster	Obs (33)	A	B	∅	C
Diamond	8				
$\alpha = 0.23$		0.87	0.67	0.23	0.47
Circle	5				
$\alpha = 0.39$		0.56	0.49	0.41	0.37
Square	12				
$\alpha = 0.02$		0.86	0.73	0.41	0.38
Triangle	8				
$\alpha = -0.23$		0.90	0.67	0.51	0.23

Heterogeneity: Receivers



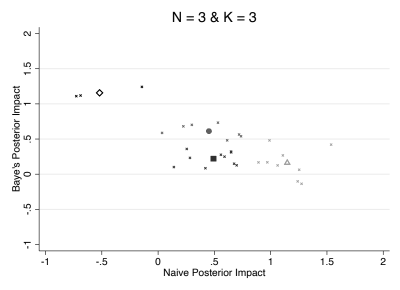
Cluster	Obs (29)	A	B	∅	D
Diamond	1				
$\alpha = 4.20$		0.60*	0.23*	0.60*	n/a
Circle	17				
$\alpha = 0.28$		0.66	0.26	n/a	0.11
Square	8				
$\alpha = 0.56$		0.58	0.60	n/a	0.60
Triangle	8				
$\alpha = -0.23$		0.62	0.52	n/a	0.11

Heterogeneity: Receivers



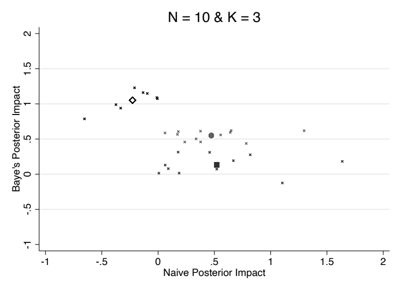
Cluster	Obs (34)	A	B	$\emptyset$	D
Diamond	3				
$\alpha = 0.89$		0.35	0.17	0.21*	0.75
Circle	13				
$\alpha = 0.15$		0.71	0.29	0.46*	0.11
Square	18				
$\alpha = 0.26$		0.63	0.53	n/a	0.19
Triangle	2				
$\alpha = -1.15$		0.69	0.41	n/a	n/a

Heterogeneity: Receivers



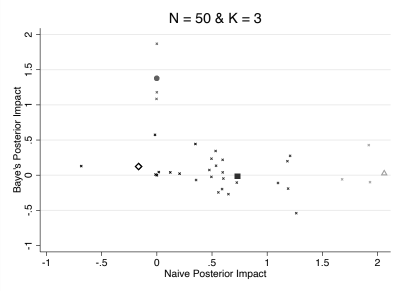
Cluster	Obs (33)	AAA	AAB	AA	AB
Diamond $\alpha = 0.35$	3	0.79*	0.90	0.82	0.50
Circle $\alpha = 0.02$	7	0.96	0.90	0.96	0.85
Square $\alpha = 0.13$	10	0.85	0.81	0.72	0.71
Triangle $\alpha = -0.24$	9	1	0.97	0.96	0.88

Heterogeneity: Receivers



Cluster	Obs (36)	AAA	AAB	AA	ABB
Diamond	8				
$\alpha = 0.19$		0.95	0.11	0.02	0.03
Circle	13				
$\alpha = -0.07$		0.89	0.70	0.24	0.26
Square	11				
$\alpha = 0.10$		0.74	0.70	n/a	0.61
Triangle	1				
$\alpha = -3.98$		1*	0.54*	n/a	0.02*

Heterogeneity: Receivers



Cluster	Obs (35)	AAA	AAB	AA	DDD
Diamond	10				
$\alpha = 0.64$		0.54	0.49	0.33	0.32
Circle	3				
$\alpha = 0.11$		0.84	0.01*	n/a	0.07
Square	18				
$\alpha = -0.04$		0.67	0.69	0.57	0.12
Triangle	4				
$\alpha = -1.16$		0.89	0.80	0.91*	n/a

Heterogeneity: Receivers

- Variation in updating strategies.
    - Extent they account for selection.
- Being closer to equilibrium $\not\to$ higher payoffs.
- However, in many treatments, groups better at accounting for selection is among the highest.
- With $N = 50$, few differences in payoffs.

Summary

Senders

- The majority:
  - Select the better balls to send.
  - Behave similarly for both urns.
- Some convey more information by conditioning on the type.

$\rightarrow$ More information transmitted than predicted.

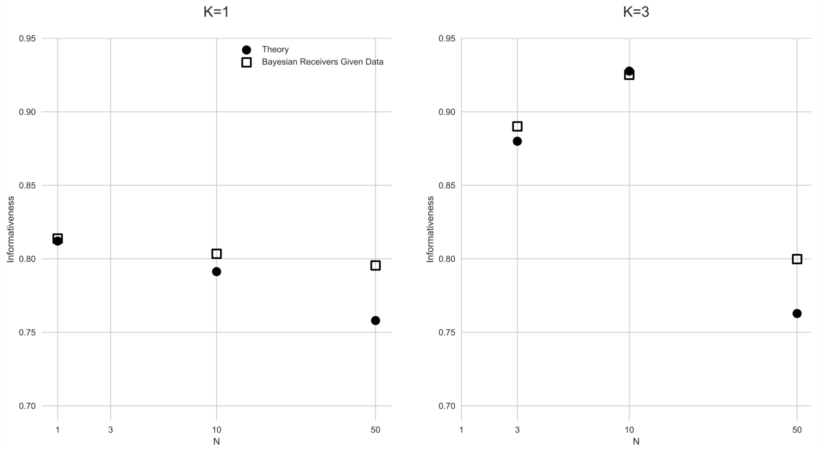
Receivers

- Many do not fully account for selection.
- Some are not very responsive.

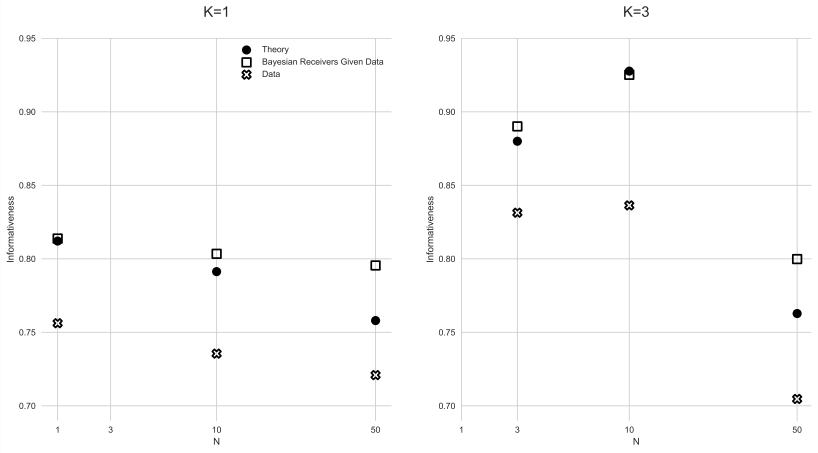
$\rightarrow$ Less information received than predicted.

Informativeness

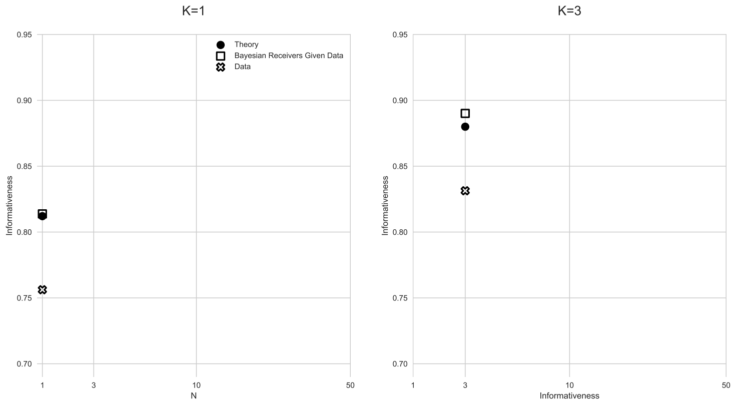
Information Transmission: Bayesian Receivers (Given Data)



Information Transmission



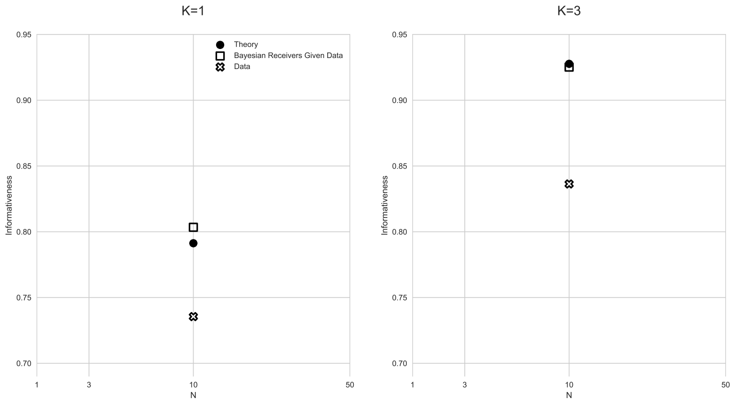
Test 1: More Information



Test 1. If $K = N$, informativeness increases with N (more info)

- Data: $p - value = 0.00$.
- Bayesian receivers given data: $p - value = 0.00$.

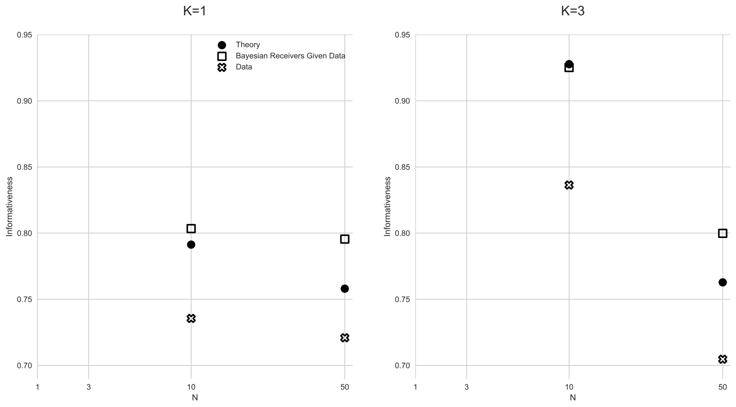
Test 2: More Verifiability



Test 2. $\uparrow K$: informativeness increases (more verifiability)

- Data: $p - value = 0.00$.
- Bayesian receivers given data: $p - value = 0.00$.

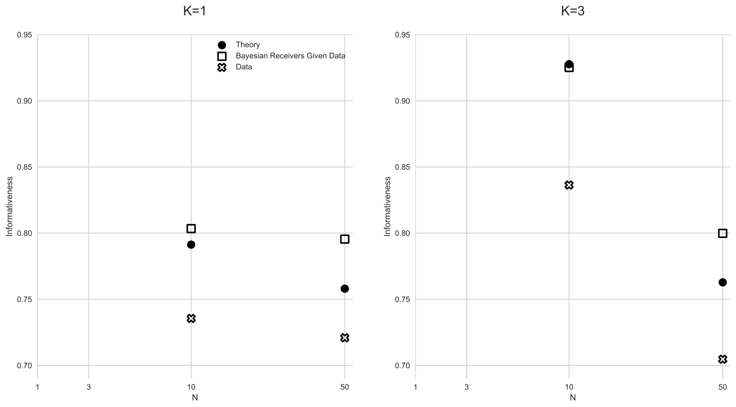
Test 3: Selection Effect



Test 3. $\uparrow N$: informativeness decreases (selection effect)

- Data ($K = 1$): $p - value = 0.43$.
- Bayesian receivers given data ($K = 1$): $p - value = 0.64$.

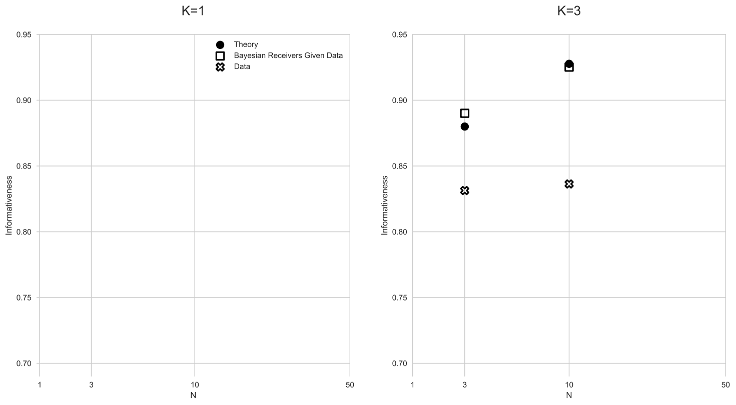
Test 3: Selection Effect



Test 3. $\uparrow N$: informativeness decreases (selection effect)

- Data ($K = 3$): $p - value = 0.00$.
- Bayesian receivers given data ($K = 3$): $p - value = 0.00$.

Test 4: Information Selection



Test 4. $\uparrow N$: informativeness increases (information effect)

- Data: $p - value = 0.81$.
- Bayesian receivers given data: $p - value = 0.04$.

Result 3 (Informativeness)

Result: Changes in K and N moves informativeness in the directions predicted by the theory in most cases.

- $N = K \uparrow \implies$ informativeness $\uparrow$.

  $\rightarrow$ More information.

- Fix N: $K \uparrow \implies$ informativeness $\uparrow$.

  $\rightarrow$ More verifiability.

- Fix K: $N \uparrow \implies$ informativeness never $\uparrow$.

  $\rightarrow$ Selection effect $\geq$ Information effect.

Conclusion

Model:

- Selective disclosure in equilibrium.
- Spans cheap talk and disclosure models.
- Studies role of information and selection effect.

Experimental results:

- Important selective disclosure (predicted and otherwise).
- Some deception aversion.
- Receivers have difficulty accounting for selection.
- Less information transmission than predicted.

APPENDIX

Some Notation: Strategies and Beliefs

Denote $\mathcal{M}$ the space of all messages

Sender's Strategy pure and θ-independent

- $\sigma : S^N \to \mathcal{M}$ s.t. $\sigma(\bar{s}) \in M(\bar{s})$, for all $\bar{s}$

where $M(\bar{s})$ is the space of available messages given $\bar{s}$

Receiver's Beliefs and Strategy

- $\mu : \mathcal{M} \to \Delta(S^N)$
- $a : \mathcal{M} \to \Delta(A)$

Given μ, receiver's optimal strategy given by

$$a(m) = \mathbb{E}(\theta|m) = \sum_{\bar{s}} \mu(\bar{s}|m)\mathbb{E}(\theta|\bar{s}) \qquad \forall\ m$$

Sequential Equilibrium

A **Sequential Equilibrium** is a pair (σ^*, μ^*) s.t.

1. For all $\bar{s} \in S^N$, $\sigma^*(\bar{s}) \in M(\bar{s})$ and

$$\sum_{\bar{s}'} \mu^*(\bar{s}'|\sigma^*(\bar{s}))\mathbb{E}(\theta|\bar{s}') \geq \sum_{\bar{s}'} \mu^*(\bar{s}'|m')\mathbb{E}(\theta|\bar{s}') \qquad m' \in M(\bar{s})$$

2. For all m, supp $\mu^*(\cdot|m) \subseteq C(m) = \{\bar{s} \in S^N : m \in M(\bar{s})\}$. In particular, if $m \in \sigma^*(S^N)$,

$$\mu^*(\bar{s}|m) = q(\bar{s}|{\sigma^\star}^{-1}(m)) \quad \forall\, \bar{s}$$

   where $q(\bar{s}) = \sum_\theta p(\theta) f(\bar{s}|\theta)$

Back

Equilibrium Multiplicity

$\Theta = \{0, 1\}$ and $p(1) = \frac{1}{2}$. $N = 2$ and $K = 1$.

$S = \{A, B\}$, $f(A|\theta_H) = 1$ and $f(A|\theta_L) = \frac{1}{2}$.

θ	$\bar{s}$	$M(\bar{s})$	$\sigma^*(\bar{s})$
1	(A, A)	$\{\varnothing, A\}$	A
0	(A, B)	$\{\varnothing, A, B\}$	A
	(B, B)	$\{\varnothing, B\}$	B

$$\mathbb{E}[\theta|m = A] = \frac{4}{7} \text{ and } \mathbb{E}[\theta|m = B] = \mathbb{E}[\theta|m = \varnothing] = 0 \implies$$

No incentive to deviate

Equilibrium Multiplicity

$\Theta = \{0, 1\}$ and $p(1) = \frac{1}{2}$. $N = 2$ and $K = 1$.

$S = \{A, B\}$, $f(A|\theta_H) = 1$ and $f(A|\theta_L) = \frac{1}{2}$.

θ	$\bar{s}$	$M(\bar{s})$	$\sigma^*(\bar{s})$
1	(A, A)	$\{\varnothing, A\}$	$\varnothing$
0	(A, B)	$\{\varnothing, A, B\}$	$\varnothing$
	(B, B)	$\{\varnothing, B\}$	$\varnothing$

$$\mathbb{E}[\theta|m = \varnothing] = \frac{1}{2} \text{ and } \mathbb{E}[\theta|m = A] = \mathbb{E}[\theta|m = B] = 0 \implies$$

No incentive to deviate

Neologism Proof Equilibrium

A **neologism** is a a pair (m, C), $C \subseteq \{\bar{s} \in S^N : m \in M(\bar{s})\}$

Literal meaning of $(m, C) \rightsquigarrow$ "*My type $\bar{s}$ belongs to C*"

A neologism (m, C) is **credible** relative to equilibrium (σ^*, μ^*) if

1. $\sum_{\bar{s}'} q(\bar{s}'|C)\mathbb{E}(\theta|\bar{s}') > \sum_{\bar{s}'} \mu^*(\bar{s}'|\sigma^*(\bar{s}))\mathbb{E}(\theta|\bar{s}')$ for all $\bar{s} \in C$
2. $\sum_{\bar{s}'} q(\bar{s}'|C)\mathbb{E}(\theta|\bar{s}') \leq \sum_{\bar{s}'} \mu^*(\bar{s}'|\sigma^*(\bar{s}))\mathbb{E}(\theta|\bar{s}')$ for all $\bar{s} \notin C$

The equilibrium is **Neologism Proof** if no neologism is credible.

Back

Back to the Example

θ	$\bar{s}$	$M(\bar{s})$	$\sigma^*(\bar{s})$
1	(A, A)	$\{\varnothing, A\}$	$\varnothing$
0	(A, B)	$\{\varnothing, A, B\}$	$\varnothing$
	(B, B)	$\{\varnothing, B\}$	$\varnothing$

$$m = A \text{ and } C = \{(A, A), (A, B)\} \implies$$

$$\mathbb{E}[\theta | m = A] = \frac{4}{7} > \mathbb{E}[\theta | m = \varnothing] = \frac{1}{2}$$

Credible neologism $\implies$ no Neologism Proof equilibrium

Back