Delegation under Liquid Democracy. Two Experiments

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Some sort of computerized participation by large numbers of the public in policy-making is in the cards in the next ten to twenty years. It may be that we will be able to turn this new technology to the improvement and defense of democratic institutions. I hope so. However, it is by no means evident that this will be the result. (Martin Shubik, 1970)

Liquid Democracy

- Each decision is subject to referendum, but voters can delegate their vote.
- Charles Dodgson (1884); James Miller (1969) (Shubik, 1970).
- Objectives: more informed decisions, more egalitarian structure.
- "*Golden medium between direct and representative democracy*"
- Protest parties: the Swedish and German Pirate parties.
- Tech community: blockchains to track delegations; governance of DAO's.

Literature

- Normative political theory: Blum and Zuber (2016), Green-Armytage (2015).

Information aggregation and experts.

- Computer science: Armstrong and Larson (2021), Bloemberger et al. (2019), Caragiannis and Michas (2019), Christoff and Grossi (2017), Kahng et al. (2018), Boldi et al. (2011).

  Algorithms on networks; typically not strategic.

- Strategic considerations: Ravindran 2021, Dhillon et al., 2021.

  Ravindran: signals' precisions are commonly known, efficient asymmetric equil, stronger results with a single expert;

  Dhillon et al.: partisans; perfectly informed experts, stronger results with complete information.

Our questions

- Focus on informational aspect. Even if experts are correctly identified - Condorcet?

- Our approach: (i) experimental; (ii) streamlined model: pure common interest; incomplete information (pure strategies); symmetric equilibrium.

- Three questions:

  1. Can LD do better than MV?

  2. Does it do better in the lab?

  3. Could the lab be biasing the results?

Our findings

- We run two very different experiments: a controlled voting experiment in the lab; and a perceptual experiment with ambiguous information on MTurk.

- The results are remarkably similar.

  1. There is evidence of overdelegation.

  2. LD does not do better than MV.

  3. Abstention emerges as superior to delegation.

  4. The replication in two very different environments suggests robustness.

Canonical common interest model

- N (odd) voters; Majority voting.
- Two alternatives: a or b. Two states of the world: A or B.
- Everyone derives utility 1 if the choice matches the state; 0 otherwise.
- Conditionally independent private signals $s(i) \in \{s_A, s_B\}$.
- Symmetry:

  (i) Common prior $\pi = 1/2$;

  (ii) $\Pr(s_\omega|\omega) = q(i) > 1/2$ for $\omega = (A, B)$.

Liquid Democracy

- N voters, with K (odd) experts E and M (even) non-experts NE.
- Identities (E or NE) are known.
- Each individual holds a single, non-divisible vote.
- All experts receive signals of known precision $q_e = p$.
- $q_{ne}(i) \equiv q(i)$ is private information; independently drawn from known $F(q)$ defined over [0.5, p].

- Having learnt $q(i)$, i decides whether to delegate her vote or use it.

- If delegating, i specifies whether to E or NE, and the vote is assigned randomly within the group identified.

- Signals are then realized and individuals with votes indicate their preferred decision.

- Each individual who votes receives a weight equal to 1 plus the delegated votes assigned to her.

Details

Equilibrium

Semi-symmetric Bayesian equilibrium in weakly undominated strategies.

Theorem. *For any F, M and K finite, there exists an equilibrium with delegation that strictly improves over MV.* Proof

Note:

- Delegation increases the weight of informed voters but reduces aggregate information.

- Excluding efficient asymmetric equilibria that require coordination (Ravindran, 2021; Nitzan and Paroush, 1982).

Proposition 1 *Suppose $K = 1$. For any M, there exists an equilibrium where:*

(i) the expert never delegates her vote and always votes according to signal;

(ii) there exists a unique $\widetilde{q} \in (0.5, p)$ such that non-expert i delegates to the expert if $q_i < \widetilde{q}$ and votes according to signal otherwise.

(iii) Such an equilibrium strictly improves over MV and is ex ante maximal among sincere semi-symmetric equilibria with these directions of delegation.

But optimal delegation must be rare.

Example

Experimental treatments and predictions

- $p = 0.7$; $F(q)$ Uniform over $[0.5, 0.7]$; $K/N = 1/5$.

$\widetilde{q}$	$F(\widetilde{q})$	EU_{LD}	EU_{MV}
0.7	1	0.7	0.717
0.543	0.215	0.731	

LD1: $N = 5$, $K = 1$.

$\widetilde{q}$	$F(\widetilde{q})$	EU^K_{LD}	EU^K_{MV}
0.532	0.162	0.843	0.832

LD3: $N = 15$, $K = 3$.

- In the superior equilibrium, delegation is rare.
- For given K/N, $F(\widetilde{q})$ falls with N (but $\widetilde{q}$ moves little).
- Available gains in utility over MV are small. Why these parameters?

Abstention

- Abstention is a simpler route to decreasing the influence of less-informed voters.
- Like LD, it saves on costs of voting and information acquisition.
- How does it compare to LD?
- Abstention increases the weight of *all* those who vote.
- McMurray (2013). There is an equilibrium with positive abstention that dominates MV.

In our model:

$\widetilde{q}_A$	$F(\widetilde{q}_A)$	EU_A	EU_{MV}
0.7	1	0.7	0.717
0.58	0.40	0.724	
0.5	0	0.717	

MVA1: $N = 5$, $K = 1$.

$\widetilde{q}_A$	$F(\widetilde{q}_A)$	EU_A^K	EU_{MV}^K
0.7	1	0.78	0.83
0.58	0.40	0.85	
0.5	0	0.83	

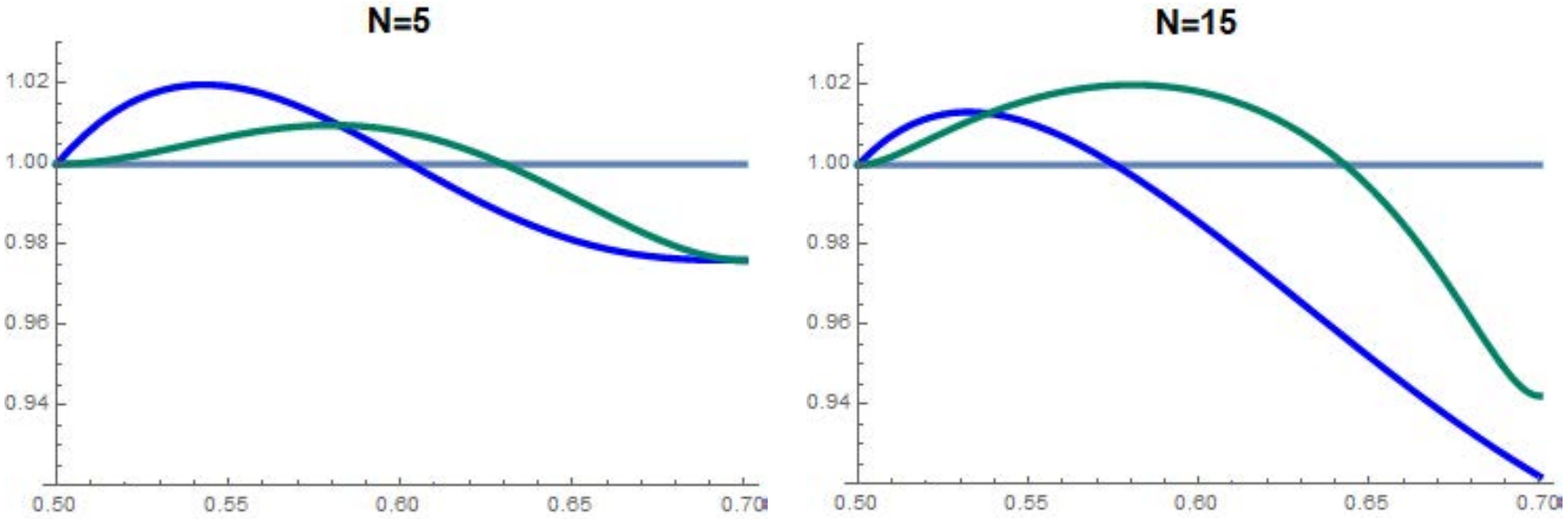
MVA3: $N = 15$, $K = 3$.

- In the interior equilibrium, the abstention probability is higher than equilibrium delegation. (With $N = 15$, $ED \approx 2$, $EA \approx 5$).

- There can be gains over MV, but they remain small.

Comparison

How robust to mistakes?



The horizontal axis is $\widetilde{q}$. Grey is MV; Blue is LD; Green is MVA

$\Longrightarrow$ (i) MVA is more robust to deviations from $\widetilde{q}^*$.

(ii) The difference is stronger at larger N.

(iii) With larger N, LD has small potential gains, larger potential losses.

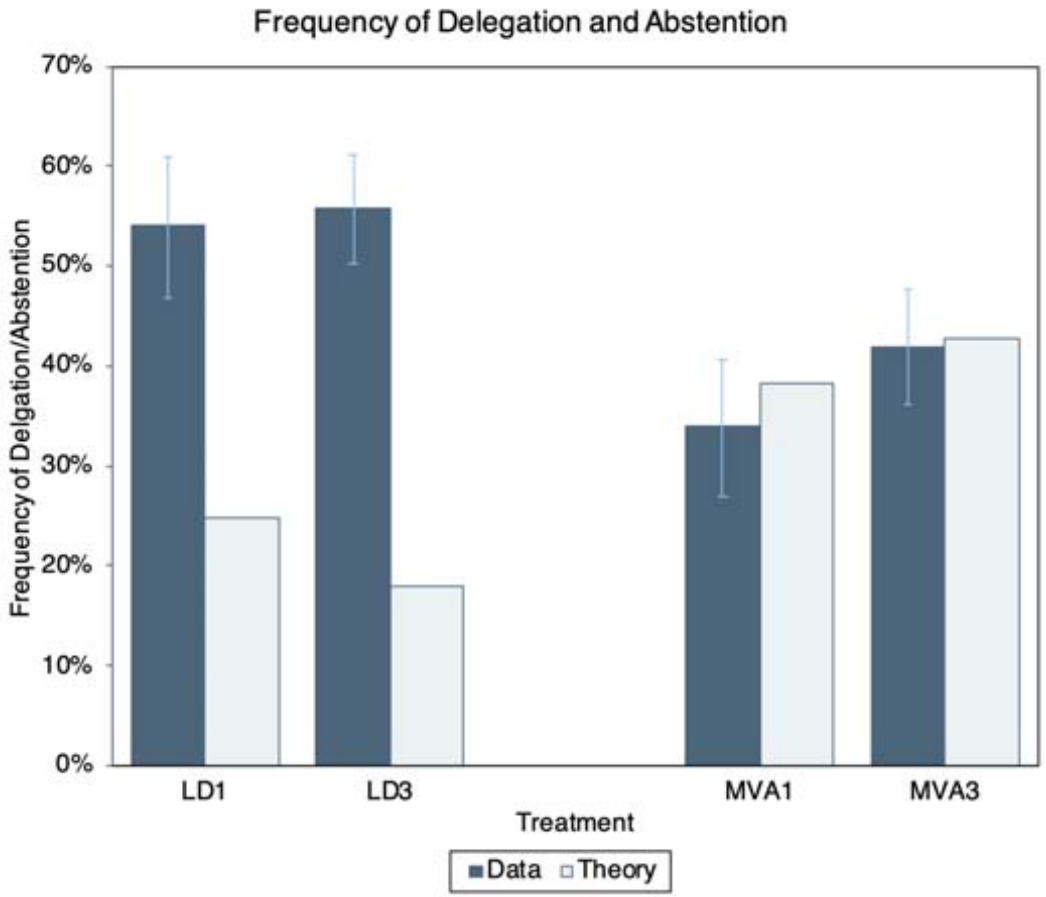
Experiment 1: Design

- The experiment follows very closely the theoretical model.
- In the LD treatments, E's cannot delegate; NE's can delegate only to E's.
- In the MVA treatments, E's cannot abstain.
- 10 sessions, 150 subjects, random matching across rounds when multiple groups.
- Run on Zoom, programmed on oTree, Summer 2021.

Sessions	Treatments	Rounds	Subjects	Groups
1a	LD1, LD3	20,20	15	3,1
1b	LD3, LD1	20,20	15	1,3
2a	MVA1, MVA3	20,20	15	3,1
2b	MVA3, MVA1	20,20	15	1,3
3a, 3a'	LD3, MVA3	20,20	15	1,1
3b, 3b'	MVA3, LD3	20,20	15	1,1
4a	LD1, MVA1	20,20	15	3,3
4b	MVA1, LD1	20,20	15	3,3

Results of experiment 1

1. Participants overdelegate under LD. Abstention is closer to predictions.

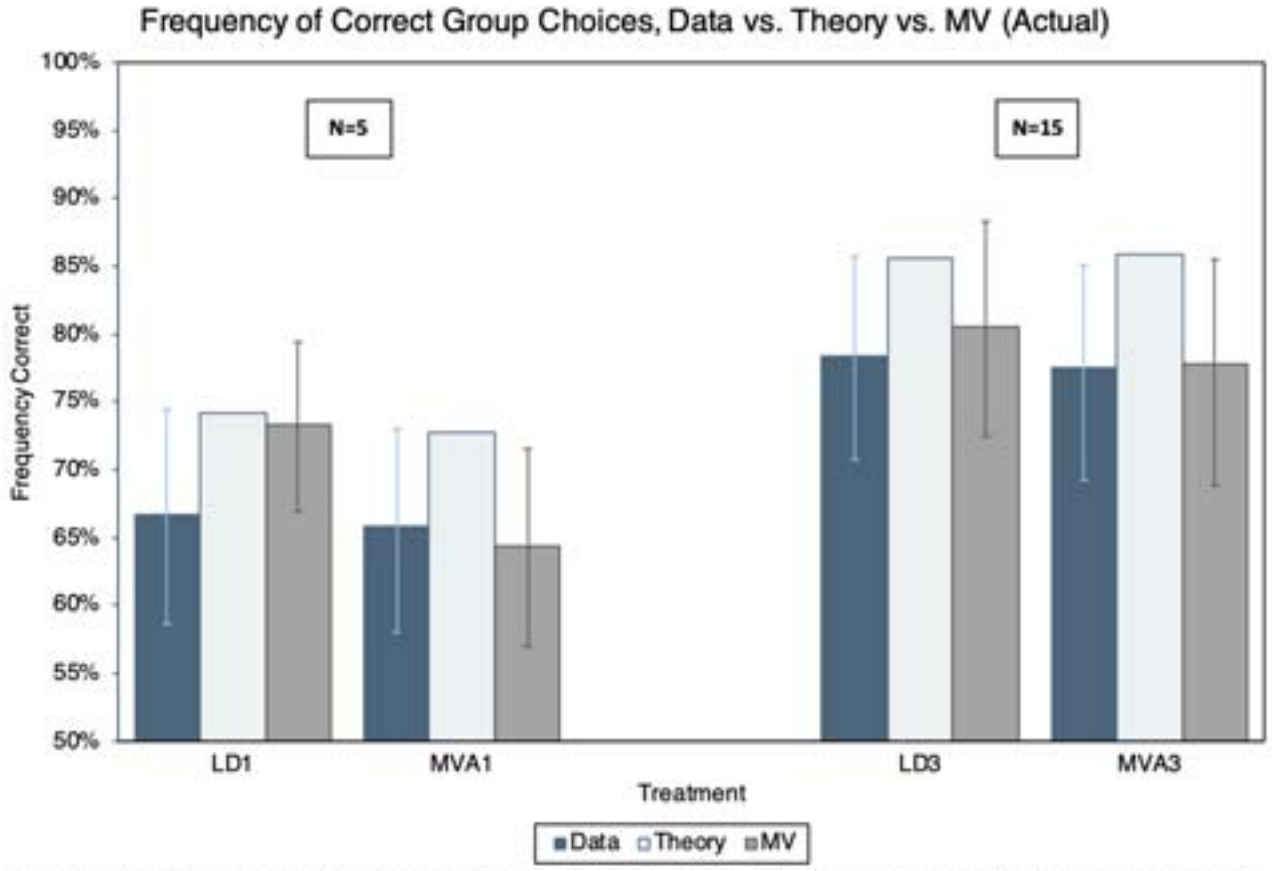


Note: Standard errors clustered at individual level.

Robust to: disaggregating by session; considering only 10 final rounds; clustering at session level.

Individual analysis
Regressions

2. As a result, LD underperforms relative to MV. MVA's results are comparable to MV.



Both systems underperform relative to their theoretical potential.

3. How informative are there results?

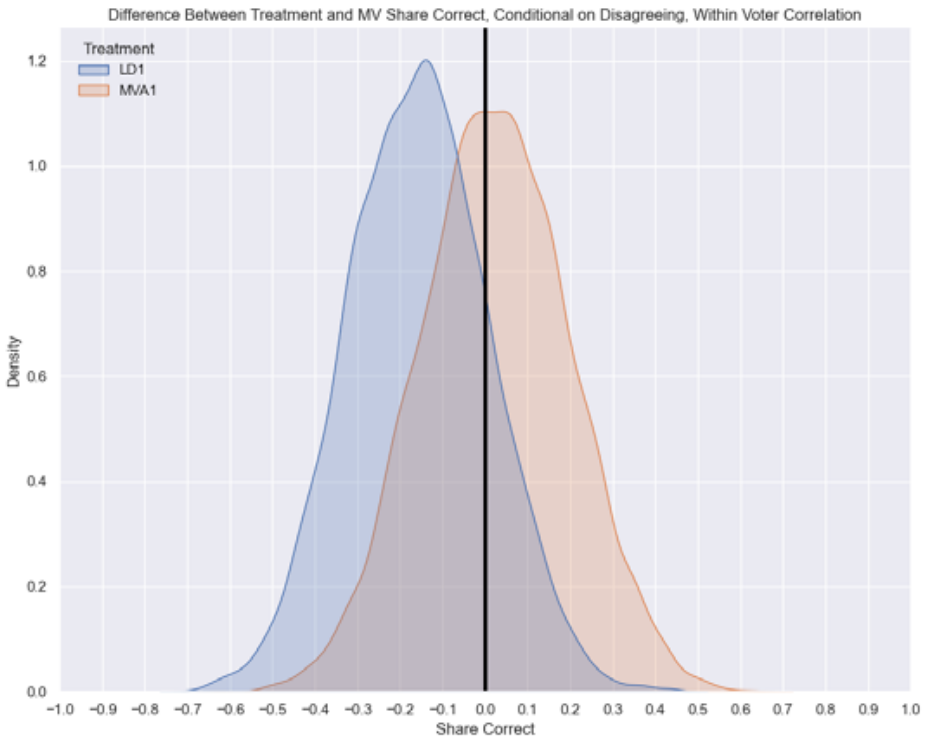
- Outcomes differ rarely from MV ($\simeq 1/4$ under LD; $1/7$ under MVA).

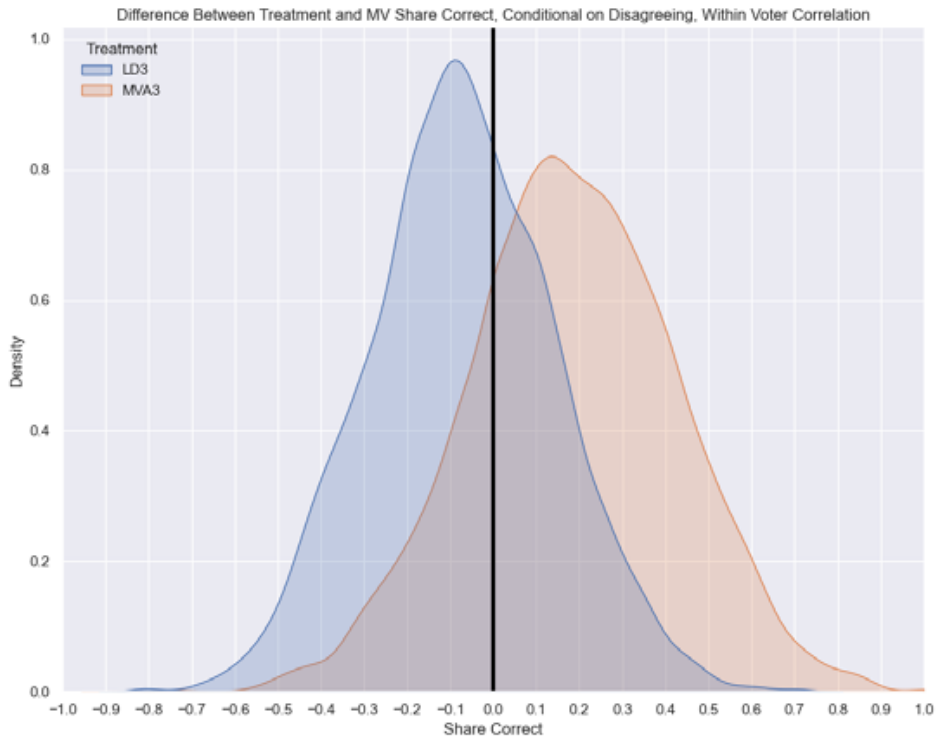
- The correlation structure is complex.

  $\Longrightarrow$ bootstrap the data to evaluate statistical significance.

- Bootstrapping exercise: 100,000 simulations of 240 LD1 or MVA1 (120 LD3 or MVA3) elections generated by drawing subjects with replacement from our subject pool, allowing for within-subject correlation.

Differential frequency of correct decisions re MV, conditional on disagreeing





Blue is LD, Orange is MVA

- Conditional on disagreement:
  Re LD: MV is more correct 4/5 of the times (LD1); 2/3 (LD3).
  Re MVA: MV is more correct 1/2 of the times (MVA1); 1/4 (MVA3).

$\Longrightarrow$

(i) In Experiment 1, LD falls short of MV

(ii) MVA is comparable or superior to MV.

(iii) Even when experts are correctly identified.

But could the design be biasing the results?

1. The mathematical communication of the precisions makes the relative magnitude very salient.

   $\Longrightarrow$ overdelegation under LD?

2. It can also be confusing: if a signal is correct with prob 55%, should one vote against it about half of the time?

   $\Longrightarrow$ Voting against signal at low precisions. Regression

3. Would over-delegation persist in larger samples?

   $\Longrightarrow$ Margolis (1976) "Note on Incompetence": what if some $q(i)$ are *below* 0.5?

Experiment 2

- Introduce noise without a precise statistical representation.
- Individuals do not have a representation of their (and others') precision.
- A perceptual task where individual perceptual accuracy is the noisy signal.

  $\Longrightarrow$ the Random Dot Kinematogram, a classic perceptual task in vision and cognitive research.

The Random Dot Kinematogram (RDK)

- A number of moving dots are displayed for a short interval (1s. for us).
- Some move in a coherent direction. Others move at random.
- Subjects report their perceived direction of the coherent dots.
- With two directions: a binary structure of information and choice.
  - Objective state of nature: coherent direction
  - Signal: individual perception of direction, varying across subjects.

Experiment 2: Design

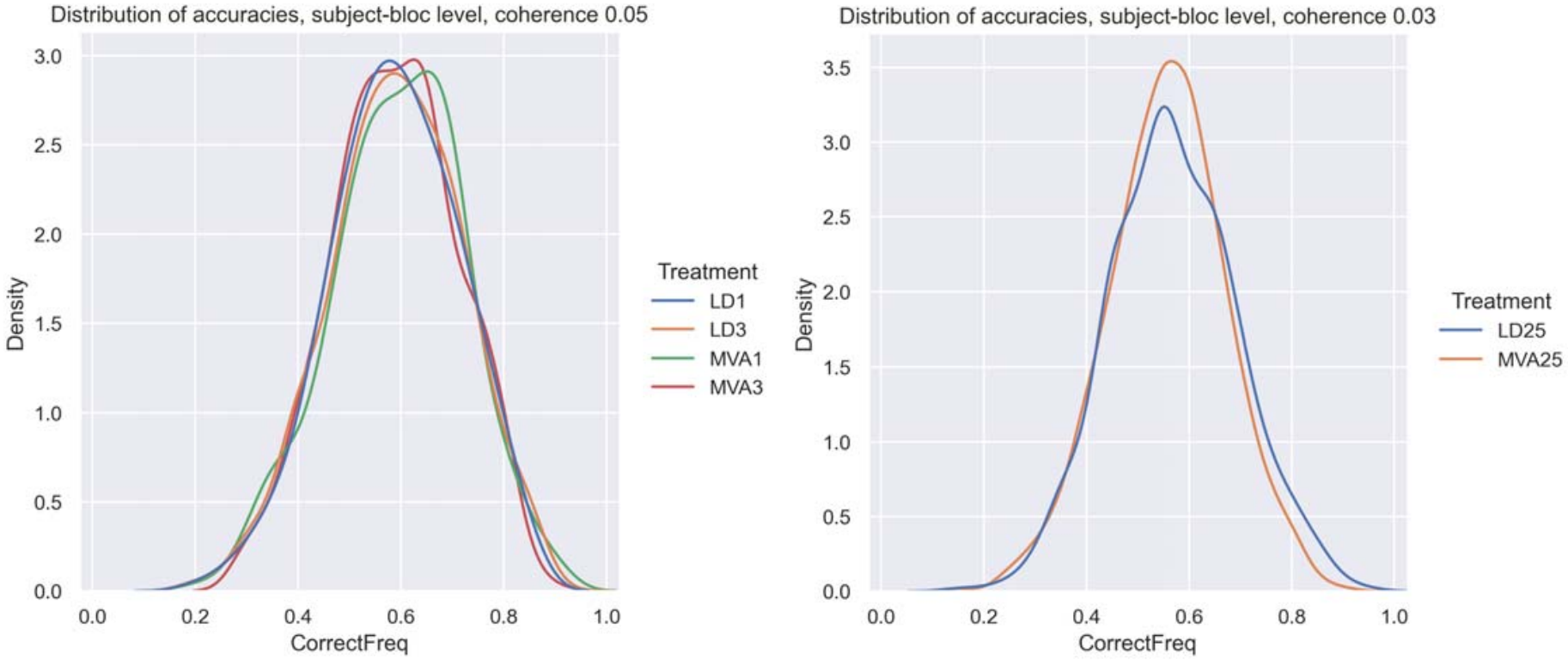
- Amazon MTurk; 30 minutes; 550 subjects.
- Part One: individual RDK tasks. Six blocs of decreasing coherence, each of 20 tasks.
- Subjects are rewarded according to their performance.
- Part Two: again six blocs, each of 20 tasks. Coherence is fixed (and low).
- In Part Two, each task has both an individual component and a group decision with possibility of delegation/abstention.

- Both tasks are rewarded.
- Experts: 20 percent of subjects with best individual performance in the two last blocs (40 tasks).
- Three group sizes for both LD and MVA: $N = 5$, $N = 15$, $N = 125$.
- Coherence is 5% for $N = 5$, $N = 15$; it is 3% for $N = 125$.
- Example.

Results of experiment 2

Accuracy

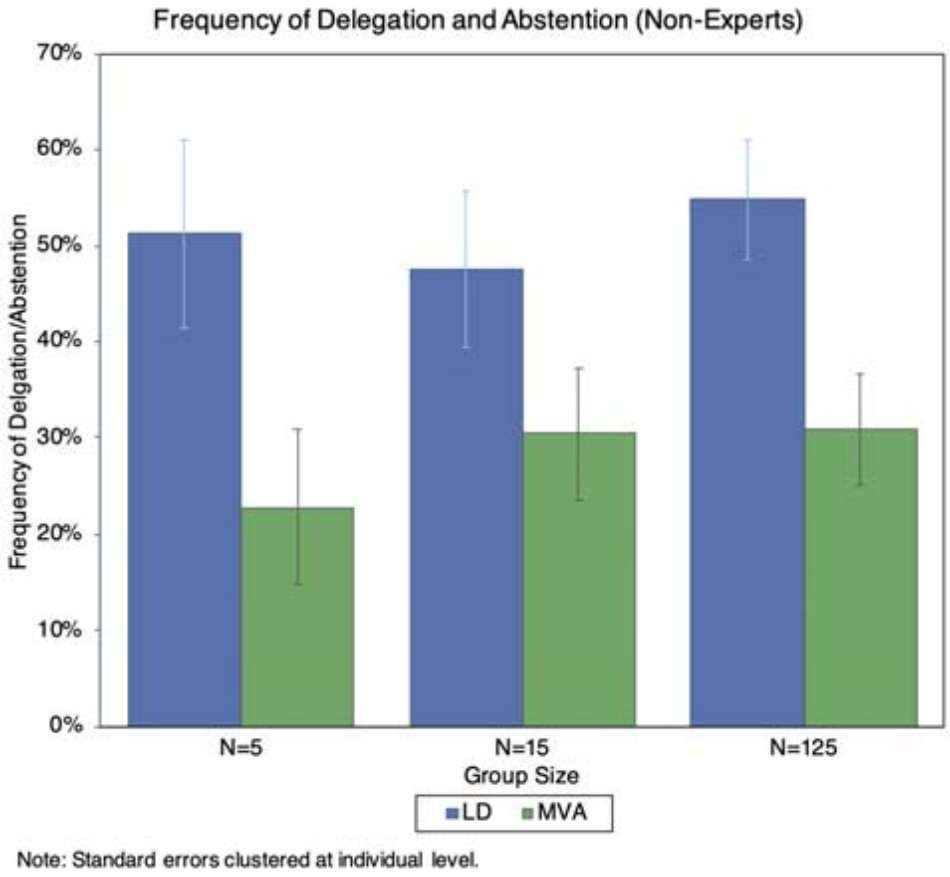
Distributions of correct responses in Part 2 by level of coherence.



Over 20 tasks, more than 30% of subjs are no better than random (20% are below).

Over 120 tasks, 15% of subjs are no better than random (10% are below).

Frequency of delegation and abstention

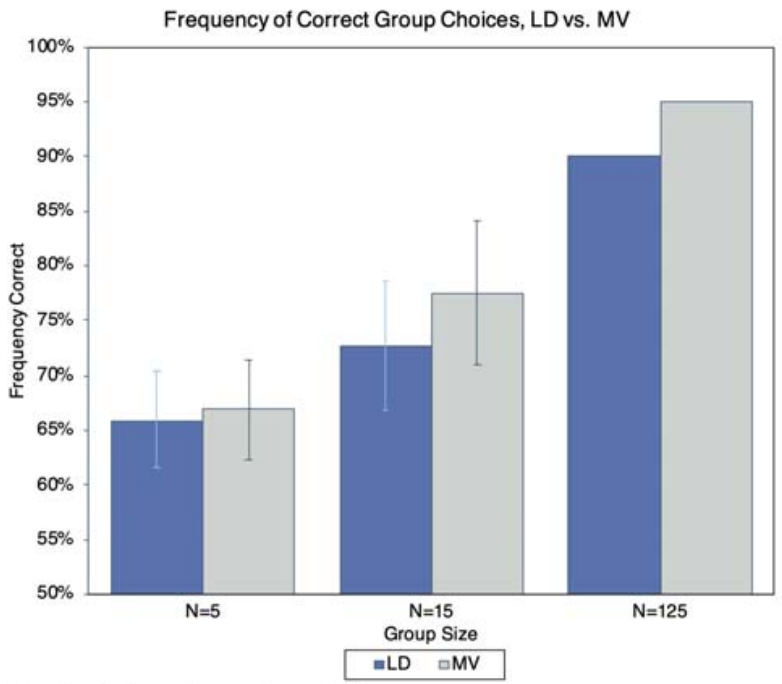


At comparable accuracies, delegation is much more frequent than abstention, for all group sizes.

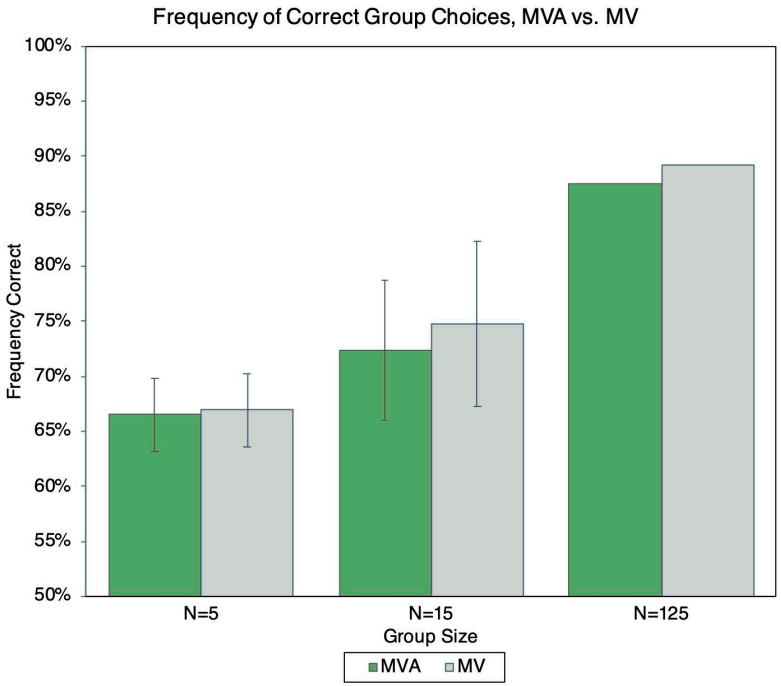
Results are surprisingly similar to Experiment 1.

Regressions

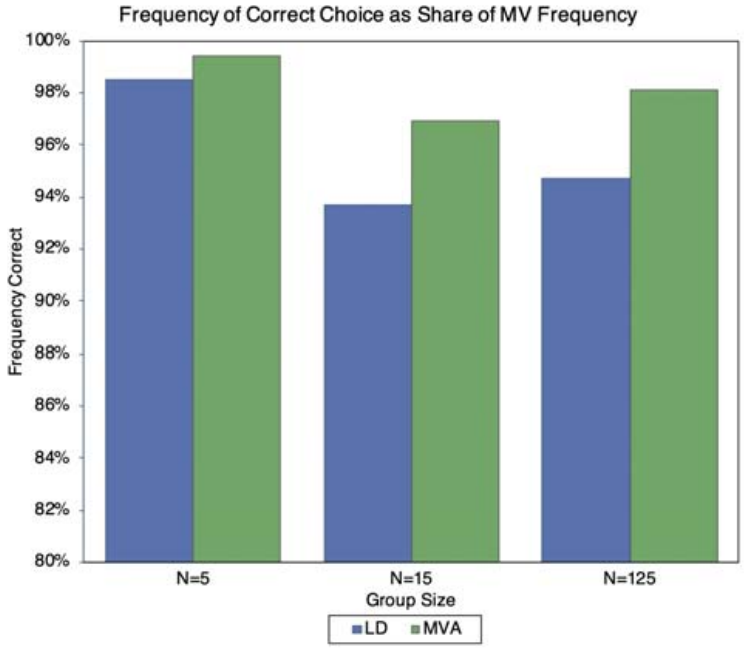
Frequency of correct outcomes



Note: Standard errors clustered at group level.

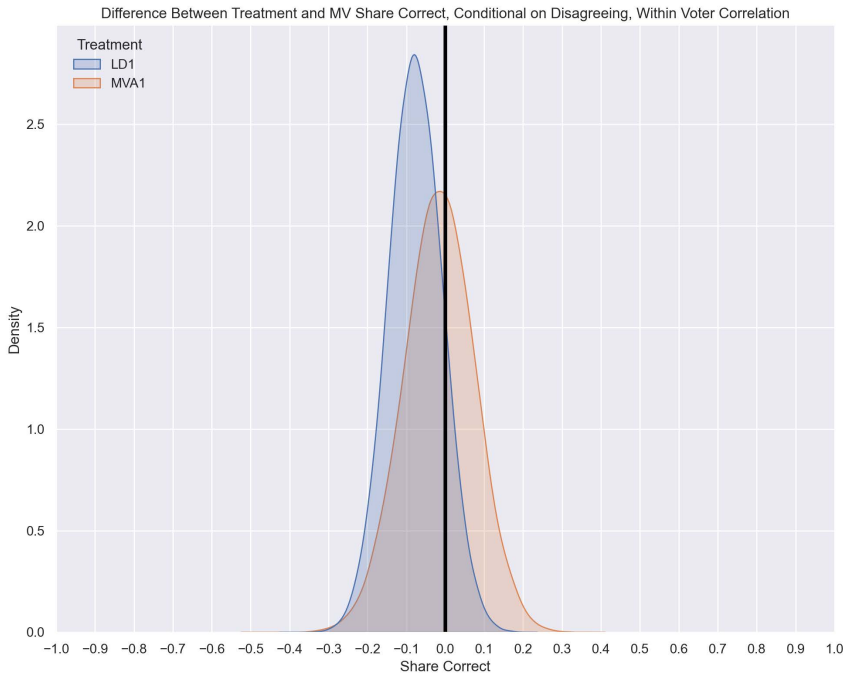


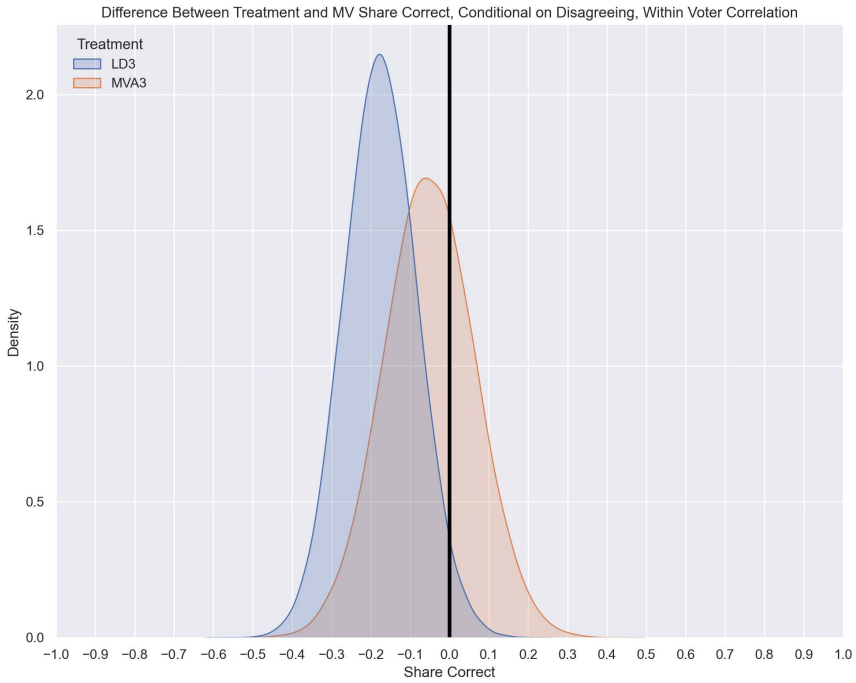
Note: Standard errors clustered at group level.

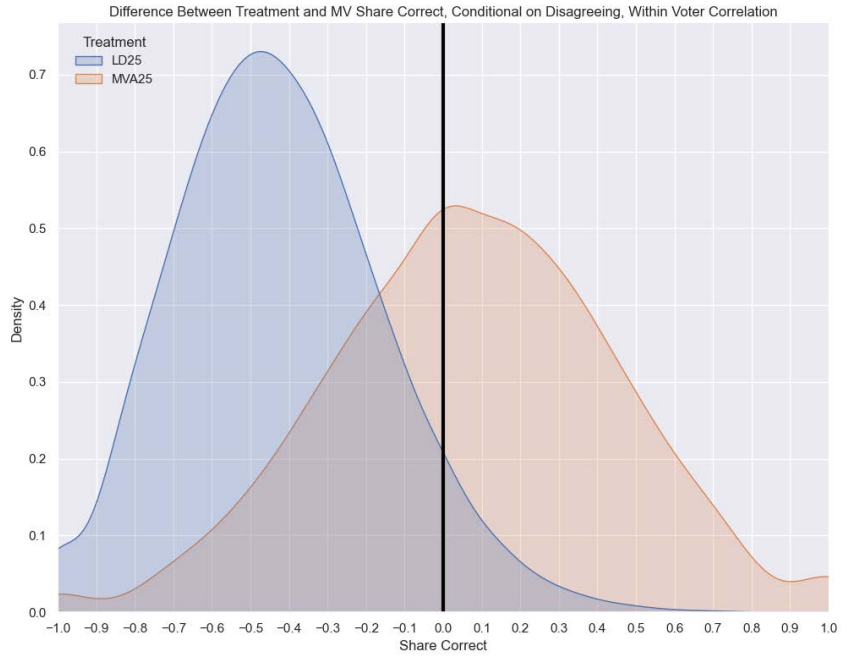


Comparison

Differential frequency of correct decisions re MV, conditional on disagreeing







- Conditional on disagreement:
  Re LD: MV is more correct 87% of the times (LD1); 97% (LD3), 95% (LD25).

  Re MVA: MV is more correct 58% of the times (MVA1); 69% (MVA3), 48% (MVA25).

Conclusions

LD

- In two very different experiments, delegation is much more frequent than abstention.
- LD is dominated by MV, MVA is comparable to MV.
- On informational grounds, the value of LD seems at best uncertain.
- Other objectives?

A methodological suggestion

- Collective decision-making in an ambiguous world.
- Perceptual tasks are a good tool.
- If possible, combined with a more controlled lab experiment.

Beliefs

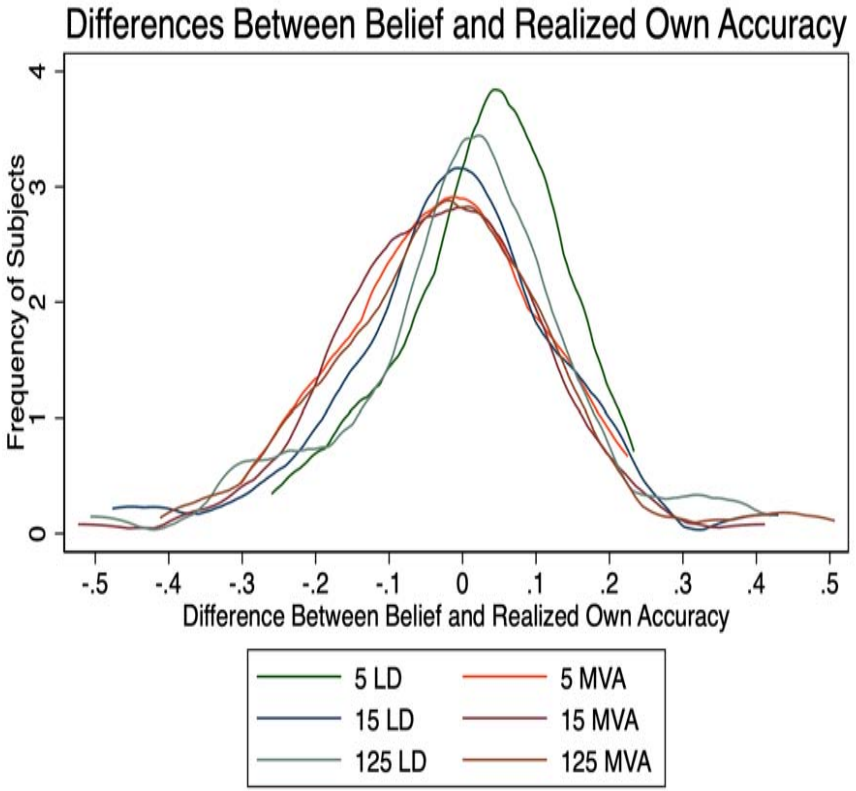
At the end of the RDK experiment, we ask:

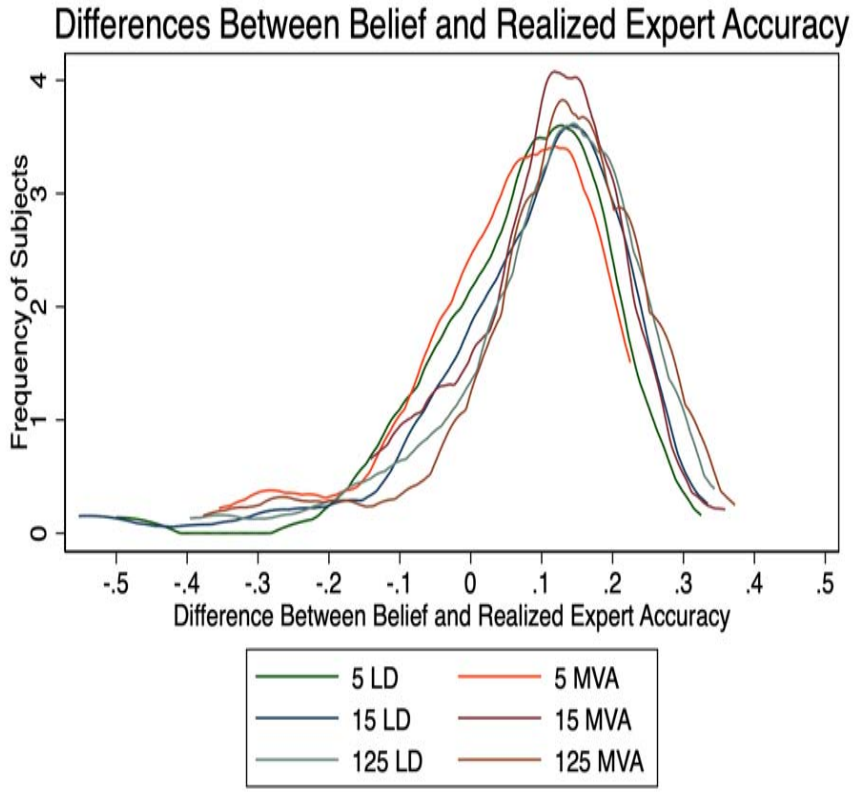
- On average what percentage of trials in the second part do you think **you** got right?

- On average what percentage of trials in the second part do you think **the experts** got right?

Very noisy measure. We find:

- Beliefs about own accuracy track actual accuracy fairly well (overestimation for LD1)
- Beliefs about experts' accuracy are enflated.
- Delegation is better explained by beliefs than by actual accuracy (role for overconfidence).
- Beliefs cannot explain overdelegation under LD


Differences Between Belief and Realized Own Accuracy
Frequency of Subjects
0
1
2
3
4
-.5
-.4
-.3
-.2
-.1
0
.1
.2
.3
.4
.5
Difference Between Belief and Realized Own Accuracy
5 LD
5 MVA
15 LD
15 MVA
125 LD
125 MVA


Differences Between Belief and Realized Expert Accuracy
Frequency of Subjects
0
1
2
3
4
-.5
-.4
-.3
-.2
-.1
0
.1
.2
.3
.4
.5
Difference Between Belief and Realized Expert Accuracy
5 LD
5 MVA
15 LD
15 MVA
125 LD
125 MVA

Frequency of Delegation/Abstention

Dependent variable:	(1) Delegation/ Abstention Frequency	(2) Delegation/ Abstention Frequency	(3) Delegation/ Abstention Frequency	(4) Delegation/ Abstention Frequency	(5) Delegation/ Abstention Frequency	(6) Delegation/ Abstention Frequency
Accuracy	-0.186					
	(0.212)					
	[0.379]					
Belief About Own Accuracy		-0.465***	-0.314**			
		(0.0959)	(0.138)			
		[1.58e-06]	[0.0234]			
(Own - Expert) Belief				-0.568***		
				(0.0949)		
				[4.06e-09]		
(Belief - Realized) Own Accuracy					-0.404***	-0.404***
					(0.0939)	(0.0943)
					[1.96e-05]	[2.10e-05]
LD	0.226***	0.239***	0.402***	0.236***	0.236***	0.236***
	(0.0280)	(0.0276)	(0.111)	(0.0272)	(0.0276)	(0.0277)
	[0.000]	[0.000]	[0.000322]	[0.000]	[0.000]	[0.000]
Belief About Own Accuracy x LD			-0.288			
			(0.191)			
			[0.131]			
N=5	-0.0432	-0.0292	-0.0284	-0.0266	-0.0435	-0.0435
	(0.0370)	(0.0359)	(0.0359)	(0.0355)	(0.0359)	(0.0359)
	[0.243]	[0.417]	[0.428]	[0.455]	[0.225]	[0.226]
N=15	-0.0388	-0.0370	-0.0379	-0.0419	-0.0486	-0.0486
	(0.0326)	(0.0315)	(0.0314)	(0.0311)	(0.0316)	(0.0316)
	[0.234]	[0.240]	[0.228]	[0.178]	[0.124]	[0.125]
Share of Rounds as Expert						-0.00104
						(0.0572)
						[0.986]
Constant	0.420***	0.566***	0.483***	0.224***	0.306***	0.306***
	(0.121)	(0.0570)	(0.0790)	(0.0287)	(0.0247)	(0.0272)
	[0.000567]	[0.000]	[1.96e-09]	[0.000]	[0.000]	[0.000]
Observations	550	550	550	550	550	550
R-squared	0.111	0.147	0.151	0.165	0.139	0.139

*** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors in parentheses. P-values in brackets. Delegation/abstention is measured as the share of rounds across all six blocs that a subject chose to delegate/abstain (with a range from 0 to 1). Accuracy is the share of rounds that subject answered correctly. Belief about own average accuracy as reported by subject. (Own - Expert) Belief is the difference between a subject's belief about their own average accuracy and their belief about the average accuracy of experts in their group (a negative value thus indicates that the subject thinks they underperformed the experts in their group). (Belief - Realized) Own Accuracy is the difference between a subject's belief about their own accuracy and their realized accuracy (a positive value thus indicates an "overconfident" subject).

- Some claims are extreme:

  We seek nothing less than true democratic governance for the Internet age, one of the foundational building blocks [..] that will change what it means to be human on Earth. (Democracy.Earth: https://democracy.earth/)

- And the applications for which data are easily available are still trivial:

  Google Votes (2012-15): choice of food items, logos for charitable events...

- But practical implementations have been tried, and obstacles have been identified and discussed:

  LiquidFeedback: https://liquidfeedback.com/en/

  Association for Interactive Democracy:
  https://interaktive-demokratie.org/association.en.html

  Liquid Democracy - the film:
  https://www.youtube.com/watch?v=AiZPbVcsdTY.

back

Note:

- Delegation is transitive. But if a cycle occurs, all delegations involved are null.
- Delegation does not convey information about the signal.
- A voter casts all votes in the same direction.
- Signals are not communicated (or such communication is babbling).

Back

Proof: McLennan (1998)

- With pure common interest, the strategies that maximize expected utility must be an equilibrium.

  $\Longrightarrow$ An equilibrium exists.

- There cannot be an equilibrium where delegation is excluded with probability 1 (and MV is replicated):

  - if everyone else votes, an individual with precision close to 0.5 prefers to delegate.

  $\Longrightarrow$ All equilibria must include a positive probability of delegation.

$\Longrightarrow$ There must exist an equilibrium that dominates MV (or MV would be an equilibrium).

- The environment is symmetric for all E (NE) voters.

  $\Longrightarrow$ The conclusion applies to semi-symmetric strategies (McLennan, Theorem 2).

Back

Example

Suppose $N = 3$ and $K = 1$ (i, j, and k).

- i's vote matters only if (i) i and k disagree; (ii) j does not delegate; (iii) j does not agree with k.

- Equivalent to conditioning on i disagreeing with the expert and agreeing with j (who votes).

- $p = 0.7$, $F(q)$ Uniform on $[0.5, 0.7]$ $\implies$ $\widetilde{q} = 0.572$.

- $q(i) < p$ always, but the ex ante prob of delegation is just above $1/3$.

Back

Comparison (interior equilibria):

R	$\widetilde{q}_R$	$F(\widetilde{q}_R)$	EU_R	EU_{MV}
LD	0.543	0.215	0.731	0.717
MVA	0.580	0.40	0.724	0.717

$N = 5,\ K = 1.$

R	$\widetilde{q}_R$	$F(\widetilde{q}_R)$	EU_R^K	EU_{MV}^K
LD	0.532	0.162	0.843	0.832
MVA	0.580	0.40	0.849	0.832

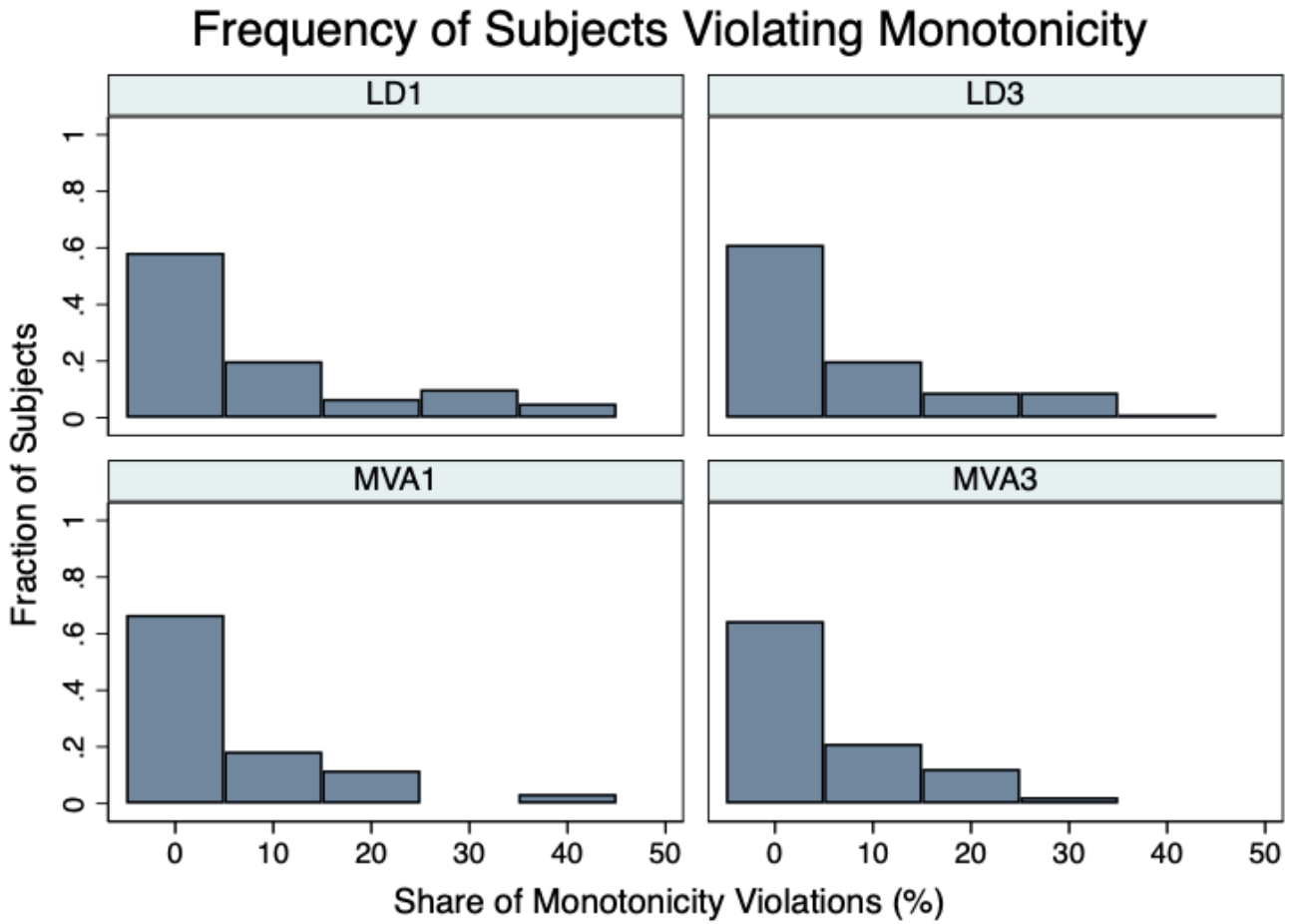
$N = 15,\ K = 3.$

Back

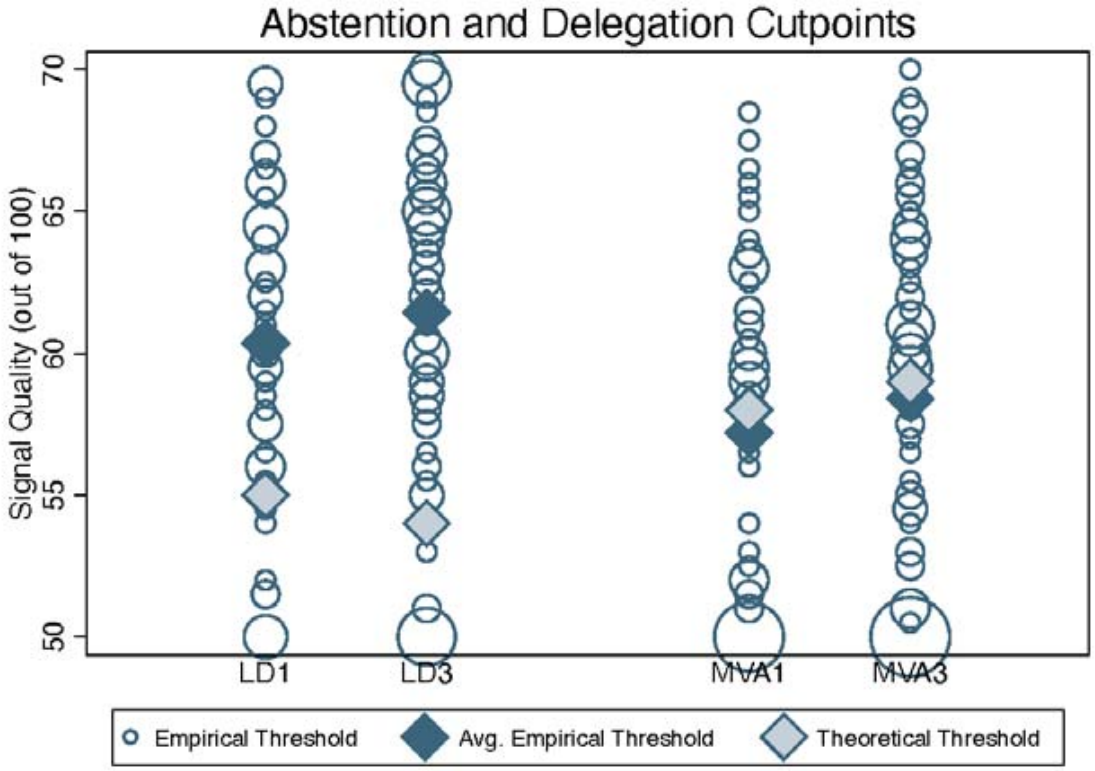
Individual Subjects' Results

Experiment 1.

Participants' choices are monotonic in signal precision: $\geq 80\%$ of NE subjects fully monotonic by changing ≤ 2 choices (of 16 expected as NE).

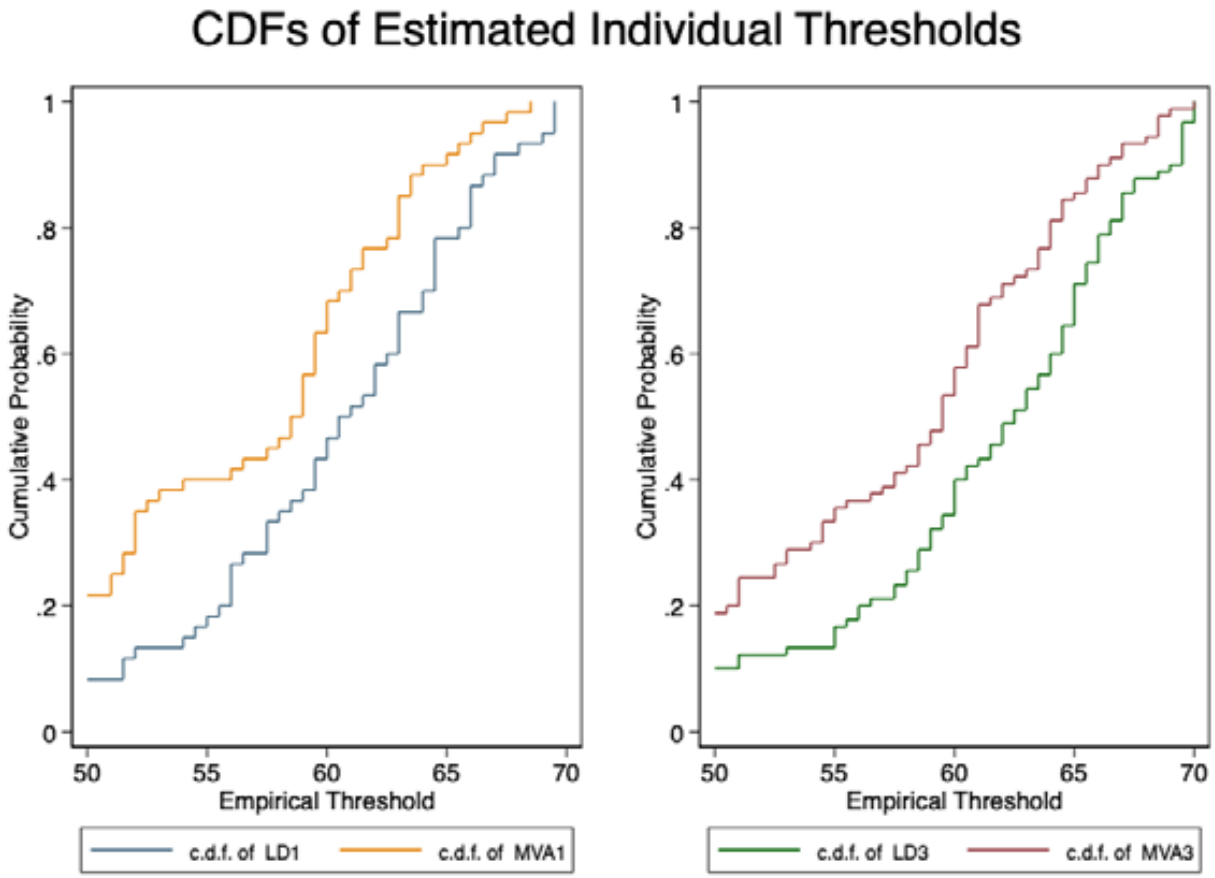


Delegation and abstention thresholds are heterogeneous. Mean estimated thresholds for LD are higher than predicted; comparable for MVA.



Robust to considering only the last 10 rounds.

The distribution of estimated thresholds under LD FOSD's the distribution under MVA.



Frequency of Delegation or Abstention

	(1) Linear Probability	(2) Probit
LD	0.328***	0.938***
	(0.0971)	(0.333)
	[0.00107]	[0.00491]
Round	0.0309	0.0851
	(0.0442)	(0.158)
	[0.486]	[0.590]
Signal Quality	-0.777***	-2.624***
	(0.0759)	(0.283)
	[0.000]	[0.000]
Second	0.154*	0.534*
	(0.0868)	(0.307)
	[0.0801]	[0.0815]
Second * Mixed	-0.129	-0.451
	(0.0967)	(0.337)
	[0.186]	[0.182]
LD * Second	-0.0896	-0.332
	(0.118)	(0.413)
	[0.449]	[0.421]
LD * Second * Mixed	-0.0253	-0.0327
	(0.144)	(0.492)
	[0.861]	[0.947]
LD * Round	-0.112*	-0.345
	(0.0665)	(0.233)
	[0.0956]	[0.138]
LD * Signal	-0.0776	0.0653
	(0.0893)	(0.348)
	[0.387]	[0.851]
Constant	0.675***	0.582***
	(0.0759)	(0.216)
	[0.000]	[0.00705]
Observations	1,920	1,920
R-squared	0.309	

*** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors in parentheses, clustered at the individual subject level. P-values in brackets. Delegation/abstention is measured as a binary 0-1 subject decision. Experts are dropped because they cannot delegate or abstain. Only LD1 and MVA1 rounds are included. "Second" indicates that the treatment appeared second in the session. "Mixed" indicates that both an LD treatment and an MVA treatment appeared in the session.

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Frequency of Delegation or Abstention

	(1) Linear Probability	(2) Probit
LD	0.208***	0.677**
	(0.0746)	(0.283)
	[0.00609]	[0.0167]
Round	0.0783*	0.274**
	(0.0401)	(0.136)
	[0.0532]	[0.0444]
Signal Quality	-0.861***	-2.691***
	(0.0553)	(0.220)
	[0.000]	[0.000]
Second	-0.0963	-0.341
	(0.0797)	(0.275)
	[0.229]	[0.214]
Second * Mixed	0.0784	0.295
	(0.0865)	(0.298)
	[0.367]	[0.322]
LD * Second	0.0367	0.125
	(0.113)	(0.384)
	[0.745]	[0.745]
LD * Second * Mixed	-0.166	-0.577
	(0.118)	(0.402)
	[0.160]	[0.151]
LD * Round	-0.0506	-0.174
	(0.0600)	(0.205)
	[0.401]	[0.395]
LD * Signal	0.0107	0.102
	(0.0690)	(0.287)
	[0.877]	[0.721]
Constant	0.832***	0.992***
	(0.0614)	(0.199)
	[0.000]	[0.000]
Observations	2,880	2,880
R-squared	0.309	

*** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors in parentheses, clustered at the individual subject level. P-values in brackets. Delegation/abstention is measured as a binary 0-1 subject decision. Experts are dropped because they cannot delegate or abstain. Only LD3 and MVA3 rounds are included. "Second" indicates that the treatment appeared second in the session. "Mixed" indicates that both an LD treatment and an MVA treatment appeared in the session.

Frequency of Voting Against Signal

	(1) Linear Probability	(2) Probit
Signal Quality	-0.472***	-2.244***
	(0.0560)	(0.235)
	[0.000]	[0.000]
Round	0.00264	0.00454
	(0.0158)	(0.0832)
	[0.868]	[0.956]
LD	-0.00539	-0.0447
	(0.0270)	(0.150)
	[0.842]	[0.765]
N = 15	-0.00637	-0.0728
	(0.0362)	(0.197)
	[0.860]	[0.712]
Second	-0.0115	-0.0700
	(0.0383)	(0.200)
	[0.764]	[0.726]
Second * Mixed	-0.0372	-0.208
	(0.0332)	(0.195)
	[0.264]	[0.286]
N = 15 * Second	0.0288	0.164
	(0.0614)	(0.338)
	[0.640]	[0.626]
N = 15 * Mixed	-0.00469	0.00404
	(0.0398)	(0.242)
	[0.906]	[0.987]
Constant	0.452***	0.221
	(0.0692)	(0.239)
	[0.000]	[0.356]
Observations	2,552	2,552
R-squared	0.154	

*** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors in parentheses, clustered at the individual subject level. P-values in brackets. The dependent variable is a 0-1 indicator of whether the subject voted against their signal. Only non-experts are included, and only the instances in which they did not delegate or abstain are included. "Second" indicates that a treatment appeared second in the session. "Mixed" inidcates that both an LD treatment and MVA treatment appeared in the session.

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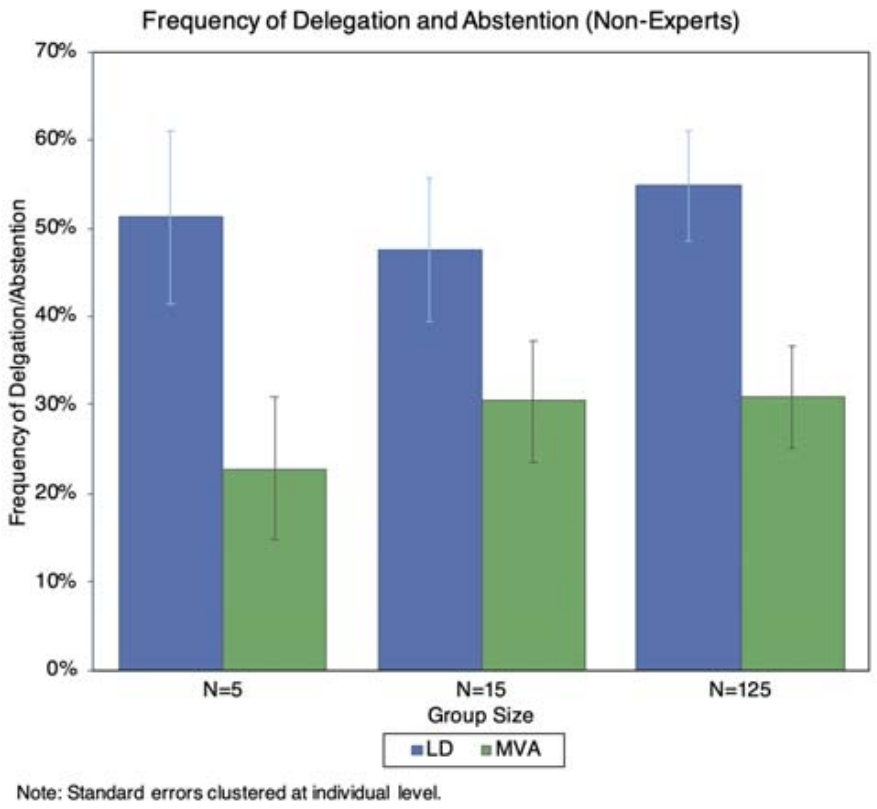
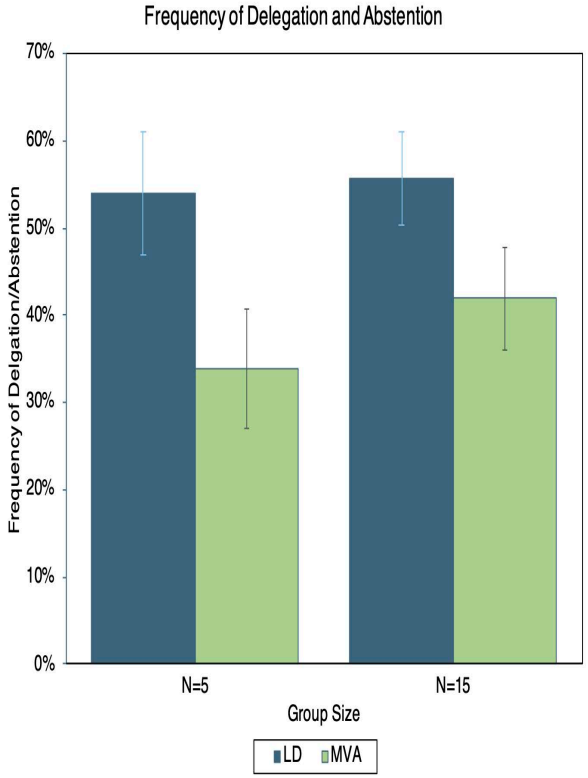
Frequency of delegation and abstention. Comparison between the two experiments

Experiment 2



Note: Standard errors clustered at individual level.

Experiment 1



Note: Standard errors clustered at individual level.

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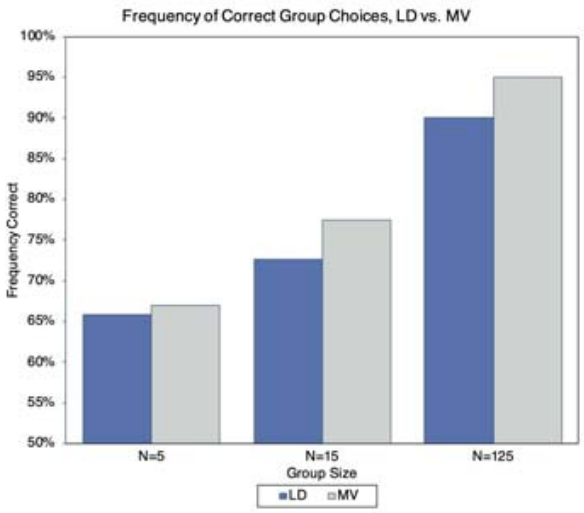
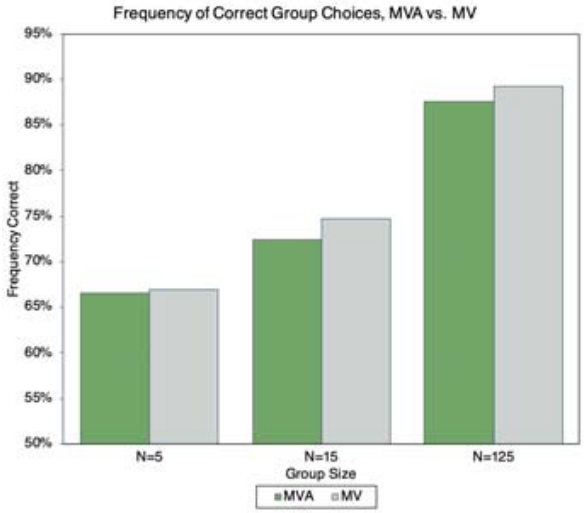
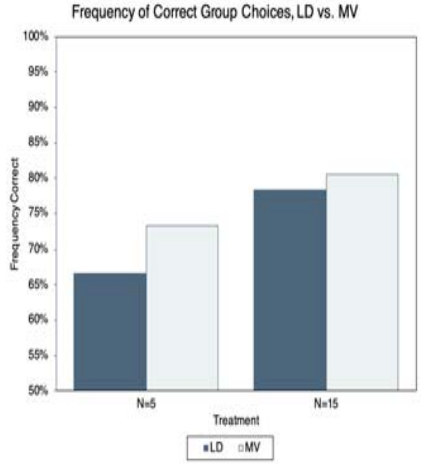
Frequency of correct outcomes. Comparison between the two experiments

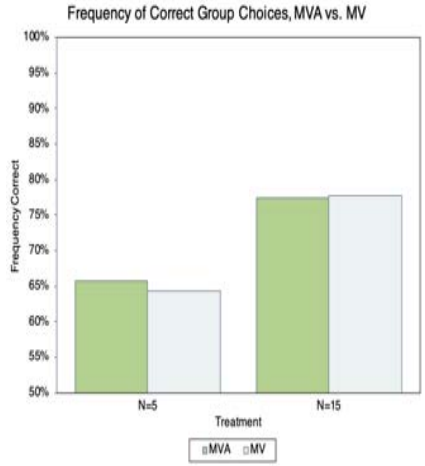
Experiment 2





Experiment 1





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Frequency of Delegation/Abstention, N=5 and N=15

	(1) Linear Probability	(2) Linear Probability	(3) Probit	(4) Probit
Accuracy	-0.122	-0.122	0.356	0.354
	(0.0839)	(0.0839)	(0.309)	(0.308)
	[0.146]	[0.146]	[0.249]	[0.251]
LD	0.226***	0.226***	0.547***	0.548***
	(0.0378)	(0.0378)	(0.139)	(0.140)
	[0.000]	[0.000]	[0.000]	[0.000]
N=15	0.00451	0.00446	0.0506	0.0503
	(0.0384)	(0.0384)	(0.139)	(0.140)
	[0.907]	[0.908]	[0.717]	[0.719]
Keys: [E][Y]		-0.00884		-0.0401
		(0.0379)		(0.139)
		[0.816]		[0.772]
Bloc		0.000511		-0.256***
		(0.0115)		(0.0654)
		[0.965]		[0.000]
Constant	0.339***	0.343***	0.163	0.313
	(0.0627)	(0.0656)	(0.222)	(0.234)
	[0.000]	[0.000]	[0.463]	[0.181]
Observations	1,800	1,800	1,800	1,800
R-squared	0.100	0.100		

*** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors in parentheses, clustered at the individual subject level. P-values in brackets. Delegation/abstention is measured as the share of rounds in a given bloc that a subject chose to delegate/abstain (with a range from 0 to 1). Accuracy is the share of rounds in the bloc that subject answered correctly. Subjects randomly use either keys [E] and [Y] or [V] and [N] to decide whether to delegate; a dummy for being assigned [E][Y] is included. The values for bloc have been scaled to be between 0 and 1; the coeffient for "bloc" thus indicates the effect of going from the first to last bloc.

Frequency of Delegation/Abstention, N=125

	(1) Linear Probability	(2) Linear Probability	(3) Probit	(4) Probit
Accuracy	0.000304	0.00380	0.479	0.455
	(0.101)	(0.102)	(0.357)	(0.359)
	[0.998]	[0.970]	[0.180]	[0.205]
LD	0.224***	0.223***	0.661***	0.663***
	(0.0415)	(0.0415)	(0.164)	(0.164)
	[0.000]	[0.000]	[0.000]	[0.000]
Keys: [E][Y]		0.0291		-0.0430
		(0.0414)		(0.161)
		[0.484]		[0.790]
Bloc		0.00192		-0.0363**
		(0.00258)		(0.0147)
		[0.459]		[0.0138]
Constant	0.316***	0.282***	0.313	0.694**
	(0.0623)	(0.0721)	(0.225)	(0.288)
	[0.000]	[0.000119]	[0.163]	[0.0162]
Observations	1,500	1,500	1,500	1,500
R-squared	0.095	0.097		

*** p<0.01, ** p<0.05, * p<0.1

Notes: Standard errors in parentheses, clustered at the individual subject level. P-values in brackets. Delegation/abstention is measured as the share of rounds in a given bloc that a subject chose to delegate/abstain (with a range from 0 to 1). Accuracy is the share of rounds in the bloc that subject answered correctly. Subjects randomly use either keys [E] and [Y] or [V] and [N] to decide whether to delegate; a dummy for being assigned [E][Y] is included. The values for bloc have been scaled to be between 0 and 1; the coeffient for "bloc" thus indicates the effect of going from the first to last bloc.

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RDK experiment

- How often do outcomes differ from MV?

  Between 20 and 25% for LD1/LD3, 12% for LD25; around 12% for MVA1/MVA3, less than 8% for MVA25.

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