

**ONLINE APPENDIX for**  
**The effect of leadership on free-riding: results from a public-good experiment**

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**Abstract:** We examine the impact of two types of communication: (i) encouragement of honesty and (ii) encouragement of lying that benefits the group. Subjects choose contributions to a public good, with a portion of the contribution framed as determined by a self-reported die roll. While honesty is typically viewed as desirable, in our setting it is more equivocal, since it results in a sub-optimal group payoff. We find that when leaders encourage their followers to lie in a cooperative way, followers increase these “die roll” contributions. There is also a positive spillover into additional discretionary contributions to the public good. By contrast, the way leaders are chosen and their observed contribution history have little effect.

**Keywords:** leader; cheap talk; lying; honesty; group culture

**JEL codes:** D91, D23, C72, C92, H41, M14

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## **Appendix B: Survey questions**

### **Demographic questions**

Age (in years, as on last birthday): [positive integer]

What is your sex? [Female/Male]

Are you employed? [No/Yes, Part time/Yes, Full time]

Residency status in Australia? [Australian citizen/Australian permanent resident/New Zealand citizen/ New Zealand permanent resident/Student visa/ Aboriginal or Torres Island/Other]

How long have you been in Australia (in years)? [positive integer]

Class? [First year/Second year/Third Year/Fourth Year/Honours/Masters/PhD]

Major: [Economics/Other Business/Psychology/Sciences/Other]

How many Economics classes have you taken at the university level?

[None/One/Two/Three/Four/Five/Six/More than Six]

What major political party do you identify with? [Liberal-National/Labor/Australian Green/Neither]

How often do you attend religious services? [Never/Seldom/Often/Always]

### **Attitudinal questions**

Each question was answered on a 10-point Likert scale from not true to very true.

You should always obey laws, even if you are unlikely to get caught.

You should never try to get even.

You should always declare everything at customs.

You should never drive faster than the speed limit.

You should never take things that don't belong to you.

You should never copy material and turn it in as your own work.

You should never do less than your share of work in a group project.

If you receive too much change from a salesperson, you should tell him or her.

You should never take sick leave from school unless you are actually sick.  
If you damage a library book or a store's merchandise, you should report it.  
When you hear people talking privately, you should avoid listening.  
You should never drop litter on the street.  
You should never cheat on an exam.  
You should never help anyone cheat on an exam.  
You should never lie.

## Appendix C: Screenshots

Die-roll contribution screen (all treatments):

Period: 1  
Your ID: 1  
Your Group: 1

Please roll your die and record your roll to determine how 2 of your tokens will be distributed between your individual and group accounts.

1 or 2  
 3 or 4  
 5 or 6

Top-up contribution screen (all treatments):

Period: 1  
Your ID: 1  
Your Group: 1

For your remaining 2 tokens, please indicate how you wish to allocate them between the group account and your individual account.

Group Account   
Individual Account

Leader message choice screen (R treatment):

Period:26  
Your ID: 1  
Your Group: 1

You have been randomly selected to be the group leader for today's session.

Please choose one of the three message options to send to the other group members:

- No message
- Everyone should record their true roll
- Everyone should record a 1 or 6. If all do this we will all earn the most money

Follower information screen (R/G leader treatments):

Period:26  
Your ID: 3  
Your Group: 1

Summary of Leader's recorded first 25 rolls

Die Roll	Number Recorded
1, 2	6
3, 4	13
5, 6	6

Your group's leader sent the following message:

**Everyone should record their true roll**

Questionnaire screen:

The screenshot shows a questionnaire interface. At the top right, there is a small red text label: "Remaining time: 20". The main title is "Survey One - Part 3" with the instruction "Please complete all questions, Thanks." below it. The questionnaire contains three questions, each with a Likert scale response format. The questions are:

- 11. You should always obey laws, even if you are unlikely to get caught.
- 12. You should never try to get even.
- 13. You should always declare everything at customs.

Each question is followed by a response scale with "Not true" on the left and "very true" on the right, and a central area with a horizontal line of 10 empty circles for selecting a response. At the bottom of the questionnaire area, there is a "Submit" button.

## Appendix D: Subject characteristics by treatment

Characteristic	Treatment			Test statistic
	N	R	G	p-value
Age	23.8 (0.5)	22.4 (0.6)	21.1 (0.3)	0.0003 <sup>a</sup>
Male	0.56	0.59	0.67	0.47 <sup>b</sup>
Employed	0.24	0.31	0.39	0.21 <sup>b</sup>
Economics major	0.06	0.07	0.07	0.97 <sup>b</sup>
Economics classes	1.3 (0.3)	1.6 (0.3)	1.3 (0.3)	0.67 <sup>a</sup>
<i>Attend religious services</i>				
Never	27	16	23	
Seldom	25	23	21	0.21 <sup>a</sup>
Often	5	9	5	
Always	6	6	5	
Pro-social (average response from attitudinal questions)	8.0 (0.2)	8.0 (0.2)	7.9 (0.2)	0.53 <sup>a</sup>
<i>Political party</i>				
Liberal/National (right)	9	9	10	
Labor (left-centre)	6	8	6	0.85 <sup>a</sup>
Greens (left)	6	2	4	
None of these	42	35	34	
No. of observations	63	54	54	

a: Kruskal-Wallis test, b: chi-square contingency table test

Table D1: Subject characteristics by treatment (standard deviations in parentheses)

## Appendix E: Additional analysis

### E1 Dynamic analysis

Even though subjects were not given end-of-round feedback, it is still possible that their behaviour changed over time within each half of the experiment. Such changes could be due to continued introspection, or to reciprocal behaviour (e.g., “conditional cooperation”) combined with beliefs that other subjects’ contributions changed over time.

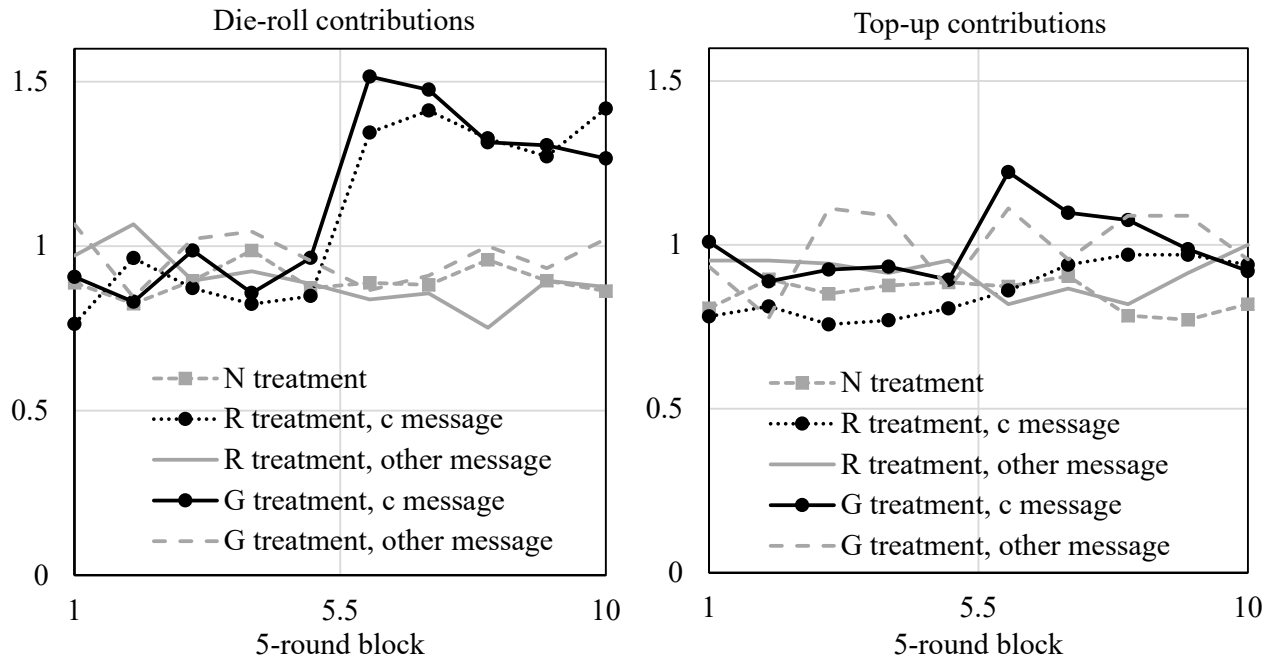


Figure E1: Die-roll and top-up contributions by 5-round block, treatment and leader’s message

Figure E1 shows how contributions change over time. To reduce noise, the figure shows averages by 5-round blocks rather than every round. There are no systematic differences during the first half (blocks 1-5). In the sixth block, die-roll contributions rise by about half a token following a cooperate message in the R and G treatments, while remaining roughly the same in the N treatment and following any other message in the R and G treatments. There is some tendency for die-roll contributions to decline over time over blocks 6-10 following a cooperate message, but the difference from the other treatments persists until the end of the session. (Pooling the R and G treatments, die-roll contributions in the last 5-round block are significantly higher after a cooperate message than otherwise: two-tailed robust rank-order test,



group-level data,  $p \approx 0.009$ ). There are no apparent treatment effects in top-up contributions, and as with die-roll contributions, there is little overall time trend within either half of the session. This is in contrast to typical public good experiments, where contributions tend to decline substantially over time, and is very likely due to the lack of between-round feedback in our experiment.

Tables E1 and E2 present results of regressions similar to those in Tables 4 and 5 of the main text, but allowing for changes in behaviour over time. Rather than estimating Tobit models on the sample of subject-level averages as in Tables 4 and 5, here we use the (larger) sample of all individual subject contribution choices, and estimate panel Tobits. In addition to the variables in Tables 4 and 5, we include the round number, dummies for rounds 26 and 50 (the first and last rounds of the second half, to capture restart and endgame effects), the interactions of these three variables with our treatment dummies (and the leader dummy in Table E1 where it is present).

As in the main text, Table E1 presents second-half results for all subjects, while Table E2 focuses on followers in treatments R and G. In Table E1, the results for die-roll contributions are similar to those seen in Table 4. Second-half contributions are significantly higher in the R and G treatments compared to the baseline N treatment, and the differences are driven by the groups in which the leader sent a cooperate message. The effect of the round number is significantly negative, but treatment effects remain significant even in late rounds.<sup>18</sup> As in Table 4, there are no significant treatment effects on top-up contributions, suggesting that the gains in die-roll contributions are truly gains, rather than coming at the expense of top-up contributions.

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<sup>18</sup> In round 49, estimated marginal effects for the R and G dummies in model E1 are +0.217\* and +0.230\*\*, with standard errors of 0.112 and 0.113 respectively, while the corresponding marginals for round 50 (where endgame effects may occur) are +0.384\*\*\* and +0.359\*\*\* with standard errors 0.145 and 0.145. The estimated marginal effects for the “R + c message” and “G + c message” dummies in model E2 are +0.470\*\*\* (standard error 0.110) and +0.243\*\* (0.111) in round 49 and +0.580\*\*\* (0.140) and +0.338\*\* (0.150).

	(1)	(2)	(3)	(4)
Dependent variable (Tobit):	Die-roll contribution		Top-up contribution	
R treatment	0.194*		-0.041	
	(0.100)		(0.103)	
R treatment + c message		0.440***		0.023
		(0.096)		(0.119)
R treatment + other message		-0.229*		-0.137
		(0.128)		(0.129)
G treatment	0.328***		0.030	
	(0.101)		(0.106)	
G treatment + c message		0.384***		-0.007
		(0.095)		(0.109)
G treatment + other message		-0.057		0.198
		(0.169)		(0.204)
Leader	0.218**	0.226**	0.165	0.167
	(0.107)	(0.098)	(0.113)	(0.112)
Round number	-0.003*	-0.003**	-0.005***	-0.005***
	(0.001)	(0.002)	(0.001)	(0.001)
Die-roll contribution (1 <sup>st</sup> -half avg.)	0.053	0.029	0.235*	0.251*
	(0.131)	(0.121)	(0.132)	(0.132)
Top-up contribution (1st-half avg.)	0.513***	0.522***	1.019***	1.021***
	(0.065)	(0.059)	(0.068)	(0.068)
Demographics?	Yes	Yes	Yes	Yes
Round-26 and round-50 dummies, interactions with treatments?	Yes	Yes	Yes	Yes
Observations	4275	4275	4275	4275
ln(L)	4198.08	4174.80	4266.50	4361.66

Table E1: Factors affecting contributions (all subjects) – average marginal effects and standard errors (clustered by group)

In Table E2, the results for die-roll contributions are mostly similar to those seen in Table 5. Followers' second-half contributions are significantly higher in the R and G treatments when a cooperate message was sent by the leader, and the effect is still significant in late rounds (marginal effects of 0.505\*\*\* and 0.377\* in rounds 49 and 50 respectively, with standard errors of 0.162 and 0.211). The effect of the round number is negative as in Table E1, but typically insignificant. The results for top-up contributions are the only place where allowing for time dependence affects the results; unlike in model 8 of Table 5, in model E8 the marginal effect of a cooperate message is insignificant (though still positive), suggesting that the significant positive effect seen in Table 5 is largely transitory. However, once again it is important to emphasise that even if this effect is not significant, it is certainly not negative, implying that the gains in die-roll contributions from cooperate messages are not crowding out top-up contributions.

	(E5)	(E6)	(E7)	(E8)
Dependent variable (Tobit):	Die-roll contrib. (2 <sup>nd</sup> -half avg.)	Top-up contrib. (2 <sup>nd</sup> -half avg.)		
Group-oriented leader	0.058 (0.147)	-0.110 (0.138)	0.107 (0.115)	0.169 (0.142)
c message		0.610*** (0.153)		0.226 (0.165)
Leader die-roll contribution (1 <sup>st</sup> -half avg.)	-0.062 (0.282)	-0.141 (0.334)	0.439* (0.225)	0.534 (0.335)
Round number	-0.003 (0.002)	-0.003 (0.002)	-0.003 (0.002)	-0.004* (0.002)
Die-roll contribution (1 <sup>st</sup> -half avg.)	0.022 (0.206)	-0.266 (0.203)	-0.067 (0.162)	-0.073 (0.206)
Top-up contribution (1 <sup>st</sup> -half avg.)	0.594*** (0.104)	0.523*** (0.101)	0.876*** (0.061)	0.972*** (0.111)
Demographics?	Yes	Yes	Yes	Yes
Observations	1800	1800	1800	1800
ln(L)	1512.75	1499.80	1300.80	1624.05

Table E2: Factors affecting contributions (followers in leader treatments) – average marginal effects and standard errors (clustered by group)

## E2 A note on payoffs

Because the public good in our setting is linear, contributions and money earnings at the group level are closely related. From (1) in the main text, if we define  $X_t$  and  $\Pi_t$  as the group-level total contribution and money earnings in the  $t$ -th round, we have

$$\begin{aligned}\Pi_t &= \sum_{i=1}^3 \pi_{it} = \sum_{i=1}^3 0.08 \left[ (4 - x_{it}) + \frac{1}{3} \sum_{j=1}^3 (2x_{jt}) \right] \\ &= 0.08 \left[ (12 - \sum_{i=1}^3 x_{it}) + \frac{1}{3} \sum_{i=1}^3 \sum_{j=1}^3 (2x_{jt}) \right] \\ &= 0.08 [12 + X_t]\end{aligned}$$

so that group average profit is one-third of this. Hence, both total and average profit per round are affine functions of total per-round contributions at the group level. Also, the same relationship must hold for any superset of individual groups, such as 25-round group-level data, and treatment-level data. Thus, the effects we have seen at the aggregate level for contributions are preserved when we talk about earnings instead, as are significance results.

Treatment	Earnings (\$)	
	Rounds 1-25	Rounds 26-50
No leader	11.81	11.68
Random leader, c message	11.40	13.88
Random leader, h/blank message	12.42	11.78
Group-oriented leader, c message	11.97	14.35
Group-oriented leader, h/blank message	12.41	12.44

Table E3: Per-person total earnings

Table E3 shows 25-round average subject earnings according to whether a cooperate message was sent, disaggregated as usual by treatment and 25-round block. Earnings in the first half of the session are similar across treatments and messages, ranging from the lowest average to the highest by about one dollar. By contrast, earnings in the second half vary more across treatments, with a cooperate message associated with about two dollars' additional earnings compared to other messages – holding the treatment constant – despite first-half earnings actually having been slightly lower in those groups where cooperative messages were sent.