Online Appendix

Exploration in Teams and the Encouragement Effect: Theory and Experimental Evidence

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Online Appendix A

A.1 QRE of the public goods and exploration game

We now derive the quantal response equilibria for the exploration game and public goods game, reasoning by backward induction. For simplicity, we analyse here the case where players are self-interested. This is sufficient to break the non-monotonicity result (see Section 2).

Exploration game: We start by analysing player two's behavior. There are three possible cases to consider: (i) player one did not contribute, (ii) player one contributed but did not find the treasure, (iii) player one contributed and found the treasure.

In case (i) [no contribution by player one, $a_1 = 0$], player two's payoff to not contributing is 0 and to contributing is

$$\frac{\alpha}{K} - c_2.$$

Thus the probability of contributing equals

$$b_2(a_1 = 0) = \frac{exp\left((1/\mu)\left(\frac{\alpha}{K} - c_2\right)\right)}{1 + exp\left((1/\mu)\left(\frac{\alpha}{K} - c_2\right)\right)} \tag{1}$$

and the proportion of choice probabilities between contributing and not contributing equals

$$\frac{b_2(a_1 = 0)}{1 - b_2(a_1 = 0)} = exp\left((1/\mu)\left(\frac{\alpha}{K} - c_2\right)\right) \tag{2}$$

and the log of the odds ratio is thus merely

$$\left((1/\mu)\left(\frac{\alpha}{K} - c_2\right)\right). \tag{3}$$

It is easy to see that the probability of contributing is increasing in α and decreasing in c_2. Moreover, if $\frac{\alpha}{K} - c_2 > 0$ then $b_2(a_1 = 0)$ is decreasing in μ.

In case (ii) [failed exploration by player one], the payoff to not contributing still equals 0 but the payoff to contributing now equals $\frac{\alpha}{K-1} - c_2$ which is higher than $\frac{\alpha}{K} - c_2$.

The implied probability of contributing now equals

$$b_2(a_1 = 1, Y = K-1) = \frac{exp\left((1/\mu)\left(\frac{\alpha}{K-1} - c_2\right)\right)}{1 + exp\left((1/\mu)\left(\frac{\alpha}{K-1} - c_2\right)\right)} \tag{4}$$

which is larger than $b_2(a_1 = 0)$. Moreover

$$\frac{b_2(a_1 = 1, Y = K-1)}{1 - b_2(a_1 = 1, Y = K-1)} = exp\left((1/\mu)\left(\frac{\alpha}{K-1} - c_2\right)\right) \tag{5}$$

and the log of the odds ratio is thus merely

$$log\left(\frac{b_2(a_1 = 1, Y = K-1)}{1 - b_2(a_1 = 1, Y = K-1)}\right) = \left((1/\mu)\left(\frac{\alpha}{K-1} - c_2\right)\right). \tag{6}$$

The difference between expressions (6) and (3) reflect a positive encouragement effect

$$\frac{1}{\mu}\frac{\alpha}{K(K-1)}. \tag{7}$$

This encouragement effect is increasing in the treasure size and decreasing in μ.

In case (iii) [successful exploration by player one i.e. $a_1 = 1$ and $Y = 0$], the payoff to not contributing equals α and the payoff to contributing equals $\alpha - c_2$. Thus the choice probability equals

$$b_2(a_1 = 1, Y = 0) = \frac{exp\left((1/\mu)(\alpha - c_2)\right)}{exp\left((1/\mu)(\alpha)\right) + exp\left((1/\mu)(\alpha - c_2)\right)},$$

and the proportion of choice probabilities between contributing and not contributing equals

$$\frac{b_2(a_1 = 1, Y = 0)}{1 - b_2(a_1 = 1, Y = 0)} = \frac{exp\left((1/\mu)(\alpha - c_2)\right)}{exp\left((1/\mu)(\alpha)\right)},$$

and the odds ratio between those probabilities is thus

$$log\left(\frac{b_2(a_1 = 1, Y = 0)}{1 - b_2(a_1 = 1, Y = 0)}\right) = \left((1/\mu)(\alpha - c_2)\right) - \left((1/\mu)(\alpha)\right) = -(1/\mu)\, c_2,$$

Thus, the model predicts that even when player one did explore and found the treasure, player two contributes with a positive probability. The probability of contributing is predicted to be below 50% and if we let μ tend to zero, the probability of mistakenly contributing tends to zero.

Let us next consider player one's incentives to contribute. The payoff to not contributing equals

$$0 + b_2(a_1 = 0)[\alpha/K].$$

The payoff to contributing equals

$$\frac{\alpha}{K} - c_1 + \frac{K-1}{K} b_2(a_1 = 1, Y = K-1)[\alpha/(K-1)] = \frac{\alpha}{K}(1 + b_2(a_1 = 1, Y = K-1)) - c_1$$

Thus, the log of the odds ratio of choice probabilities of the first-player equals

$$log\left(\frac{b_1}{1-b_1}\right) = (1/\mu)\left(\frac{\alpha}{K}(1 + b_2(a_1 = 1, Y = K-1) - b_2(a_1 = 0)) - c_1\right).$$

Since $b_2(a_1 = 1, Y = K-1) - b_2(a_1 = 0) > 0$, there is an additional dynamic incentive to contribute beyond the myopic incentive

$$\frac{\alpha}{K} - c_1 < 0.$$

Moreover, in the present model where we allow for imperfect optimization, player one can have dynamic incentives to explore even when $max\{\frac{c_1 K}{1+\delta}, c_2(K-1)\} < \alpha < Xc_2$ [the condition for the encouragement effect to be realised in the SPE] does not hold.

Differentiating $log\,(b_1/1-b_1)$ with respect to α, yields

$$\begin{aligned} &(1/\mu)\left(\frac{1}{K}(1 + b_2(a_1 = 1, Y = K-1) - b_2(a_1 = 0))\right) \\ &\quad + (\alpha/(\mu K))\,\frac{\partial(b_2(a_1 = 1, Y = K-1) - b_2(a_1 = 0))}{\partial\alpha} \end{aligned}$$

where $\partial(b_2(a_1 = 1, Y = K-1) - b_2(a_1 = 0))/(\partial\alpha)$ has the sign of

$$\begin{aligned} &\frac{1}{\mu(K-1)} exp(\frac{1}{\mu}(\frac{\alpha}{K-1} - c_2))(1 + exp(\frac{1}{\mu}(\frac{\alpha}{K} - c_2))) \\ &\quad - \frac{1}{\mu(K)} exp(\frac{1}{\mu}(\frac{\alpha}{K} - c_2))(1 + exp(\frac{1}{\mu}(\frac{\alpha}{K-1} - c_2))) \end{aligned} \tag{8}$$

When μ approaches infinity, (8) approaches

$$2(\frac{1}{\mu(K-1)} - \frac{1}{\mu(K)}) \tag{9}$$

which is positive. Thus for μ sufficiently high, $log\,(b_1/1-b_1)$ is strictly increasing in α.

Public goods Game: Again, reasoning by backward induction, we first consider player two's contribution decision. There now exist only two possible cases: (i) Player one does not contribute; or (ii) Player one contributes.

In case (i) [no contribution by player one, $a_1 = 0$], player two's probability of contributing equals

$$b_2(a_1 = 0) = \frac{exp\left((1/\mu)\left(\frac{\alpha}{K} - c_2\right)\right)}{1 + exp\left((1/\mu)\left(\frac{\alpha}{K} - c_2\right)\right)}$$

which in log-odds terms corresponds to $1/\mu(\alpha/K - c_2)$. In case (ii) [player one contributes, i.e. $a_1 = 1$], player two's probality of contributing equals

$$b_2(a_1 = 1) = \frac{exp\left((1/\mu)\left(2\alpha/K - c_2\right)\right)}{exp\left((1/\mu)\left(\alpha/K\right)\right) + exp\left((1/\mu)\left(2\alpha/K - c_2\right)\right)},$$

or in log-odds terms $1/\mu(\alpha/K - c_2)$.

There is thus no encouragement effect in the public goods game now that we abstract from other-regarding preferences in this appendix.

Let us summarize the findings.

QRE-Predictions. Second player.

Proposition A.1

- *For a given first player action and outcome, the second player probability of contributing increases in treasure size.*
- *The second player probability of contributing is identical in the public goods game and in the exploration game if the first player did not contribute. The probability of contributing is lower in the public goods game than in the exploration game when, in the exploration game, there are unexplored alternatives left which contain a treasure with positive probability.*
- *The second player probability of contributing is positive even if there is no treasure left.*

Proposition A.2 *Second-player probability of contributing is higher if the first-player explored an alternative that did not contain a treasure than if the first-player did not explore an alternative (compare to Second-mover bullet point two above). For μ sufficiently high, this encouragement effect is increasing in treasure size.*

QRE-Predictions. First-player.

Proposition A.3 *For μ sufficiently high, the first player probability of contributing increases in treasure size.*

Denote by $b_{1,PGG}$ and $b_{2,PGG}$ the contribution rates (probabilities) of the first-mover and second-mover, respectively in the PGG. Denote by $b_{2,found}$ the second-mover contribution rate conditional on first-mover having found the treasure in the EG (clearly below 1/2 and tends to 0 when $\mu \to 0$). As shown in the theory Section, the behavioral model predicts that the contribution rates of the second-mover are highest in the EG when first-mover contributes but did not find the treasure. Denote this second-mover contribution rate by $b_{2,PGG} + \Delta_{b_2}$. Denote also the first-mover contribution rate in the EG by $b_{1,PGG} + \Delta_{b_1}$. Notice that $b_{1,PGG}$, $b_{2,PGG}$ as well as Δ_{b_1} and Δ_{b_2} are functions of the treasure size and μ. Keep in mind that if the first-mover does not contribute, then the probability that the second-mover contributes coincides in the PGG and EG.

Proposition A.4 *For a given treasure size, the total expected contributions are greater in the EG than in the PGG iff*

$$\frac{1}{4}\left(3(b_{1,PGG} + \Delta_{b_1})(b_{2,PGG} + \Delta_{b_2}) - 4(b_{1,PGG} + b_{2,PGG} - 1)\right) + \frac{3}{4}\left((b_{1,PGG} + \Delta_{b_1})b_{2,found}\right) \geq 0$$

PROOF: Assume that the other-regarding preference parameters are zero. For a given treasure size, the total expected contributions in the EG can now be expressed as

$$\begin{gathered}
0\left((1 - b_{1,PGG} - \Delta_{b_1})(1 - b_{2,PGG})\right) + \left((1 - b_{1,PGG} - \Delta_{b_1})b_2\right) \\
+ \left((b_{1,PGG} + \Delta_{b_1})[\frac{3}{4}(1 - b_{2,PGG} - \Delta_{b_2}) + \frac{1}{4}(1 - b_{2,found})]\right) \\
+2\left((b_{1,PGG} + \Delta_{b_1})[\frac{3}{4}(b_{2,PGG} + \Delta_{b_2}) + \frac{1}{4}b_{2,found}]\right).
\end{gathered}$$

The total contributions in the PGG equal

$$0(1 - b_{1,PGG})(1 - b_{2,PGG}) + (1 - b_{1,PGG})b_{2,PGG} + b_{1,PGG}(1 - b_{2,PGG}) + 2b_{1,PGG}b_{2,PGG},$$

and the difference between these two equals

$$\frac{1}{4}\left(3(b_{1,PGG}+\Delta_{b_1})(b_{2,PGG}+\Delta_{b_2})-4(b_{1,PGG}+b_{2,PGG}-1)\right)+\frac{3}{4}\left((b_{1,PGG}+\Delta_{b_{1,PGG}})b_{2,found}\right)$$

QED

The condition merely reflects the fact that whenever the first mover contributes, the encouragment effect (first-mover does not find and thus second-mover has a higher incentive to contribute) takes place with 3/4 probability whereas choices are independent in the PGG. When $b_{1,PGG}$ and $b_{2,PGG}$ are sufficiently close to one and thus Δ_{b_1} and Δ_{b_2} must tend to zero , $4(b_{1,PGG}+b_{2,PGG}-1)$ is positive and the expression is negative (unless $b_{2,found}$ is substantial). Thus in that case the total contributions must be higher in PGG than in EG. Yet, for $b_{1,PGG}, b_{2,PGG} \leq 1/2$, $4(b_{1,PGG}+b_{2,PGG}-1)$ is negative and thus the contributions are higher in EG than in PGG. It is easy to see for instance that $4(b_{1,PGG}+b_{2,PGG}-1)$ is positive for the highest treasure size when $\mu \to 0$ since then $b_{1,PGG}, b_{2,PGG} \to 1$. Yet, for other treasure sizes either $b_{1,PGG}$ or $b_{2,PGG}$ tends to 0 when $\mu \to 0$ and thus $4(b_{1,PGG}+b_{2,PGG}-1)$ does not tend to exceed zero. Nevertheless $\Delta_{b_2} > 0$ for μ sufficiently high. Thus the encouragement effect plays a role and also Δ_{b_1} is positive (due to strategic complementarities). Also $b_{2,found}$ is positive. Therefore EG has higher total contributions than PGG.

A.2 Purely private good case

It is fairly easy to understand the implications of introducing partly private benefits which accrue to the one who discovers the treasure. The model then becomes more reminiscent to that of **?** (although important differences still exist). Let us assume for the sake of illustration that only the one who finds the treasure receives the reward (i.e., the invention yields a purely private reward). Let us begin by considering the second player. Suppose that the first player has contributed but did not find the treasure. In this case the expected utility of a second player who contributes equals

$$\left(\frac{\alpha}{K-1}-c_2\right)(1-\rho)-c_1\rho \tag{10}$$

and the utility of a second mover who does not contribute equals $-c_1\rho$, and thus the log-odds of the choice probabilities between these two choices equal

$$(1/\mu)\left(\frac{\alpha}{K-1} - c_2\right)(1-\rho). \tag{11}$$

Comparing this expression to (10) in the paper shows that the other-regarding second player who puts a positive weight ρ on the first-mover's payoff has less of an incentive to contribute when the reward is purely private than when the reward is in the public domain. Formally,

$$b_{2,private}(a_1 = 1, Y = K-1) - b_{2,public}(a_1 = 1, Y = K-1) \tag{12}$$

$$= \frac{1}{1 + exp[-\left(\frac{\alpha}{K-1} - c_2\right)(1-\rho)]} - \frac{1}{1 + exp[-\frac{\alpha}{K-1} + c_2(1-\rho)]} \tag{13}$$

for all treasure sizes. The term within square brackets of the probability expression $b_{2,private}(a_1 = 1, Y = K-1)$ differs from the corresponding expression in $b_{2,public}(a_1 = 1, Y = K-1)$ by a factor

$$-\left(\frac{\alpha}{K-1}\right)\rho \tag{14}$$

and thus $b_{2,private}(a_1 = 1, Y = K-1) - b_{2,public}(a_1 = 1, Y = K-1)$ is negative. In sum, in the case where $a_1 = 1$ but the treasure was not found, the private nature of the reward ceteris paribus dampens the second player's incentive to explore. The incentives of a self-regarding second player ($\rho = 0$) are unaffected.

Consider next the second player's exploration decision when the first player has not contributed. The expected utility for contributing in this case equals $\left(\frac{\alpha}{K} - c_2\right)(1-\sigma)$ which is also the same as the log-odds between contributing and not contributing for the second mover since the expected utility of not contributing equals zero. Thus,

$$b_{2,private}(a_1 = 0, Y = K) - b_{2,public}(a_1 = 0, Y = K) \tag{15}$$

$$= \frac{1}{1 + exp\{-\left(\frac{\alpha}{K} - c_2\right)(1-\sigma)\}} - \frac{1}{1 + exp\{-\frac{\alpha}{K} + c_2(1-\sigma)\}} \tag{16}$$

The term within square brackets of the probability expression $b_{2,private}(a_1 = 0, Y = K))$

differs from the expression $b_{2,public}(a_1 = 0, Y = K)$ by a factor

$$-\frac{\alpha}{K}\sigma \tag{17}$$

and thus $b_{2,private}(a_1 = 0, Y = K) - b_{2,public}(a_1 = 0, Y = K)$ is negative if $\sigma > 0$ and positive if $\sigma < 0$. The other-regarding second player who puts a positive weight σ on the first-mover's payoff has less of an incentive to contribute when the reward is purely private than when the reward is in the public domain. Conversely, the other-regarding second player who is inequity averse, is now more likely to explore. Notice also that if $\sigma > 0$, then $b_{2,private}(a_1 = 1, Y = K-1) - b_{2,public}(a_1 = 1, Y = K-1)$ is smaller than $b_{2,private}(a_1 = 0, Y = K) - b_{2,public}(a_1 = 0, Y = K)$ since $\sigma \leq \rho$ and $\frac{1}{K} < \frac{1}{K-1}$. In other words, the difference between second mover's exploration in the private good versus public good case is smaller when first mover explored (but did not find the treasure) than when first mover did not explore. Nevertheless, if $\sigma < 0$, then in fact $b_{2,private}(a_1 = 0, Y = K) - b_{2,public}(a_1 = 0, Y = K)$ is smaller in size than $b_{2,private}(a_1 = 1, Y = K-1) - b_{2,public}(a_1 = 1, Y = K-1)$ since now $\sigma < 0 < \rho$.

In sum, in the case where $a_1 = 0$, the private nature of the reward dampens incentives to explore when the second player has social welfare concerns, but amplifies incentives to explore when the agent is inequity averse.

What happens to first mover exploration with purely private goods? The log-odds between contributing and not for the first-mover in the private goods case equal

$$(\frac{\alpha}{K} - c_1)(1-\rho) + \frac{K-1}{K} b_{2,private}(a_1 = 1, Y = K-1)\sigma(\frac{\alpha}{K-1} - c_2)$$

$$-\sigma b_{2,private}(a_1 = 0, Y = K)(\frac{\alpha}{K} - c_2)$$

whereas in the public goods case they equal

$$\rho(\frac{\alpha}{K}) + (\frac{\alpha}{K} - c_1)(1-\rho) + \frac{K-1}{K} b_{2,public}(a_1 = 1, Y = K-1)[(1-\sigma)\frac{\alpha}{K-1} + \sigma(\frac{\alpha}{K-1} - c_2)]$$

$$-b_{2,public}(a_1 = 0)((1-\sigma)\frac{\alpha}{K} + \sigma(\frac{\alpha}{K} - c_2)).$$

Subtracting the latter from the former yields an expression that reflects the difference in the first player contribution probability when the rewards is a pure private good versus a pure public good:

$$-\rho(\frac{\alpha}{K}) - \frac{K-1}{K} b_{2,public}(a_1 = 1, Y = K-1)(1-\sigma)\frac{\alpha}{K-1} + b_{2,public}(a_1 = 0, Y = K)(1-\sigma)\frac{\alpha}{K}$$

$$+\sigma\{\frac{K-1}{K}[b_{2,private}(a_1 = 1, Y = K-1) - b_{2,public}(a_1 = 1, Y = K-1)](\frac{\alpha}{K-1} - c_2)$$

$$-[b_{2,private}(a_1 = 0) - b_{2,public}(a_1 = 0)](\frac{\alpha}{K} - \sigma c_2)\}$$

where the first row reflects the effect of privatization on first player's incentives to explore that runs through the other-regarding channel and the second term in curly brackets captures the effect that runs through the informational channel. The first term is negative since $b_{2,public}(a_1 = 1, Y = K-1) > b_{2,public}(a_1 = 0)$.

What about the second term? If $\sigma > 0$, and $\frac{\alpha}{K} - c_2 > 0$ then the second term is negative since $b_{2,private}(a_1 = 1, Y = K-1) - b_{2,public}(a_1 = 1, Y = K-1) < b_{2,private}(a_1 = 0) - b_{2,public}(a_1 = 0) < 0$ and $c_2(K-1)/K < c_2$. If $\sigma > 0$ and $(\frac{\alpha}{K} - c_2) < 0 < (\frac{\alpha}{K-1} - c_2)$ (this holds in the experiment if and only if α equals the second-lowest treasure size), then the second term is negative. To the contrary if $\sigma < 0$ and $\frac{\alpha}{K} - c_2 > 0$, then both terms inside the curly brackets are negative and since they are multiplied by a negative σ, the second term is positive. If $0 > (\frac{\alpha}{K-1} - c_2) > (\frac{\alpha}{K} - c_2)$ (no private incentive to contribute under no circumstances) and $-\sigma > \left(\frac{K}{K-1}\right)\rho$ then the latter term is positive and greater in absolute value than the former term; again since multiplied by a negative parameter σ the second term is negative in total. If $0 > (\frac{\alpha}{K-1} - c_2) > (\frac{\alpha}{K} - c_2)$ and $-\sigma < \left(\frac{K}{K-1}\right)\rho$ then the sign of the second row depends on the relative magnitudes of the various factors in the two terms of the sum.

So what can we say about the effect of privatization in total? The effects of privatization that run through the information and the other-regarding channel are both negative when $\sigma \geq 0$ and $0 < (\frac{\alpha}{K-1} - c_2)$. In particular, for self-interested players, the effect of privatization on contributions is always negative since then the informational channel is all that matters and it is always negative.

The encouragement effects (both the informational and the other-regarding encouragement effects) are undermined since the first mover now gets less of both pecuniary and other-regarding benefits from second-mover finding the treasure. The incentive to contribute is now lower for the first mover since there is reason to encourage the second-mover only to the extent that the first mover is altruistic towards the second mover. In fact if $\sigma < 0$, the first mover has no incentive to encourage the other since she can only lose from the second-mover finding the treasure.

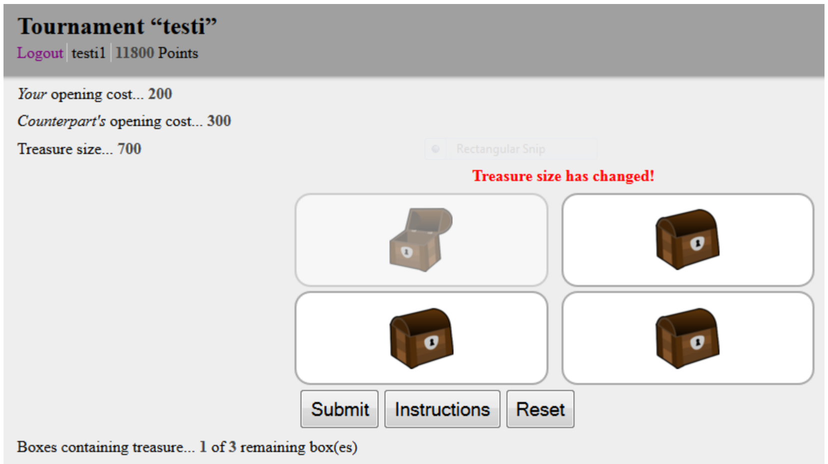
Online Appendix B

Table B.1: OLS: Differences in exploration. Tournament incentive removed.

	(1) Open	(2) Open	(3) Open
Game Type	0.255^{***}	0.255^{***}	0.071
	(0.064)	(0.064)	(0.060)
First Player		-0.061	-0.239^{**}
		(0.064)	(0.087)
Game Type X First Player			0.369^{**}
			(0.117)
Constant	0.394^{***}	0.425^{***}	0.513^{***}
	(0.049)	(0.049)	(0.047)
Observations	1728	1728	1728

Robust standard errors clustered on session and individual

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$



Tournament "testi"

Logout testi1 11800 Points

Your opening cost... 200

Counterpart's opening cost... 300

Treasure size... 700

Treasure size has changed!

Boxes containing treasure... 1 of 3 remaining box(es)

Figure B.1: Second player decision screen.

Table B.2: Differences between game types. Randomization check.

	(1) Female	(2) Risk question	(3) Cognitive reflection task	(4) Social Value Orientation
Exploration game	0.002	-0.154	-0.008	1.431
	(0.049)	(0.212)	(0.048)	(1.304)
Constant	0.550***	5.881***	0.605***	26.654***
	(0.036)	(0.158)	(0.036)	(0.972)
Adjusted R^2	-0.002	-0.001	-0.002	0.000
Observations	428	416	416	416

OLS regressions.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.3: MHT correction for the comparisons between player types and game types applying List et al (2016)

Treatment1	**Treatment2**	**Difference**	**Remark31**	**Thm31**	**Remark37**	**Bonf.**	**Holm**
PGG player 1	EG player 1	.3330	.0003	.0003	.0003	.0020	.0020
PGG player 1	PGG player 2	.1289	.0003	.0003	.0003	.0020	.0010
PGG player 1	EG player 2	.2841	.0003	.0003	.0003	.0020	.0007
EG player 1	PGG player 2	.2041	.0003	.0003	.0003	.0020	.0007
EG player 1	EG player 2	.0490	.1073	.1073	.1073	.644	.1073
PGG player 1	EG player 2	.1551	.0003	.0003	.0003	.0020	.0013

*Using mean contributions as the outcome. We collapsed the 32 contribution decisions to 1 average per participant.

Table B.4: Logit: Differences in contributions across player types.

	(1) Public goods game	(2) Exploration game
First mover	-0.135	-0.780***
	(0.132)	(0.192)
Exploration game	1.319***	0.749***
	(0.135)	(0.136)
First mover X Exploration game		1.156***
		(0.262)
Constant	-0.549***	-0.233**
	(0.098)	(0.088)
Observations	13760	13760

Robust standard errors clustered on individual

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.5: Pooled OLS: Differences in contributions across player types

	(1) meanopen	(2) meanopen
First-player	-0.030	-0.129***
	(0.021)	(0.024)
Exploration game	0.244***	0.155***
	(0.027)	(0.025)
First-player X Exploration game		0.178***
		(0.033)
Constant	0.402***	0.452***
	(0.019)	(0.018)
Adjusted R^2	0.219	0.247
Observations	430	430

Collapsed into one contribution decision per participant. Robust standard errors clustered on session

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.6: First players. Pairwise OLS comparison of sizes of treasure and game types

	(1) Lowest/2nd lowest	(2) 2nd lowest/2nd highest	(3) 2nd highest/highest
Treasure size	0.048^{*}	0.142^{***}	0.412^{***}
	(0.023)	(0.035)	(0.044)
Exploration game	0.315^{***}	0.466^{***}	0.435^{***}
	(0.040)	(0.045)	(0.050)
Treasure size x Type of game	0.149^{***}	-0.031	-0.336^{***}
	(0.037)	(0.044)	(0.050)
Constant	0.114^{***}	0.161^{***}	0.303^{***}
	(0.024)	(0.030)	(0.041)
Adjusted R^2			
Observations	3408	3400	3472

OLS has robust standard errors clustered on individual.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.7: Second players. Pairwise OLS comparison of sizes of treasure and game types

	(1) Lowest/2nd lowest	(2) 2nd lowest/2nd highest	(3) 2nd highest/highest
Treasure size	0.001	0.633^{***}	0.114^{***}
	(0.020)	(0.039)	(0.028)
Exploration game	0.334^{***}	0.479^{***}	-0.050
	(0.037)	(0.034)	(0.042)
Treasure size x Type of game	0.137^{***}	-0.530^{***}	-0.097^{**}
	(0.030)	(0.046)	(0.035)
Constant	0.110^{***}	0.103^{***}	0.736^{***}
	(0.020)	(0.022)	(0.036)
Adjusted R^2			
Observations	3408	3400	3472

OLS has robust standard errors clustered on individual.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.8: Second players. Pairwise pooled OLS comparison of sizes of treasure and game types

	(1) Lowest/2nd lowest	(2) 2nd lowest/2nd highest	(3) 2nd highest/highest
Treasure size	0.004	0.623***	0.114***
	(0.017)	(0.034)	(0.024)
Exploration game	0.338***	0.470***	-0.050
	(0.038)	(0.033)	(0.039)
Treasure size x Type of game	0.131***	-0.520***	-0.096**
	(0.032)	(0.046)	(0.030)
Constant	0.109***	0.112***	0.736***
	(0.018)	(0.020)	(0.033)
Adjusted R^2	0.193	0.216	0.019
Observations	3408	3400	3472

OLS has robust standard errors clustered on individual.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.9: Second players. Encouragement effect CG and UG.

	(1) Lowest	(2) 2nd lowest	(3) 2nd highest	(4) Highest
First player behavior	0.071*	0.241***	0.131***	-0.018
	(0.035)	(0.038)	(0.038)	(0.032)
Exploration game	0.290***	0.341***	-0.082*	-0.185***
	(0.027)	(0.030)	(0.040)	(0.039)
Encouragement (interaction)	0.232***	0.241***	0.184***	0.256***
	(0.049)	(0.049)	(0.048)	(0.045)
Risk question	-0.008	-0.001	-0.011	-0.008
	(0.006)	(0.005)	(0.006)	(0.005)
Cognitive reflection task	0.036	0.021	0.005	-0.003
	(0.024)	(0.021)	(0.025)	(0.021)
Social Value Orientation	0.001	0.001	-0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.092	0.030	0.777***	0.912***
	(0.051)	(0.042)	(0.053)	(0.042)
Adjusted R^2				
Observations	3093	2909	2911	2937

OLS has robust standard errors clustered on individual.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.10: First players: Pairwise comparison of size of treasure and game types.

	(1) Lowest/2nd lowest	(2) 2nd lowest/2nd highest	(3) 2nd highest/highest
Exploration game	0.308***	0.465***	0.434***
	(7.91)	(10.32)	(8.80)
Treasure size	0.104***	0.144***	0.461***
	(3.56)	(3.99)	(8.56)
Treasure size x Type of game	0.155***	-0.0332	-0.339***
	(4.16)	(-0.75)	(-6.80)
Observations	3408	3400	3472
Adjusted R^2			

OLS has robust standard errors clustered on individual.

32 dummies for round of the game are surpressed in the Table.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.11: Only within assignment: Pairwise comparison of size of treasure.

	(1) Lowest/2nd lowest	(2) 2nd lowest/2nd highest	(3) 2nd highest/highest
Exploration game	0.242***	0.408***	0.398***
	(0.062)	(0.067)	(0.058)
Treasure size	0.039	0.156***	0.405***
	(0.025)	(0.038)	(0.048)
Treasure size x Type of game	0.169***	-0.037	-0.334***
	(0.043)	(0.051)	(0.056)
Constant	0.142***	0.183***	0.324***
	(0.037)	(0.042)	(0.047)
Adjusted R^2			
Observations	2656	2656	2656

OLS has robust standard errors clustered on individual.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.12: Controlling for order: Pairwise comparison of size of treasure.

	(1) Lowest/2nd lowest	(2) 2nd lowest/2nd highest	(3) 2nd highest/highest
Exploration game	0.285***	0.433***	0.422***
	(0.050)	(0.057)	(0.050)
Treasure size	0.048*	0.143***	0.413***
	(0.023)	(0.035)	(0.044)
Treasure size x Type of game	0.148***	-0.032	-0.337***
	(0.037)	(0.044)	(0.050)
ascendingorder	0.124***	0.125**	0.104*
	(0.034)	(0.042)	(0.040)
Constant	0.052	0.098*	0.242***
	(0.034)	(0.043)	(0.043)
Adjusted R^2			
Observations	3392	3384	3456

OLS has robust standard errors clustered on individual.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table B.13: 4 last rounds: Pairwise comparison of size of treasure.

	(1) Lowest/2nd lowest	(2) 2nd lowest/2nd highest	(3) 2nd highest/highest
Exploration game	0.315***	0.449***	0.449***
	(0.048)	(0.049)	(0.052)
Treasure size	0.055*	0.136***	0.452***
	(0.026)	(0.039)	(0.048)
Treasure size x Type of game	0.123**	-0.006	-0.387***
	(0.044)	(0.051)	(0.055)
Constant	0.099***	0.145***	0.277***
	(0.027)	(0.032)	(0.042)
Adjusted R^2			
Observations	1696	1692	1728

OLS has robust standard errors clustered on individual.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Online Appendix C

What can be inferred about ρ and σ when looking at the choices in the six sliders tasks (see Figure C.1)? In Figure C.2, decision maker's own monetary compensation is measured along the horizontal axis, and the other's monetary compensation is measured along the vertical line. Each of the 6 tasks is presented as a line segment in Figure C.2. The marginal rate of substitution captures the individual rate at which the decision maker is indifferent between giving up a marginal amount against higher income for the other. Below the 45-degree line through the origin the decision maker's own payoff is higher than that of the other. Therefore the marginal rate of substitution between own earnings m against those of the other y equals

$$MRS(m, y) = -\frac{(1-\rho)}{\rho},$$

and above the 45-degree line where $y > m$,

$$MRS(m, y) = -\frac{(1-\sigma)}{\sigma}.$$

Thus when estimating σ from the SVO choice data, we should focus on tasks 3, 4, and 5 where at least a fraction of the corresponding line segment lies above the 45-degree line in Figure C.2. If a decision maker chooses an allocation strictly above the 45 degree

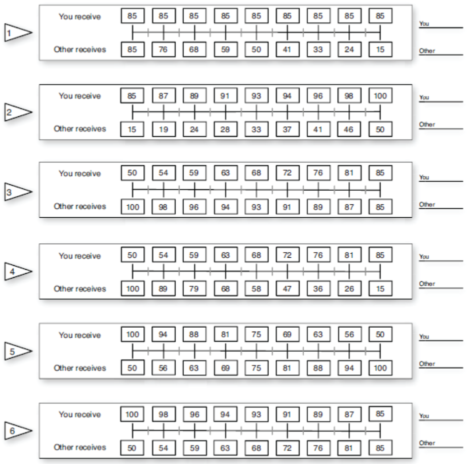


Figure C.1: SVO slider task.

line all these tasks, then the estimate satisfies $MRS \geq -3/7,$.i.e. $\sigma < 7/10$. If the decision maker chooses an allocation at the 45-degree line for slider task 3, but above the 45-degree line in tasks 4 and 5, then $\sigma \geq 1/2$. Otherwise $\sigma < 1/2$.

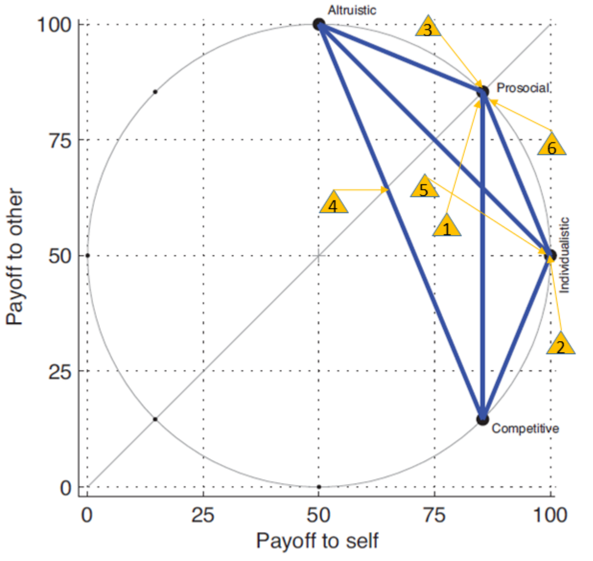
By a similar argument, all slider tasks apart from task 3 contribute to the estimation of ρ. If choices associated with sliders 4 and 5 at extreme south-east , then $\rho < 3/10$, otherwise $\rho \geq 3/10$. In this latter case, if moreover slider 5 lies at extreme south-east, then $1/2 > \rho \geq 3/10$. Otherwise $\rho \geq 1/2$. If slider 1 is in extreme south, then $\rho < 0$. If moreover slider 2 is in extreme south-west, then $\rho \leq -3/10$.

The connection between the exploration task and the slider tasks is as follows.

- The further to the northwest from the 45-degree line are sliders 3, 4, and 5, the more willing is player two to explore when the first-player has not explored, with slider 3 to the extreme northwest indicating willingness to sacrifice and explore even for low treasure sizes and without first-player exploration.

- The further away from extreme south and east are the sliders 4, 5, and 6 below the 45-degree line, the more willing is the player to explore in reaction to first-player exploration. When sliders 1 and 2 are towards the south (and sliders 4, 5, and 6 are to the extreme south-east), a player prefers free-riding on the other's exploration effort.

Let us then consider first-player incentives to explore. The encouragement effect is defined as a positive effect of first-player exploration on second-mover probability of exploration. Keep in mind that the analysis above concludes that for a self-interested



Slider predictions assuming 1/2 > ρ > 3/7 and 3/7 > σ

Figure C.2: SVO slider predictions.

second-mover, there is an encouragement effect in the exploration game but not in the public goods game. The encouragement effect appears in the public goods game if the second-player is other-regarding, $1 > \rho \geq \sigma > 0$. Moreover, the behavioral other-regarding motivation always strengthens the incentives to explore. Thus from the first-player perspective, the other-regarding motivation magnifies the strategic incentives to explore.

Let us first assume that both the first-player and the second-player are self-interested and they perfectly implement their optimal strategies and expect each other to do so (self-interest & subgame perfect equilibrium). Then there is never an encouragement effect in the public goods game but there is an encouragement effect in the exploration game if the conditions in Proposition 1 hold, that is when the treasure size is at the second-lowest level of 700 in our experiment.

Suppose then that the first-player and the second-player are self-interested and they imperfectly implement their optimal strategies and rather choose according to the QRE so that the log-odds of the choice probabilities are as displayed in Section X. Then there is again no encouragement effect in the public goods game. Yet an encouragement effect appears in the exploration game for all treasure sizes, not just the second-lowest one.

Suppose then that the first-player is self-interested but the second-player is other-regarding and both implement their optimal strategies according to the QRE (and the first-player knows that the second-player is other-regarding). Then there is an encouragement effect both in the public goods game and in the exploration game for all treasure sizes. Yet, the encouragement effect is stronger in the exploration game.

If the first-player is other-regarding and inequity averse, $\sigma < 0$, then the first-player's intrinsic motivation generates a force that counteracts this indirect effect driven by the stronger encouragement effect. An inequity averse first-player knows that she has a higher cost of exploring than the second-player and the only way to reach equal payoffs or a position with advantageous inequality is by refraining from exploration. Yet, if the first-player's σ parameter is positive, then the first-player is efficiency concerned and more willing to contribute than a self-interested first-player for all the treasure sizes (if there is a sufficient encouragement effect).

C.1 Estimating sigma and rho

To retrieve a crude estimate for σ we use slider task 3, 4, and 5. We first estimate a separate sigma for each slider task relevant ofr σ. Here the choice is coded as a share of other regarding behavior. Then we estimate an average of the estimated sigmas. For example, in task 3 there are 3 possible options lying strictly above the 45 degree line. If the individual chose the distribution in which the other gets the highest possible amount it is coded as 1, if the individual choses the second to highest amount for the other it is coded as 2/3 and if the individual chose the third to highest amount to the other we code it as 1/3. The rest of the options lying oin the 45 degree line or below are coded as 0. All options where the individual's outcome is large than the other's is relevant for rho, i.e., below the 45 degree line. We used the equivalent procedure to find an estimate for ρ as we did for estimating σ . Here, we use slider task 4, 5 and 6 to calculate the separate ρ.

Online Appendix D

Welcome!

Participant

Tournament

Thank you for participating in this economic decision making tournament!

Throughout the study your choices are anonymous to other participants and all your answers will be treated confidentially.

Please read the following instructions carefully. Depending on how you and your partners decide, you can earn money in cash. Therefore, it is important that you read and follow the instructions. Should you have any questions after having read them, please raise your hand and we will come to you to answer your question. In this tournament, you are invited to make a series of decisions in a series of interactions. Each interaction has two specific roles. You will be assinged a single role which will be held constant throughout the experiment.

Throughout this study you will collect points. At the beginning of the series of interactions every participant receives an endowment. Points will be added or subtracted based on the outcome of each interaction. When you have conducted the last interaction and the tournament has come to an end two winners with highest number of points are announced, one for each role of the two-party interaction. Every participant receives 2€ in cash for participation and each winner receives an additional winning prize of 12€.

Tournament [tournament id]

Logout
[participant id]

Each interaction consists of two stages, where two sequential decisions are made. You are assigned to make the second decision and your counterpart the first decision. You will participate in a number of interactions throughout the study. For each new two-stage interaction you will be randomly paired with a new anonymous participant. The random draw may match you with the same counterpart more than once, but you and your couterpart will always be anonymous to each other.

Stage 1

You and your counterpart are both presented with the same 4 boxes. Your counterpart must make the first decision and must decide whether or not to open one or more boxes. Your counterpart can open *0* up a maximum of *1* box(es).

1 of the 4 boxes (25%) contain(s) a treasure. For each treasure found by your counterpart, both you and your counterpart receive *P* points. This treasure size can vary across interactions, but notice that both are equally rewarded regardless of whether you or your counterpart finds a treasure.

Your counterpart's private cost of opening a box is *300* points per box. (There's no cost incurred by you when a box is opened by your counterpart.)

Stage 2

When a decision has been made by your counterpart, you will learn which boxes, if any, were opened, and how many treasures were found. You must decide whether or not to open *0* or more box(es). You can open up a maximum of *1* box(es).

1 of the 4 boxes (25%) contain(s) a treasure. For each treasure found by you, both you and your counterpart receive *P* points. Recall that this treasure size can vary across interactions, but notice that both are equally rewarded whether you or your counterpart finds a treasure.

Your cost of opening a box is *200* points per box. (There's no cost incurred by your counterpart when a box is opened by you.)

When the interaction—that is, the two consecutive stages—is over, you will be given feedback about the outcome of the interaction and thereafter matched with a new randomly drawn anonymous counterpart and a new interaction starts with updated points and possibly with a new treasure size.

Tournament

At the start of each new interaction, you will be randomly paired with a new anonymous counterpart and a new interaction starts with updated points. Please note that the treasure size can vary across interactions, but not across participants. The private costs of opening a box varies across participants but not across interactions.

When you have conducted the last interaction and the study has come to an end, two winners are announced: one winner is the first-mover (the participant making the first decision in each interaction) with the highest number of points, the other winner is the second-mover (the participant making the second decision in each interaction) with the highest number of points. Every participant receives *2€* in cash for participation and each winner receives an additional winning prize of *12€*.

Examples

Let, for example, the treasure size be *500* points, your box opening cost be *200*, and your counterpart's opening cost be *300*. *E* is the amount of points collected by your counterpart by the beginning of the interaction. *A* is the amount of points collected by you by the beginning of the interaction. Suppose in the first stage, a box with a treasure is opened by your counterpart. In the second stage, no box is opened by you. In the end of the game:

- your counterpart will have *E-300+500* points
- you will have *A+500* points

Take another example. Suppose no box is opened by your counterpart in the first stage. A box with a treasure is opened by you in the second stage. The final points earned in this interaction will be as follows:

- your counterpart will have *E+500* points
- you will have *A-200+500* points

☐ I have understood the instructions.
(By disagreeing, you will be logged out.)

Tournament [tournament id]

Logout
[participant id]

Before entering the very first interaction we ask you to answer the following questions

Questions

1.Tick which of the following claims is correct:

- ☐ the participants with highest and second highest number of points will win a prize
- ☐ all first- and second-movers compete for the same unique tournament prize
- ☐ the second-mover with the highest number of points wins a prize

2. Tick which of the following claims is correct:

- ☐ you will be a first-mover throughout the tournament
- ☐ you will interact with the same anonymous participant throughout the tournament
- ☐ a new second-mover participant will be randomly assigned to you for each new two-stage interaction

Suppose *10400* points have been collected by you by the beginning of the interaction. Your cost of opening a box is *300* points. Your counterpart's cost of opening a box is *200* points. The treasure size is *500* points.

If a box is opened by you in the first stage of the interaction and a treasure is found, while no box is opened by your counterpart in the second stage:

- 2. is your number of points at the end of the interaction.
- 3. is the net amount of points collected by your counterpart in the described interaction.

If no box is opened by you in the first stage and a box with a treasure is opened by your counterpart in the second stage:

- 4. is your number of points at the end of the interaction.
- 5. Your counterpart will ○ gain or ○ lose points in the described interaction.
- 6. is by how many points your counterpart's tally of points will change in the described interaction.

(If you choose to view instructions, you'll lose any answers!)

Online Appendix E

Welcome!

Participant

Tournament

Thank you for participating in this economic decision making tournament!

Throughout the study your choices are anonymous to other participants and all your answers will be treated confidentially.

Please read the following instructions carefully. Depending on how you and your partners decide, you can earn money in cash. Therefore, it is important that you read and follow the instructions. Should you have any questions after having read them, please raise your hand and we will come to you to answer your question. In this tournament, you are invited to make a series of decisions in a series of interactions. Each interaction has two specific roles. You will be assinged a single role which will be held constant throughout the experiment.

Privacy

Tournament [tournament id]

Logout
[participant id]

Each interaction consists of two stages, where two sequential decisions are made. You are assigned to make the second decision and your counterpart the first decision. You will participate in a number of interactions throughout the study. For each new two-stage interaction you will be randomly paired with a new anonymous participant. The random draw may match you with the same counterpart more than once, but you and your couterpart will always be anonymous to each other.

Stage 1

You and your counterpart are both presented with the same 4 boxes. Your counterpart must make the first decision and must decide whether or not to open one or more boxes. Your counterpart can open *0* up a maximum of *1* box(es).

1 of the 4 boxes (25%) contain(s) a treasure. For each treasure found by your counterpart, both you and your counterpart receive *P* points. This treasure size can vary across interactions, but notice that both are equally rewarded regardless of whether you or your counterpart finds a treasure.

Your counterpart's private cost of opening a box is *300* points per box. (There's no cost incurred by you when a box is opened by your counterpart.)

Stage 2

When a decision has been made by your counterpart, you will learn which boxes, if any, were opened, and how many treasures were found. You must decide whether or not to open *0* or more box(es). You can open up a maximum of *1* box(es).

1 of the 4 boxes (25%) contain(s) a treasure. For each treasure found by you, both you and your counterpart receive *P* points. Recall that this treasure size can vary across interactions, but notice that both are equally rewarded whether you or your counterpart finds a treasure.

Your cost of opening a box is *200* points per box. (There's no cost incurred by your counterpart when a box is opened by you.)

When the interaction—that is, the two consecutive stages—is over, you will be given feedback about the outcome of the interaction and thereafter matched with a new randomly drawn anonymous counterpart and a new interaction starts with updated points and possibly with a new treasure size.

Tournament

At the start of each new interaction, you will be randomly paired with a new anonymous counterpart and a new interaction starts with updated points. Please note that the treasure size can vary across interactions, but not across participants. The private costs of opening a box varies across participants but not across interactions.

When you have conducted the last interaction and the study has come to an end, the points you have collected will be transformed to Norwegian Crowns (NOK) using an exchange rate announced in the laboratory.

Examples

Let, for example, the treasure size be *500* points, your box opening cost be *200*, and your counterpart's opening cost be *300*. *E* is the amount of points collected by your counterpart by the beginning of the interaction. *A* is the amount of points collected by you by the beginning of the interaction. Suppose in the first stage, a box with a treasure is opened by your counterpart. In the second stage, no box is opened by you. In the end of the game:

- your counterpart will have *E-300+500* points
- you will have *A+500* points

Take another example. Suppose no box is opened by your counterpart in the first stage. A box with a treasure is opened by you in the second stage. The final points earned in this interaction will be as follows:

- your counterpart will have *E+500* points
- you will have *A-200+500* points

☐ I have understood the instructions.
(By disagreeing, you will be logged out.)

Tournament [tournament id]

Logout
[participant id]

Before entering the very first interaction we ask you to answer the following questions

Questions

1. Tick which of the following claims is correct:

- ☐ you will be a first-mover throughout the tournament
- ☐ you will interact with the same anonymous participant throughout the tournament
- ☐ a new second-mover participant will be randomly assigned to you for each new two-stage interaction

Suppose *10400* points have been collected by you by the beginning of the interaction. Your cost of opening a box is *300* points. Your counterpart's cost of opening a box is *200* points. The treasure size is *500* points.

If a box is opened by you in the first stage of the interaction and a treasure is found, while no box is opened by your counterpart in the second stage:

- 2. is your number of points at the end of the interaction.
- 3. is the net amount of points collected by your counterpart in the described interaction.

If no box is opened by you in the first stage and a box with a treasure is opened by your counterpart in the second stage:

- 4. is your number of points at the end of the interaction.
- 5. Your counterpart will ○ gain or ○ lose points in the described interaction.

- 6. is by how many points your counterpart's tally of points will change in the described interaction.

(If you choose to view instructions, you'll lose any answers!)