Who Cooperates? Reciprocity and the Causal Effect of Expected Cooperation in Representative Samples[*]

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Abstract

When do societies succeed in providing public goods? Previous research suggests that public goods contributions correlate with expectations about cooperation by others among students and other demographic subgroups. However, we lack knowledge about whether the effect of expected cooperation is causal and a general feature of populations. We fielded representative surveys (N=8,500) in France, Germany, the United Kingdom, and the United States that included a public goods game and a novel between-subjects experiment. The experiment varied expectations about cooperation by others. We find that higher expected cooperation by others causes a significant increase in individual contributions. When classifying contribution schedules we find that almost 50% of the population employs a conditionally cooperative strategy. These individuals are on average richer, younger and more educated. Our results help explain the varying success of societal groups in overcoming cooperation problems and assist policymakers in the design of institutions meant to solve social dilemmas.

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A Survey Sample

The online survey was carried out by YouGov. YouGov employs a carefully executed opt-in panel together with matched sampling to approximate a random sample of the adult population (Rivers 2011). Matched sampling involves taking a stratified random sample of the target population and then matching available internet respondents to the target sample. Previous work (Ansolabehere and Rivers 2013; Ansolabehere and Schaffner 2014) shows that matched sampling produces accurate population estimates and replicates the correlational structure of random samples using telephones and residential addresses.

The sampling procedure looked as follows. First, a target frame was constructed using official statistics on the distribution of socio-demographic in the national population. Within each strata respondents from YouGovs online panel were chosen by weighted sampling with replacement based on a proximity matching method. The matching method measured how close a member of the panel was to a member of the target sample on a range of variables. Survey respondents were selected based on the proximity of the overall distance as measured by the weighted sum of the individual distance functions on each attribute. The matching variables were:

- France (2,000): Age, gender, education.

- Germany (N=2,000): Age, gender, education.

- United Kingdom (N=2,000): Age, gender, education, region.

- United States (N=2,500): Gender, age, race, education, party identification, ideology, and political interest.

Since matching is approximate, survey weights were computed based on official information about the distribution of socio-demographic characteristics to eliminate remaining imbalances. Table A-1 shows the distributions of socio-demographic variables in the population, the weighted sample, and the raw sample.

B Eliciting and Coding Individuals' Conditional Contribution Schedules

The second part of the survey asked respondents about their conditional contribution schedules. To determine individuals' reciprocity types, immediately after our survey respondents played the payoff-relevant public goods game, we asked them to indicate how their own contribution potentially depends on the other individual's contribution (Rauhut and Winter 2010; Fischbacher, Gächter and Fehr 2001; Selten 1967). The exact question wording was:

"Now suppose you knew how much the other winner of the voucher was going to contribute. Please indicate how much you would like to give if the other winner of the voucher gives the following amount? Remember that any amount that you decide to give to the other winner is doubled."

The respondent then chose a value they would give if they knew the other winner contributed 0, 25, 50, 75, 100 $/£/€.

Using the information respondents provided about their conditional contribution schedules we plotted these schedules for all 8,500 respondents. We then coded each respondent in one of the following categories:

1. Freerider: The respondent always contributes less than 5

2. Positive nonconditional: The respondent gives a constant positive contribution. The contribution does not vary across the different known values of the other winner's contribution (graph is a horizontal line placed above 0). The horizontal line need not be perfectly flat but cannot vary across all values by more than 5

3. Positive reciprocity: Contributions increase monotonically and the total increase is greater than 5

4. Inverse U-shaped reciprocity: The contribution function is concave and the difference between the maximum and the minimum contribution is greater than 5

5. Other: All cases that do not fit the definitions above.

C   Payoff-relevant Contributions and Contributions in the Strategy Method

The survey had two parts. The first part was the payoff-relevant public goods game. The pay-off relevance of the contribution choice was made explicit. The second part used the strategy method, to elicit respondents contribution schedules (Selten 1967). The strategy method asks respondents to indicate how much they would contribute given the contribution of the other player. This provides us with each individual's conditional contribution schedule. The strategy method part of the survey was not explicitly incentivized. However, responses in these two parts of the survey remain very consistent (see below). The exact question wording was:

"Now suppose you knew how much the other winner of the voucher was going to contribute. Please indicate how much you would like to give if the other winner of the voucher gives the following amount? Remember that any amount that you decide to give to the other winner is doubled."

The respondent then chose a value they would give if they knew the other winner contributed 0, 25, 50, 75, 100 $/£/€.

To explore whether the two parts generated differences in the level of conditional cooperation, we use an individuals expectation about the other contribution and his/her strategy (which maps from other to own contribution) to generate the contribution we would expect

him/her to make based on his/her answers in the strategy method part of the survey. Since we have values from 0 to 100 (in steps of 25), we used the following bins to map from beliefs to predicted contributions:

- If the stated expectation in the payoff-relevant public goods game is below 12.5, an individuals predicted contribution is the contribution that she/he said she/he would make if the other gave 0 in the strategy method part

- If the stated expectation in the payoff-relevant public goods game is between 12.5 and 37.5, an individuals predicted contribution is the contribution that she/he said she/he would make if the other gave 25 in the strategy method part

- If stated expectation in the payoff-relevant public goods game is between 37.5 and 62.5, an individuals predicted contribution is the contribution that she/he said she/he would make if the other gave 50 in the strategy method part

- If stated expectation in the payoff-relevant public goods game is between 62.5 and 87.5, an individuals predicted contribution is the contribution that she/he said she/he would make if the other gave 75 in the strategy method part

- If stated expectation in the payoff-relevant public goods game is between 87.5 and 100, an individuals predicted contribution is the contribution that she/he said she/he would make if the other gave 100 in the strategy method part.

  We also used an alternative coding with 10 as the critical threshold instead of 5. The results remain very similar.

Clearly, this introduces some measurement error since we do not have a continuous contribution function, but since expectations measured in the payoff-relevant public goods game already cluster around these values, the measurement error likely is smaller than one would expect. Also, the measurement error would bias the results against our conjecture that there is a very strong positive correlation between contribution choices in the payoff-relevant part of the survey and the strategy method part.

We find that there is a strong positive and significant correlation between an individual's own contribution in the payoff-relevant public goods game and the contribution one would predict based on his/her answers in the strategy method part (the correlation is .76 with p<.001). Table A-6 shows the results from several regression models in which we explore whether the results based on the payoff relevant part of the survey differ from those measured in the strategy method part that was not explicitly incentivized. Specifically, we estimated three regressions that are reported in Table A-6.

- Model 1: Regression of own contribution on socio-demographics

- Model 2: Regression of predicted own contribution on socio-demographics

- Model 3: Regression of the difference between own contribution and predicted own contribution on socio-demographics. This model provides us with the difference in the two coefficients from the first two models. A negative sign means that this socio-demographic group should give less according to its strategy and a positive sign means

that the group should contribute more on average given their contribution schedules as measured in the strategy method part of the survey.

We find that the results for predicted own contribution based on the strategy method (which was not explicitly payoff-relevant) are very similar to those for observed own observed contribution in the payoff-relevant public goods game. There are only minor significant socio-demographic differences: Older respondents (over 70) and those between 50 and 59 should give slightly more according to their strategy while highly educated should give somewhat less (about 1.2 \$/£/€ on average). All other socio-demographic and political variables are not significant (and their coefficients in models 1 and 2 not significantly different from each other).

D Appendix Tables

	Population (%)	Weighted Sample (%)	Raw Sample (%)
France (N=2,000)			
Age: 18-39	31.6	31.6	30.6
Age: 40-54	28.5	25.9	26.8
Age 55+	39.9	42.6	42.7
Gender: Male	47.6	47.6	47.7
Gender: Female	52.4	52.4	52.4
Education: CAP/BEP or less	59.8	59.8	59.1
Education: Bac to Bac+2	27.5	27.5	28.2
Education: Bac+3 or more	12.7	12.7	12.8
Germany (N=2,000)			
Age: 18-39	23.1	23.1	24.8
Age: 40-54	36.6	36.6	32.3
Age 55+	40.3	40.3	42.9
Gender: Male	49	49	49
Gender: Female	51	51	51.1
Education: 16 or fewer	43.4	43.6	42.5
Education: 17 to 19 yrs	33	33.3	34.8
Education: 20 yrs or more	23.6	23.1	22.8
United Kingdom (N=2,000)			
Age: 18-34	23.4	23.4	25.4
Age: 35-54	33.7	33.7	44.6
Age 55+	42.9	43	30
Gender: Male	47.3	47.3	47.3
Gender: Female	52.7	52.7	52.7
Education: 16 or fewer	55.3	53.5	50.4
Education: 17 to 19 yrs	21.2	23	24.7
Education: 20 yrs or more	23.5	23.6	25
United States (N=2,500)			
Age: 18-34	29.5	27.1	19.4
Age: 35-54	38.5	34	32.4
Age 55+	32.1	39	48.1
Gender: Male	48.2	48.3	47.6
Gender: Female	51.8	51.2	52.4
Education: HS or less	45	44.9	39.7
Education: Some college	30	22.2	23.4
Education: College graduate	16.3	24	27.5

Table A-1: *Distributions of Socio-demographics in the Survey Sample and the Population.* The table shows the distributions of socio-demographics in the population, the weighted sample, and the raw sample. The population socio-demographics are taken from the following sources: France: French Statistical Office, 2009 Population Census. Germany: Sept-Oct 2011 Eurobarometer. France: Aug-Sept 2010 Eurobarometer. United States: 2007 American Community Survey, 2008 Current Population survey, 2007 Pew Religious Landscape Survey.

	(1) Socio-demographics	(2) Socio-demographics and Expected Contribution	(3) Own Contribution First	(4) Expected Contribution Other First	(5) Expected Contribution Indicator	(6) Tobit: All
Expected Contribution: Medium		22.20***	23.09***	23.27***	23.11***	31.11***
		(0.540)	(0.751)	(0.721)	(0.521)	(0.693)
Expected Contribution: High		50.37***	51.71***	50.78***	51.15***	61.08***
		(0.944)	(1.383)	(1.285)	(0.942)	(1.147)
Female	-2.58***	-2.31***	-2.39***	-2.41***	-2.43***	-2.30***
	(0.582)	(0.471)	(0.674)	(0.650)	(0.469)	(0.548)
Age: 30-49	2.02**	1.55**	1.97*	0.42	1.20	1.59*
	(0.948)	(0.781)	(1.064)	(1.041)	(0.745)	(0.882)
Age: 50-69	1.64*	1.07	2.02*	-0.27	0.90	1.38
	(0.991)	(0.819)	(1.033)	(1.009)	(0.723)	(0.855)
Age: 70+	-0.68	-1.05	-0.31	-1.27	-0.76	-0.27
	(1.455)	(1.166)	(1.500)	(1.490)	(1.058)	(1.235)
Income: Middle	0.13	0.15	0.09	0.91	0.45	0.68
	(0.830)	(0.689)	(0.963)	(0.910)	(0.662)	(0.772)
Income: High	0.52	0.94	1.43	1.42	1.40*	1.54*
	(0.963)	(0.794)	(1.051)	(1.007)	(0.729)	(0.856)
Education: High	-0.04	1.48***	1.58**	1.70**	1.64***	1.72***
	(0.619)	(0.506)	(0.729)	(0.691)	(0.503)	(0.586)
Altruism: High	9.29***	5.71***				
	(0.678)	(0.602)				
Married	-0.28	-0.16				
	(0.883)	(0.736)				
Separated	-3.14*	-2.59*				
	(1.774)	(1.461)				
Divorced	-1.22	-0.97				
	(1.141)	(0.933)				
Widowed	-0.75	-1.11				
	(1.639)	(1.377)				
Domestic Partnership	-0.63	-1.22				
	(1.060)	(0.869)				
Unemployed	-0.86	-0.35				
	(1.159)	(0.952)				
Ideology	0.02	0.04				
	(0.121)	(0.099)				
First: Other					-1.20**	
					(0.467)	
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,495	8,493	4,238	4,257	8,495	8,495
R-squared	0.029	0.362	0.346	0.364	0.354	

Table A-2: *The Socio-demographic Correlates of Contributions.* This table reports results from regressions of an individual's own contribution behavior on socio-demographic variables and their expectations about how much the other player will contribute (Expected Contribution). Own contribution is measured by the observed contribution behavior in the payoff-relevant public goods game. Models 1 to 4 are OLS estimates. Model 3 reports results from those randomly chosen respondents that were first asked to indicate their own contribution. Model 4 reports results from those randomly chosen respondents that were first asked to indicate the contribution they expected from the other player. Model 5 includes an indicator variable that distinguishes between those subjects that were first asked to indicate their own contribution and those that were first asked to indicate the contribution they expect from the other player. Model 6 reports Tobit estimates. Constant included but not reported. Robust standard errors reported in parentheses (*** $p < .01$, ** $p < .05$, * $p < .10$).

	(1)	(2)	(3)	(4)	(5)
	Freerider	Positive Nonconditional	Positive Reciprocity	Inverse U-shaped Reciprocity	Other
Expected Contribution: Medium	4.84***	3.74	21.85***	18.67***	18.88***
	(1.413)	(3.198)	(0.678)	(2.478)	(1.641)
Expected Contribution: High	9.19	36.22***	54.95***	43.13***	43.01***
	(5.679)	(3.829)	(1.731)	(3.728)	(1.864)
Female	-0.65	-3.99***	-2.62***	-1.16	-1.56*
	(0.792)	(1.516)	(0.639)	(2.064)	(0.908)
Age: 30-49	-0.17	-5.61*	1.47	2.16	0.06
	(1.838)	(3.112)	(0.907)	(3.338)	(1.651)
Age: 50-69	-2.35	-5.33*	1.09	-0.08	-0.32
	(1.667)	(3.024)	(0.913)	(3.254)	(1.533)
Age: 70	-2.25	-6.78*	-0.06	-0.20	-2.31
	(1.807)	(3.964)	(1.466)	(4.698)	(1.987)
Income: Middle	1.67	0.53	0.68	-0.40	-0.31
	(1.265)	(2.151)	(0.953)	(2.906)	(1.205)
Income: High	0.10	3.60	0.91	-2.64	1.28
	(1.040)	(2.370)	(1.026)	(3.429)	(1.364)
Education: High	-0.78	5.07***	1.75**	2.80	1.33
	(0.752)	(1.637)	(0.687)	(2.255)	(0.973)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	927	1,130	3,727	409	2,302
R-squared	0.088	0.238	0.374	0.320	0.279

Table A-3: *The Correlates of Contributions by Strategy Type.* This table reports coefficients from OLS regressions of own contribution behavior on expected contributions and socio-demographics by reciprocity type. Robust standard errors are reported in parentheses (*** $p < .01$, ** $p < .05$, *$p < .10$).

	(1) All	(2) Freerider	(3) Positive Nonconditional	(4) Positive Reciprocity	(5) Inverse U-shaped Reciprocity	(6) Other
Own Contribution Treatment: Medium Low (30)	2.92***	-0.24	3.46	2.96***	-1.65	2.49*
	(0.811)	(0.955)	(2.416)	(1.125)	(3.304)	(1.499)
Own Contribution Treatment: Medium (60)	2.03**	0.71	3.44	1.74	1.65	0.25
	(0.816)	(1.089)	(2.320)	(1.140)	(3.390)	(1.541)
Own Contribution Treatment: High (90)	2.41***	2.13*	2.78	1.06	-0.06	1.23
	(0.805)	(1.264)	(2.372)	(1.091)	(3.430)	(1.499)
Female	-2.75***	-0.67	-5.29***	-3.17***	-1.22	-2.66**
	(0.581)	(0.814)	(1.670)	(0.807)	(2.509)	(1.060)
Age: 30-49	1.51*	-0.13	-4.88	1.35	4.49	-0.21
	(0.905)	(1.903)	(3.348)	(1.104)	(3.846)	(1.928)
Age: 50-69	1.34	-2.28	-4.29	1.89*	1.43	-1.05
	(0.875)	(1.735)	(3.223)	(1.131)	(3.743)	(1.782)
Age: 70+	-0.14	-2.18	-3.53	1.68	-0.22	-3.26
	(1.340)	(1.858)	(4.263)	(1.965)	(5.461)	(2.359)
Income: Middle	0.64	1.68	-1.34	-0.16	-0.67	0.49
	(0.794)	(1.289)	(2.374)	(1.139)	(3.545)	(1.390)
Income: High	1.16	0.00	3.72	-0.19	-6.20	1.94
	(0.886)	(1.083)	(2.678)	(1.235)	(3.949)	(1.576)
Education: High	0.22	-0.94	4.86***	0.92	4.07	0.39
	(0.619)	(0.778)	(1.848)	(0.861)	(2.590)	(1.127)
Country Fixed Effects	yes	yes	yes	yes	yes	yes
Own Contribution Treatment	yes	yes	yes	yes	yes	yes
Observations	8,497	927	1,130	3,727	409	2,304
R-squared	0.010	0.066	0.072	0.018	0.031	0.013

Table A-4: *The Causal Effects of Cooperative Environments on Own Contributions by Strategy Type - All Treatment Indicators.* This table reports coefficients from OLS regressions of own contribution behavior on treatment group indicators. *Other Contribution Treatment: 10* is the reference group. Robust standard errors are reported in parentheses (*** $p < .01$, ** $p < .05$, *$p < .10$).

	(1)	(2)
	Own Contribution	Own Contribution
Other Contribution Treatment: $/£/€30	2.79***	2.92***
	(0.814)	(0.811)
Other Contribution Treatment: $/£/€60	2.00**	2.03**
	(0.819)	(0.816)
Other Contribution Treatment: $/£/€90	2.35***	2.41***
	(0.805)	(0.805)
Female		-2.75***
		(0.581)
Age: 30-49		1.51*
		(0.905)
Age: 50-69		1.34
		(0.875)
Age: 70+		-0.14
		(1.340)
Income: Middle		0.64
		(0.794)
Income: High		1.16
		(0.886)
Education: High		0.22
		(0.619)
Country Fixed Effects	No	Yes
Own Contribution Treatment	No	Yes
Root MSE	26.22	26.12
Observations	8,498	8,497

Table A-5: *The Causal Effects of Expected Contribution on Own Contribution.* This table reports OLS estimates of the effects of the Other Contribution Treatments on Own Contribution as measured by contributions in the payoff-relevant public goods game. The control group is Other Contribution Treatment: $/£/€10 . Robust standard errors are reported in parentheses (*** $p < .01$, ** $p < .05$, *$p < .10$).

	(1)	(2)	(3)
	Own Contribution	Predicted Contribution (Strategy Method)	Difference: Predicted vs. Observed
Expected Contribution: Medium	22.20***	21.53***	-0.67
	(0.540)	(0.514)	(0.463)
Expected Contribution: High	50.37***	53.60***	3.23***
	(0.944)	(0.884)	(0.837)
Female	-2.31***	-1.74***	0.56
	(0.471)	(0.468)	(0.406)
Age: 30-49	1.55**	1.84**	0.29
	(0.781)	(0.751)	(0.707)
Age: 50-69	1.07	2.31***	1.25*
	(0.819)	(0.788)	(0.735)
Age: 70+	-1.05	0.80	1.85*
	(1.166)	(1.181)	(0.982)
Income: Middle	0.15	-0.39	-0.56
	(0.689)	(0.687)	(0.620)
Income: High	0.94	0.85	-0.11
	(0.794)	(0.787)	(0.691)
Education: High	1.48***	0.28	-1.19***
	(0.506)	(0.506)	(0.431)
Altruism: High	5.71***	6.35***	0.64
	(0.602)	(0.605)	(0.477)
Married	-0.16	0.01	0.15
	(0.736)	(0.700)	(0.623)
Separated	-2.59*	-2.12	0.46
	(1.461)	(1.500)	(1.370)
Divorced	-0.97	0.02	1.01
	(0.933)	(0.935)	(0.821)
Widowed	-1.11	-0.05	1.06
	(1.377)	(1.320)	(1.164)
Domestic Partnership	-1.22	-0.87	0.35
	(0.869)	(0.861)	(0.786)
Unemployed	-0.35	-0.56	-0.25
	(0.952)	(0.912)	(0.779)
Ideology	0.04	0.07	0.03
	(0.099)	(0.096)	(0.088)
Country Fixed Effects	yes	yes	yes
Additional Covariates	yes	yes	yes
Observations	8,493	8,488	8,486
R-squared	0.362	0.394	0.020

Table A-6: *The Socio-demographic Correlates of Observed and Predicted Contributions.* This table reports OLS regressions of an individuals own contribution behavior (model 1), predicted contribution behavior (model 2), and the difference between these two measures (model 3) on socio-demographic variables. Own contribution is measured by the contribution behavior observed in the payoff-relevant public goods game. Predicted contribution is measured using individuals strategies and the contribution they expected from the other actor in the payoff-relevant public goods game (see Appendix for details). Robust standard errors reported in parentheses (*** $p < .01$, ** $p < .05$, *$p < .10$).

	(1) Positive Nonconditional	(2) Positive Reciprocity	(3) Inverse U-shaped Reciprocity	(4) Other
Female	0.07	0.36***	0.61***	0.30***
	(0.091)	(0.077)	(0.123)	(0.080)
Age: 30-49	0.43**	-0.39***	-0.16	-0.07
	(0.176)	(0.132)	(0.198)	(0.146)
Age: 50-69	0.30*	-1.05***	-0.78***	-0.17
	(0.167)	(0.125)	(0.192)	(0.136)
Age: 70+	0.01	-1.40***	-0.93***	-0.32*
	(0.222)	(0.180)	(0.293)	(0.184)
Income: Middle	0.26**	0.38***	0.56***	0.28***
	(0.124)	(0.103)	(0.170)	(0.107)
Income: High	0.31**	0.42***	0.46**	0.17
	(0.136)	(0.113)	(0.191)	(0.119)
Education: High	-0.20**	0.31***	-0.04	-0.25***
	(0.098)	(0.082)	(0.132)	(0.086)
Germany	-0.10	-0.23**	-0.67***	-0.35***
	(0.145)	(0.115)	(0.172)	(0.119)
United Kingdom	0.25*	-0.08	-0.50***	-0.46***
	(0.141)	(0.116)	(0.170)	(0.122)
United States	0.32**	-0.54***	-1.03***	-0.47***
	(0.131)	(0.108)	(0.176)	(0.112)
Observations	8,499			
Log-Pseudo-Likelihood	-11233			

Table A-7: *The Socio-demographic Correlates of Strategy Choice.* This table reports coefficients from multinomial regression models with freerider as the base outcome. Robust standard errors are reported in parentheses (*** $p < .01$, ** $p < .05$, *$p < .10$).

E Appendix Figures

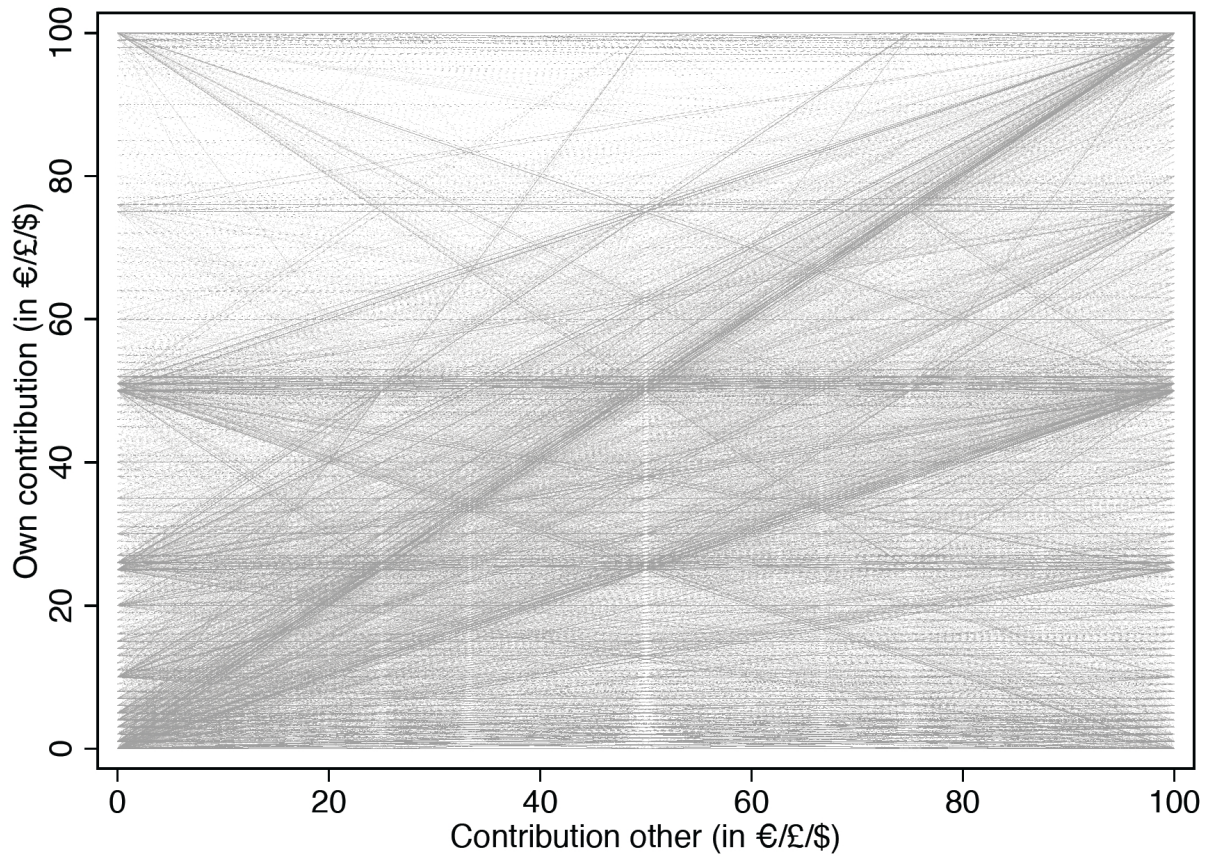Figure A-1: *Distribution of Conditional Contribution Schedules (N=8,500).* The plot shows the willingness to contribute to the public good conditional on the contribution by the other player in representative samples of the adult population in France (N=2,000), Germany (N=2,000), the United Kingdom (N=2,000), and the United States (N=2,500). Darker lines indicate higher frequency. Strategies are elicited using the strategy method (see section on "Coding of Strategies" for details).