Intelligence, Patience, and Cooperation: An Experimental Study

Omar al-Ubaydli, Garett Jones, and Jaap Weel
George Mason University

December 2010

<u>Extremely Preliminary Draft</u>

Not for Circulation or Citation

Additional results, citations, and discussion to be added

One of the great questions in social science is "What causes trust and trustworthiness?" In modern economic research, most attempts to answer this question have focused on institutions, rules, rewards, and punishments. But there have been exceptions: Most famously, Axelrod, in *The Evolution of Cooperation*, summarized and extended the literature on which strategies could create cooperation in a repeated prisoner's dilemma. And digging still deeper, Axelrod asked which underlying player traits would be most likely to create an environment of cooperation.

This paper continues Axelrod's search for the player-level roots of cooperation. We report the results of ten-round prisoner's dilemma experiments where the players are subsequently given standard tests of cognitive ability, patience, risk aversion, and personality traits. We find that cognitive ability, as measured by the Raven's Progressive Matrices, is a reliable predictor of cooperation: but this is only true at the pair level, not at the individual level. Thus, smarter pairs are more cooperative, smarter individuals are not. We explore the dynamics of this relationship below.

Other findings are also of note: risk tolerance is never a reliable predictor of cooperation, while the patience measures tend to predict pair cooperation even when controlling for a pair's cognitive ability. Thus, we find the first experimental evidence for Axelrod's claim that pairs of players who extend the "shadow of the future" by being patient are more likely to cooperate.

Previous Literature

The first paper to explore whether intelligence spurs cooperation among strangers in a repeated prisoner's dilemma is Jones (2008). Drawing on Axelrod's advice for creating cooperative groups, Jones argued that since intelligence is associated with patience, and since intelligent players are more likely to understand the rules of the game (and hence to see the likely futility of defection), high-IQ groups were more likely to cooperate.

Axelrod offered another piece of advice to advocates of cooperation: Encourage players to cooperate in the first round. Recent work had shown that intelligent players are likely to do just that: Burks et al. (2009) found that high-IQ truck driving students were more likely to trust in the first stage of a sequential, one-round prisoner's dilemma; and Putterman et al. (2010) found that IQ predicts early cooperation in a public goods game. Thus, we can now say that high-IQ players are more likely to create a high-trust environment through at least three of Axelrod's pro-cooperation channels: patience, perceptiveness (of rules) and pleasantness (in the first round). Perhaps highly intelligent individuals have other anti-cooperation traits that don't nest neatly into Axelrod's advice, but if so, they must countervail against these tendencies.

The causal mechanism running from intelligence to cooperation, if robust, is likely to be important for development economists, institutional economists, and public choice researchers. Since nations appear to differ widely in cognitive ability—whether measured by IQ tests, as in Jones and Schneider (2006) or by international math and science test scores, as in Hanushek and Woessmann (2010)— this may help explain why some nations have greater social trust and lower corruption. And since good political institutions are prisoner's dilemmas—the norm of following a constitution, for example—persistent differences in cognitive ability across countries could help explain why institutional quality differs so much across countries.

In previous experimental work, al-Ubaydli, Jones, and Weel (2010) found that patience, but not intelligence, was a good predictor of coordination in a repeated stag hunt. Taken together with our results below, these findings fulfill the prediction of Mueller, in Public Choice III, that repeated pure coordination games should be less cognitively demanding than repeated prisoner's dilemmas. Separate literatures in game theory have explored the sources of success in coordination games and in prisoner's dilemmas; the current paper, taken together with the findings of al-Ubaydli, Jones, and Weel (2010), unites the two.

Results

In this extremely preliminary draft, we report the canonical results from the experiment; the final draft will report the robustness tests and experimental dynamics. We currently have dozens of regressions, and our work over the next month will involve deciding on the most valuable results.

Table 2 reports the probability that an individual player cooperates within a given round conditioned on that player's individual attributes—intelligence, risk tolerance, and the two patience measures. Table 3 reports the probability that *both* players simultaneously cooperate conditioned on the average of that pair's attributes. All regressions include session and round dummies, not reported.

Comparing the difference in the Ravens coefficient across the two tables, we see that the coefficient is five times larger for pairs than for individuals: Thus, smarter pairs are more cooperative in a way that smarter individuals are not. Quantitatively, a one standard deviation rise in Ravens score (5.6 points) is associated with 10.1% more cooperation, a fifth of a standard deviation.

Further, patience is associated with higher cooperation for both individuals and pairs; the monthly patience measure matters more for individuals, the weekly measure more (and with a smaller p-value) for pairs. Thus, a long shadow of the future predicts more cooperation, as Axelrod hypothesized.

And Table 4, a preliminary estimate of dynamics, demonstrates one channel for sustaining cooperation: high intelligence. If both players cooperated in the first round, then Ravens score is the only reliable predictor of second-round cooperation. Smarter pairs are more likely to keep trusting each other: This result holds if patience and risk tolerance are excluded, as well as if personality measures are included.

But the cooperation of the intelligent is not naïve Pollyanna cooperation, nor is it Kantian categorical imperative cooperation: In the last round, Raven's score has zero ability to predict cooperation. This appears to be cooperation with a sense of purpose; with a sense of creating a positive sum that can be divided among players (results to be provided).

Future experiments can investigate whether high-IQ players are more likely to sustain exogenously induced cooperation—perhaps "a good start" created through threats or rewards have higher social returns when players are more intelligent.

Other noteworthy results (to be extended)

al-Ubaydli, Jones, and Weel (2010) found that males were much more likely than females to coordinate on stag in a repeated stag hunt; however, in the prisoner's dilemma, the gender dummy is *never* statistically significant, and always small. Further, we find that conscientiousness is robustly associated with *less* cooperation, a result we find puzzling but worthy of report. Both of these results persist in multiple specifications.

Conclusion (to be extended)

We have confirmed the prediction from Mueller's textbook: it is cognitively demanding to sustain cooperation in a repeated prisoner's dilemma. Pairs of players with higher cognitive ability are substantially better at cooperating. The differences in cognitive ability one finds at a typical state university in the U.S. is enough to create substantial differences in cooperation. And we find that is the cognitive ability of a *pair* of players, not the ability of an individual player, that drives cooperation. Thus, the link between intelligence and pro-social behavior is an emergent phenomenon.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Raven's	177	41.8	5.6	27	53
risk tolerance	176	0.63	0.23	0	1.22
patience	168	0.36	0.48	0	1
earnings	177	5.99	2.60	1.25	12.75
First Round Behavior					
% Cooperate	177	52.5%	50.1%	0%	100%

Table 2: Individual Results

Individual Cooperation	Coef.	Std. Err.	P-value
Raven's	0.0033	0.0043	0.453
risk tolerance	0.056	0.1046	0.595
patience1	-0.0059	0.00746	0.435
patience2	0.104	0.0617	0.093

Table 3: Group results

Pair Cooperation	Coef.	Std. Err.	P-value
Average Raven's	0.018	0.0080	0.026
Average risk tolerance	-0.017	0.0190	0.362
Average patience1	0.277	0.1321	0.039
Average patience2	0.252	0.1983	0.208

Table 4: Second Round Cooperation, conditioned on first-round pair cooperation

Individual Cooperation	Coef.	Std. Err.	P-value
Raven's	0.020	0.010	0.040
risk tolerance	0.228	0.260	0.385
patience1	-0.024	0.018	0.184
patience2	0.177	0.157	0.268