What determines cooperative behavior?

Eugenio Proto, Aldo Rustichini and Andis Sofianos

What determines cooperative behavior among people in social interactions? What enables us to adopt actions that will be beneficial to us and our neighbors, or individuals in the same country and in the same planet? We are particularly interested not in statements of intention, such as ``I feel the pain'' or ``I care'', but instead in what induces actions that make both us and others better off. In other words, what makes us effective social animals?

Economists and other social scientists provide different answers to this question. Cooperation may originate from warm feelings: consideration of others can motivate us towards generous and cooperative behavior (e.g. Dawes and Thaler 1988; Isaac and Walker 1988; Fehr and Gaechter 2000; Fehr and Schmidt, 1999; Falk, Fehr and Fischbacher 2008; among others). According to this suggestion, a cohesive society is one where good generous feelings inspire our actions. Another suggestion is that good norms and institutions provide us with the blueprint for socially useful behavior. According to this suggestion, a harmonious society is one built on good norms and trust consistently followed (e.g. Putman, 1994; Coleman, 1988; among others) or on well working institutions inherited from the past (e.g. Acemoglu, Johnson and Robinson, 2001; among others). Finally, another possibility is that insightful self-interest guides us to become effectively good citizens. According to this suggestion, cooperation arises in society if people are smart enough to foresee the social consequences of their actions, including the consequences for others.

Our conclusion

In a recently published paper (Proto, Rustichini and Sofianos, 2018), we test these three possible suggestions experimentally and find overwhelming support for the latter: intelligent people are the primary condition for a socially cohesive, cooperative society. In contrast warm feelings and good norms have a small transitory effect.

The study

The experiments we implement are based on games: a game is a set of rules that assigns a payoff to two people depending on what both choose to do. A repeated game is the repetition of a game over several periods, where the two people know that they will meet again allowing them to condition their decisions on what the other person has done in the previous periods. The repetitions have a random termination, with a frequency controlled by the experimenter. A higher continuation probability models a more lasting social interaction. These repeated games are non-zero-sum games: that is, there is room for cooperative, mutually beneficial, behavior and for selfish, mutually damaging behavior. This is an essential feature, and reflects the properties of the interactions we experience most frequently in society. We then create two "cities'', or groups of subjects: the two groups differ according to one of the three characteristics we have mentioned earlier, good heart, good norms, and intelligence. We pay particular attention to the frequency of choice of cooperative rather than non-cooperative behavior, called *cooperation rate*.

We study several games; we consider first the Prisoners' Dilemma (PD). In the PD, defecting gives a higher payoff to a player, independently of the action of the other, when the game is played only once. If the game is infinitely repeated the cooperative action can become optimal for the individual, producing an equilibrium where both players cooperate in every period, under the threat of reverting to the defecting equilibrium after a deviation. Note that at this equilibrium there is a trade-off between the current payoff (which is larger if a player defects) and long run payoff (which is smaller if the player defects).

We measure intelligence with performance in the Raven progressive matrices test. When we create groups according to intelligence, where subjects of one group are of higher intelligence than those in the other, we observe that the higher intelligence group learns to cooperate. Almost full cooperation is achieved among subjects in the same experimental session. Instead, in the group of less intelligent subjects the cooperation rate declines from the initial level. Figure 1 illustrates this result.

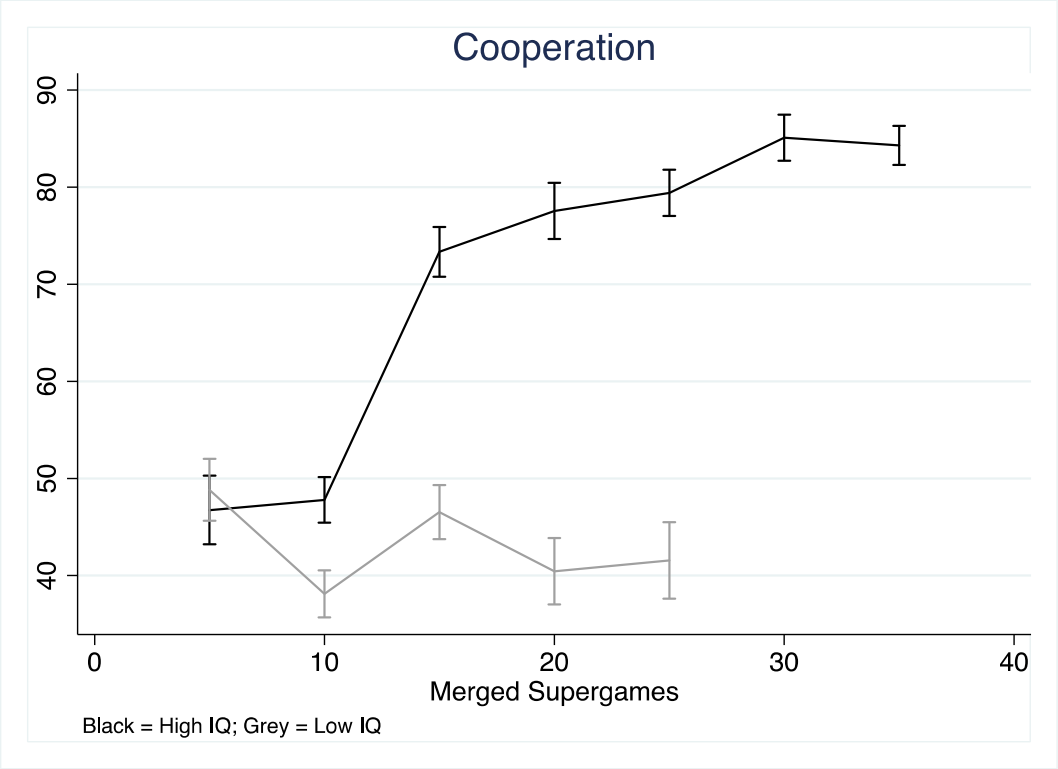

Figure 1: Cooperation rates of High and Low intelligence group (previously measured using the Raven's progressive matrices test) playing a random termination repeated Prisoners' Dilemma in different laboratory sessions.

In order to test the possible effect of warm feelings, we create two groups according to their level of *Agreeableness*, a Big 5 personality trait, which measures levels of positive social inclinations (trust and generosity). In Figure 2, we illustrate the cooperation rates of these two groups when they play an infinitely repeated Prisoners' Dilemma game. No clearly different patterns of cooperation rates between the two Agreeableness groups appear to result.

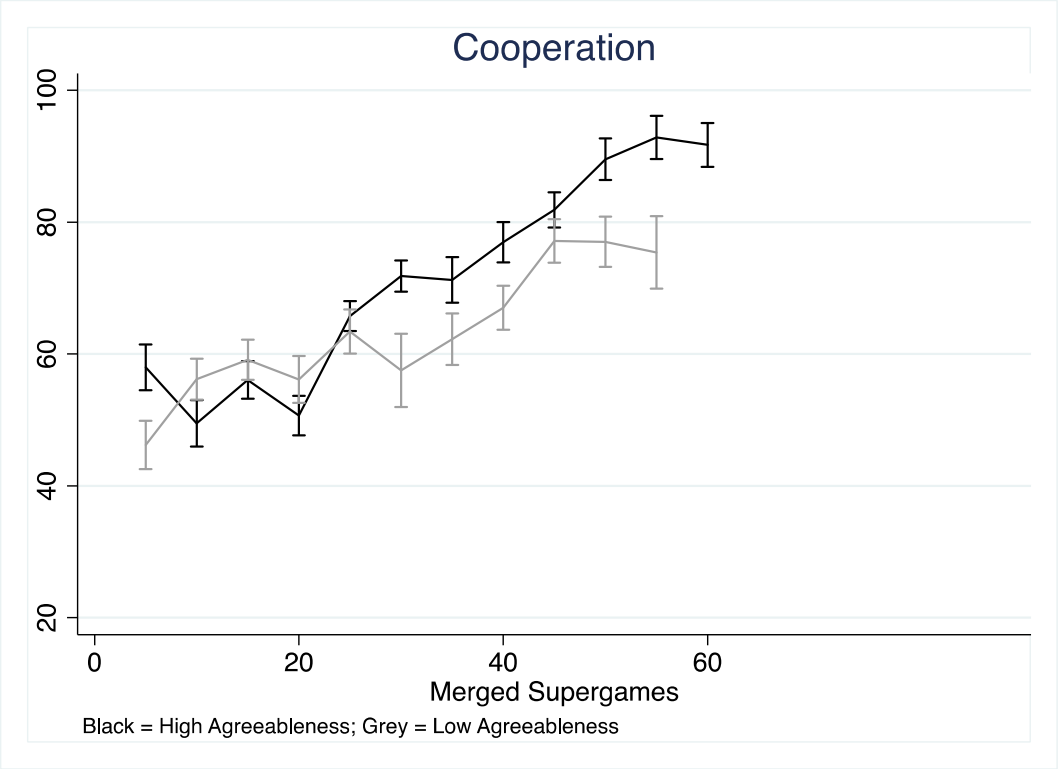

Figure 2: Cooperation rates among High and Low Agreeableness group of subjects (previously measured using a Big 5 personality questionnaire) playing a random termination repeated Prisoners' Dilemma in different laboratory sessions.

Finally, we create groups in terms of level of adherence of social norms. We identify this by individual *Conscientiousness,* defined as the general tendency to be organized and dependable, show self-discipline and dutifulness. Conscientiousness is one of the Big 5 traits. Figure 3 shows the cooperation rates among the two groups of subjects. We find that, rather than cooperating more, the high Conscientiousness group seems to learn to cooperate slower than the low Conscientiousness one. Overall, this result suggests that higher levels of compliance with social norms do not guarantee higher levels of cooperation. Our analysis shows that this occurs because the highly conscientious subjects were too cautious in their choices, and this delayed convergence to full cooperation.

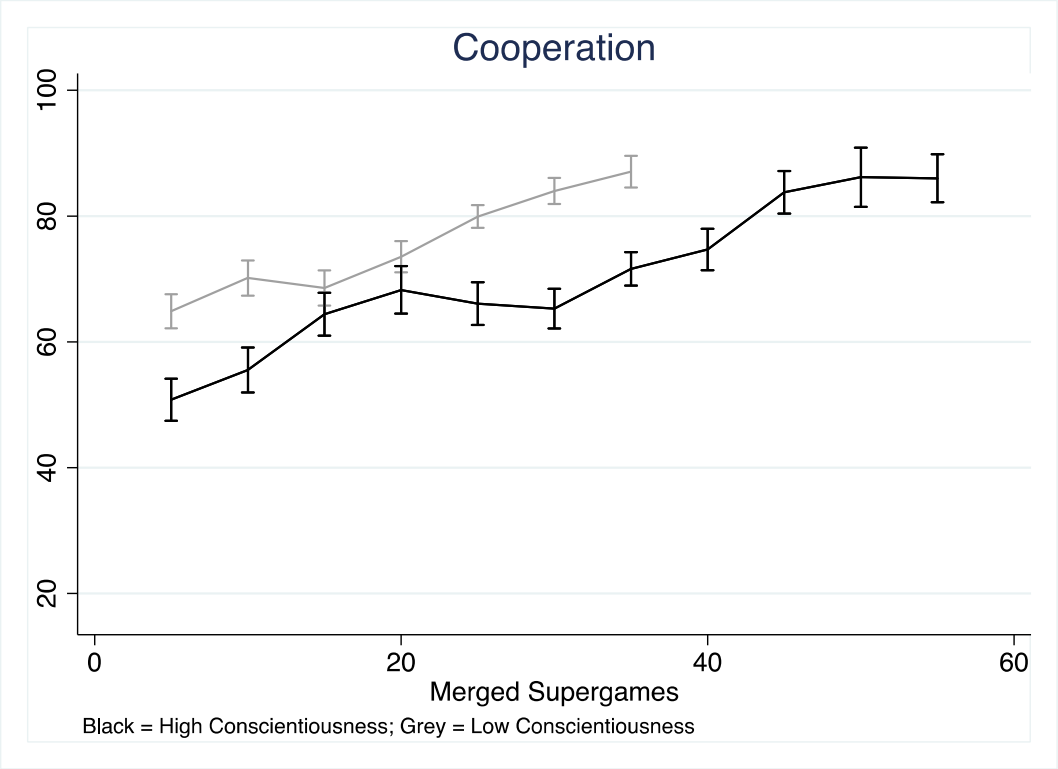

Figure 3: Cooperation rates of High and Low Conscientiousness group of subjects (previously measured using a Big 5 personality questionnaire) playing indefinitely repeated Prisoners' Dilemma in different laboratory sessions.

Investigating the effect of intelligence in simpler games

To gain more insight on the way intelligence affects cooperation or learning to cooperate, we analyzed the behavior of the two intelligence groups in *simpler* games, where the trade-off between current payoff and long-run payoff is absent. The *Stag Hunt* game is an example of such games. In SH, players must decide whether to hunt a stag or a hare. Hunting a stag yields a higher payoff if the other player also hunts a stag, but a low payoff if the other hunts a hare. Hunting a hare yields an intermediate but sure payoff, independently of the action of the other. If players only meet once, it is optimal to hunt a stag only if the player expects that the other player will also do so. When this game is repeated, once both players manage to coordinate in hunting a stag they have nothing to gain either in the short or in the long run from deviating and hunting a hare. In figure 4 we look at the coordination rates for hunting a stag across intelligence groups and we do not observe any substantial difference between the two. Both groups coordinate on hunting a stag quite fast and do not change their behavior up until the end of their interaction. We find similar results in the other game with no tradeoff between short run and long run payoff, the Battle of the Sexes

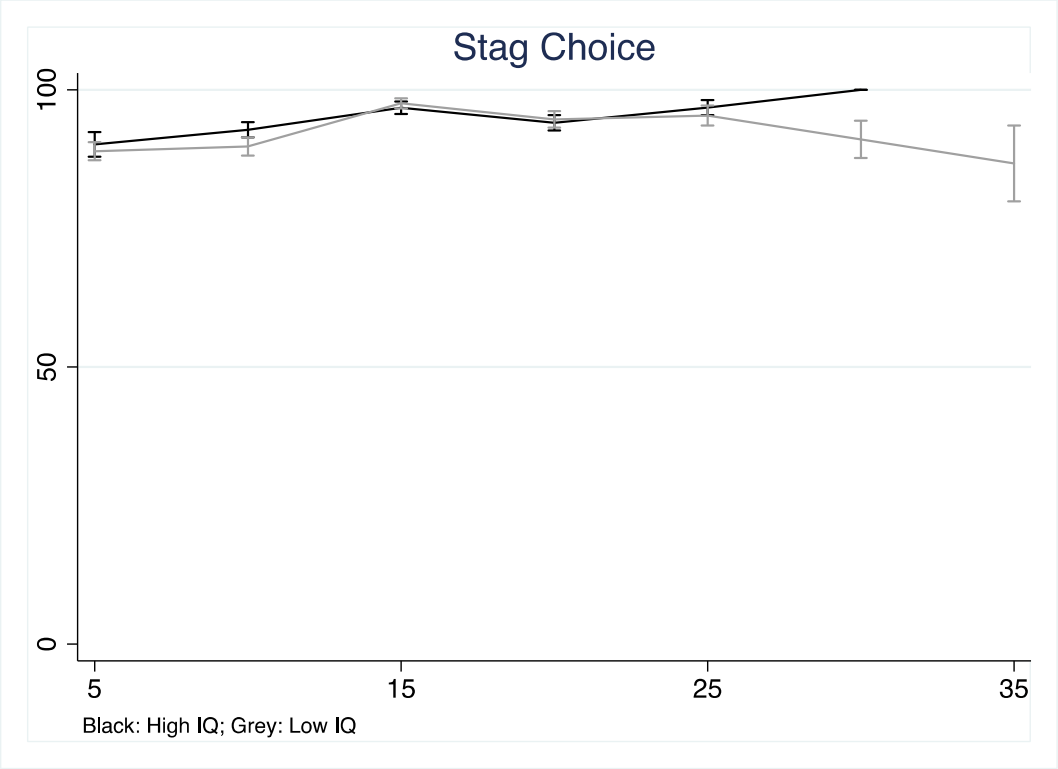

Figure 4: Coordination rates to hunt stag of high and low IQ groups of subjects (previously measured the Raven's progressive matrices test) playing indefinitely repeated Stag Hunt game in different laboratory sessions.

Goal Neglect

The results we have seen show that the difference in cooperation rates between the two groups of different intelligence levels arises in games with a trade-off between short-run and long-run payoff. Our hypothesis that in games without such a conflict the effect of intelligence on fostering cooperation is smaller is close to the *goal neglect* in non-strategic choices of lower intelligence individuals (Duncan et al., 2008). In their study, the authors experimentally show that more intelligent people tend to be more consistent with previously chosen strategies. In our setup, when individual plays a game where short term objectives conflict with the long-term ones, they are more likely to neglect their long-term goal and to make errors, namely payoff reducing choices. In Figure 6, we present the errors committed by subjects split by different intelligence quantiles. The pattern of a larger number errors at lower quantiles is quite stark.

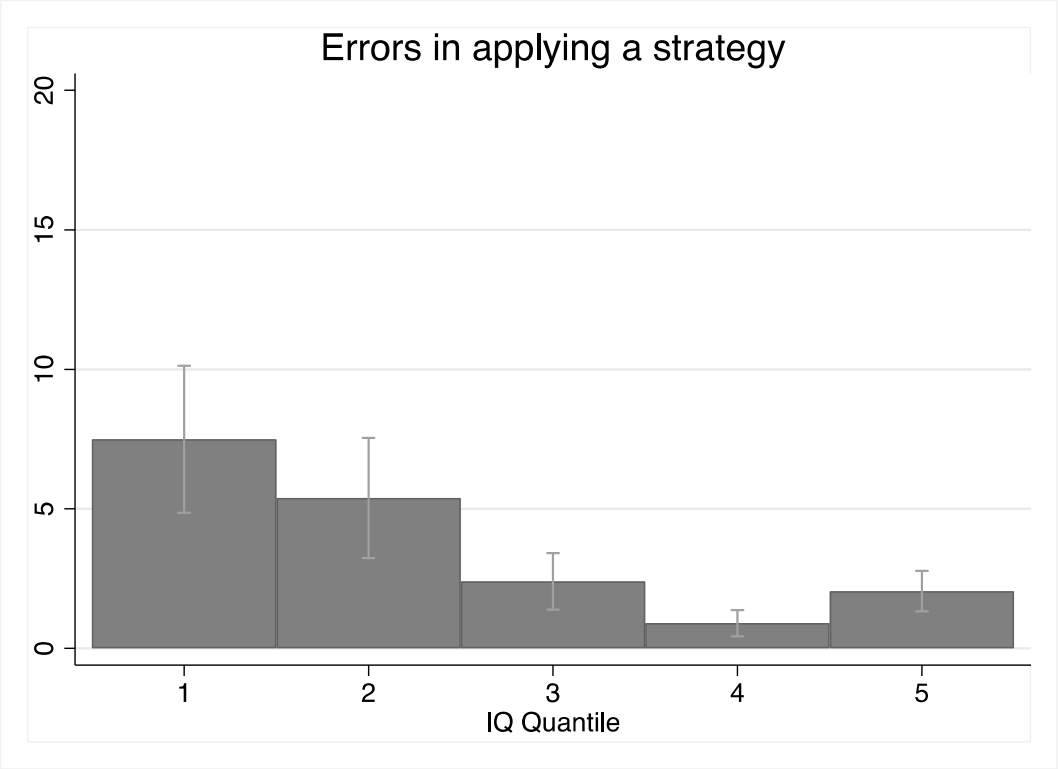

Figure 5: Errors in applying a strategy by different subjects grouped in different quantiles of the IQ distribution in the repeated Prisoner's Dilemma game. The errors are defined as defection to cooperate when in the previous period both subjects cooperated.

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