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Theory of Mind predicts cooperative behavior

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HIGHLIGHTS

- A Theory of Mind (ToM) assessment is administered to subjects.
- One-shot Prisoner Dilemma game implemented to measure cooperation.
- Subjects with high ToM are less likely to cooperate.

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ABSTRACT

Explanations for cooperation in Prisoner's Dilemma games have generated significant interest. While institutional explanations have offered considerable explanatory ability, a psychological measure of Theory of the Mind that measures an individual's ability to process social and emotional cognition offers new insights. Using this measure, we examine how it explains (un)cooperative behavior. We find that subjects who have higher ToM are less cooperative and extract higher payoffs.

1. Introduction

The sources of cooperative behavior have been the subject of numerous research investigations in biology, psychology, sociology, and economics. The facilitation of cooperation is an important issue to understand. Initial research into the drivers of cooperation focused on institutional features that may facilitate it, such as reputation through repeated play (Axelrod, 1981), incomplete information (Kreps et al., 1982), and communication (Miettinen and Suetens, 2008). Recent efforts attempt to explain differences in willingness to cooperate using social and psychological measurements. For example, Boone et al. (1999), Hirsch and Peterson (2009) and Kagel and McGee (2014) use a common assessment of personality traits as a covariate of cooperation. Additionally, Dreber et al. (2014) evaluate cooperation by examining altruism.[1] Altruistic giving is correlated with cooperation.

We investigate the psychological concept known as Theory of the Mind (ToM) as an explanation of cooperation. Simple ToM assessments have been used in economic experiments to appreciate child development (Takagishi et al., 2010) and the effects of autism (Sally and Hill, 2006). We explore the "Reading the Mind in the Eyes" assessment (hereafter Eyes) (Baron-Cohen, 1991) where subjects view photos of professional actors emoting, cropped to display only their eyes, eye brows, and a portion of their nose (see Fig. A.2 in the Appendix). Subjects are asked to identify the emotion being experienced by the actor. Subjects who record a greater number of correctly-assessed scenarios are thought to be those who are more capable of attributing mental states (beliefs, desires, intents, etc.) to oneself and others, while understanding that other people might have mental states that differ from their own (Baron-Cohen, 1991). Such a skill can be expected to enable one to understand that mental states can be the cause of the behavior of others.

Cooperative behavior requires an individual to form expectations about the preferences and beliefs of the partner. Being able

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[1] In a related but distinct argument, Serrano and Zapater (1998) consider a theoretical model where many players are paired into couples to play repeatedly a Prisoner's Dilemma. An additional prize for the couple who generates the greatest payoff is earned. Such an environment encourages cooperation. Thus, if a subject believes his/her grouping is competing with other couples in the laboratory, cooperation can arise.

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to use these expectations to appreciate the payoff from his/her choices is advantageous. Developed by Rothenberg (1970) social sensitivity, defined as the ability to accurately perceive and comprehend the behavior, feelings, and motives of other individuals, encapsulates the ability of an individual to interact socially in a cooperative environment.[2] The ability to appreciate the mental states of others, as measured by a ToM assessment, should prove to be valuable. Thus, one would expect that differences in Eyes correlate with a subject's decision to engage in cooperative behavior. An ability to appreciate one's own incentives and the incentives faced by one's partner can be expected to correlate with an individual best responding.

To examine the relationship between comprehension of mental states and (un)cooperation, a laboratory experiment is conducted. Subjects played the Prisoner's Dilemma Game. In it, two subjects are randomly and anonymously paired in a one-shot game. Each simultaneously selects one of two actions. Subjects also engage in the Eyes assessment. The relationship between their score on the assessment and their behavior in the laboratory is analyzed. In the laboratory game, approximately 60% of the subjects select the cooperative strategy (similar to Dal Bo and Frechette, 2013; Rand and Nowak, 2013 findings). Subjects who score higher on the Eyes assessment cooperate less. Consequently, they earn a greater payoff in the game. This result is robust to the inclusion of risk and ambiguity preferences, along with measures of competence levels.

2. Methods

There were 141 subjects who participated. Undergraduate students were recruited and were informed that they would be financially compensated for their participation.

Upon signing up, subjects completed an online survey. The survey collected background information, decision making under uncertainty responses, intelligence assessments, and the Eyes test was implemented. The decision making under uncertainty assessments included an assessment of the Allais and Ellsberg paradoxes and a measure of risk aversion.[3]

The "Reading the Mind in the Eyes" test was developed by Baron-Cohen (1991). The assessment provides thirty-six photographs of actors and actresses showing the facial region around the eyes. The subject is asked to choose which of four words best describes what the person in the photograph is thinking or feeling. These words refer to both basic mental states (e.g., happy) and complex mental states (e.g., arrogant). The assessment aims to evaluate social and emotional cognition. It has been used to evaluate the effects of schizophrenia (De Achával et al., 2010), autism (Baron-Cohen, 2009), eating disorders (Adenzato et al., 2012), Asperger Syndrome (Senju et al., 2009), bipolar disorder (Derntl et al., 2009), and social anxiety (Machado-de-Sousa et al., 2010) to name a few. It also has been shown to relate to biological factors. For example, ToM is promoted by the administration of Oxytocin (Domes et al., 2007), inversely correlated with fetal testosterone exposure (Chapman et al., 2006), and independent of episodic memory (Rosenbaum et al., 2007). Short-term improvements can be facilitated through literary fiction (Comer Kidd et al., 2013).

Approximately 1–2 weeks after completing the survey, the subjects were asked to report to an experimental lab. The subjects were randomly assigned to a computer cubicle and informed they

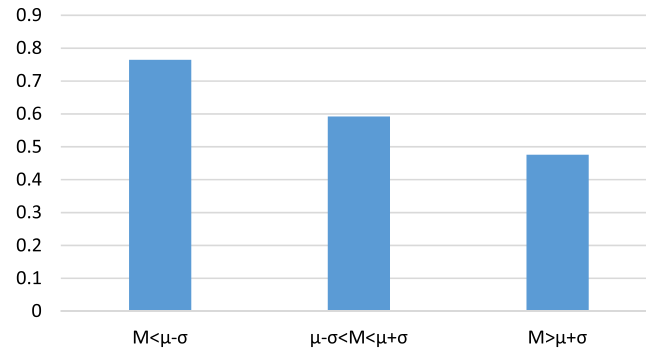

Fig. 1. Theory of mind and cooperation.

would be randomly and anonymously paired with another subject in a one-shot game.

A one-shot Prisoner's Dilemma Game was implemented in the laboratory. Along with the instructions, a payoff matrix was shown on the computer screen (presented in the Appendix).[4] The game was played once. We create the variable Prison that takes on a value of one if the individual selected the cooperative action, and zero if s/he selects the dominant strategy.

The payoff from the game was added to the $15 the subject was paid for completing the survey and the $5 show-up payment. The average payment earned in the Prisoner's Dilemma was $2.74.

3. Results

Of the 141 subjects, 59.6% of them selected the cooperative strategy (*Cooperate* $= 1$). The mean score on the Eyes assessment is 27.1 (out of 34), with a standard deviation of 3.7. In the risk assessment, 77% of the subjects are recorded as being risk averse.

Does a subject's ToM correlate with their behavior? Fig. 1 presents the proportion of subjects who selected the cooperative strategy across various values of *Eyes*. The sample is broken down into those observations where the ToM measurement (M) is greater than one standard deviation above the mean ($\mu + \sigma$), those within a standard deviation of the mean, and those where the measurement is more than one standard deviation below the mean ($\mu - \sigma$).

Subjects with the highest values cooperate the least. Those who score more than one standard deviation above the mean cooperate less than 48% of the time. Those who score more than one standard deviation below the mean cooperate over 76% of the time.

A binary probit model is estimated with *Cooperate* as the dependent variable. Background controls for gender, year in school, undergraduate major, and session fixed effects are included. Risk and uncertainty preferences, along with competence measurements (a short IQ assessment and a vocabulary quiz), are included as control variables to take into account important differences between individuals. Table 1 presents the results.

The results indicate a strong, negative relationship between a subject's Eyes score and cooperation. Using the marginal effect at the mean, a one standard deviation increase in a subject's Eyes score decreases the probability of cooperation by 10.6 percentage points (a 17.2% decrease at the mean).

Gender, risk preferences, and competence also statistically significantly correlate with the decision to cooperate. Women, more risk averse, and those with lower vocab scores have higher levels of cooperation. The Eyes score is pairwise uncorrelated with

2 Baron-Cohen et al. (1997) explicitly use ToM assessments to gauge social sensitivity in adults.

3 A copy of all assessment used are available upon request.

4 Fig. A.1 in the Appendix provides the visualization seen by the subjects. All subjects made the Up or Down decision.