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Second-order beliefs in reputation systems with endogenous evaluations – an experimental study

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ABSTRACT

We investigate a repeated public good game with group size two and stranger matching. Contributions are public information and each participant evaluates her partner's contribution. At the beginning of each period, participants receive information regarding the evaluation of the previous period. Evaluations are subjective judgments, hence our reputation system allows for some degree of noise. There are two information treatments: Each participant receives information either about her partner's evaluation, or about her own and her partner's evaluation. The results show that although participants condition their contributions on their partners' evaluations, this information alone is insufficient to raise contributions. Only if participants also know their own evaluations, we find an increase in contributions.

1. Introduction

In most experiments reputation is noise-free information about past behavior. An individual's reputation is modeled as information about her choices in previous periods of a repeated game. It is common knowledge how actions translate into reputation. Reputation does not contain noise and an individual can infer her own reputation from her past action. Examples are helping games (Milinski et al., 2002; Bolton et al., 2005; Seinen and Schram, 2006; Engelmann and Fischbacher, 2009) and trust games (Bohnet et al., 2005; Bracht and Feltovich, 2009; Charness et al., 2011; Huck et al., 2012).

In contrast to this, reputation is noisy if it is based on subjective evaluations (Abraham et al., 2016), and if there are strategic concerns in giving evaluations (Bolton et al., 2013). Moreover, in environments where formal institutions tracking and disseminating information are rare and information is transmitted informally (e.g., through word-of-mouth, gossip, see Sommerfeld et al., 2008), reputation is noisy. Reputation is a subjective belief about someone else. Since reputation is in the eye of the beholder, reputation is unobservable, but it is reasonable to assume that reputation is influenced by the available information. Uncertainty regarding the information content of the evaluation enters because there is uncertainty about how

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evaluations are given. As a consequence of noisy reputation, an individual cannot, with certainty, infer her own reputation from her own past actions.

In this paper, we investigate why cooperation rates are high in an environment that exhibits some (but not all) important characteristics of real-world reputation systems. We report the results of a repeated public good experiment with stranger matching. At the end of each period participants evaluate the behavior of their partners by assigning them zero to ten stars. At the beginning of the next period, participants get some information about evaluations. Evaluations are noisy signals of past behavior for two reasons: Assignments are not automatic but chosen by the relevant partners, and there are many possible schemes for assigning evaluations to actions (endogenous evaluation). The aim of this experiment is to inquire which kind of information about evaluations is relevant for fostering cooperation: information about the evaluation that the partner received for her behavior in the previous period, or information about one's own evaluation in addition to information about the partner's evaluation.

If reputation systems are present, two mechanisms fostering cooperation become possible. First, there is indirect reciprocity: Cooperate with those who have earned a good reputation.[2] Second, there is conditional cooperation: Cooperate with those whom you expect to cooperate with you, and use reputation as a predictor of cooperation.[3] Both mechanisms are perfect substitutes in noise-free reputation systems, but in noisy reputation systems there might be differences. This is because in noisy reputation systems there is uncertainty with respect to one's own evaluation, and this matters only for conditional cooperators. For an indirect reciprocator, her only problem is to classify her partner. For a conditional cooperator, classifying her partner is not enough. She would also like to know how her partner classifies her. These are second-order beliefs. A crucial element in forming second-order beliefs is that both participants know their own evaluation, in order to infer what the partner believes about themselves.

Noisy reputations have previously been investigated experimentally by Masclet and Pénard (2012) and Stahl (2013). Masclet and Pénard (2012) use a repeated trust game with an additional stage in which participants evaluate their partners. Within that design, they analyze how different reputation systems affect cooperation. They find that evaluations are strongly correlated with investment levels. Trust is highest in treatments in which participants simultaneously evaluate each other, and when participants sequentially evaluate each other, participants use negative evaluations as a means of reprisal against those participants who evaluated them negatively.

Stahl (2013) uses a repeated prisoners' dilemma with stranger matching. Each participant has a publicly observable, colored label which can be either green or purple. Every participant starts with a green label in the first period and, depending on the participant's behavior, the label changes. If a participant defects, the color of the label turns into purple. Since this is unknown to participants, there is uncertainty concerning the meaning of the different colors. Stahl (2013) found that participants are capable of learning the meaning of the colors and that participants condition their choices on the partner's labeling.

In contrast to Masclet and Pénard (2012), we do not vary how evaluations are given but analyze which kind of information about evaluations is relevant for fostering cooperation. In line with Masclet and Pénard (2012), we assume that reputation is unobservable while evaluations (from which reputation is derived) are observable.

In the next section, we describe the experimental design (section 2) before we derive the predictions and hypotheses (section 3). We turn to a descriptive and statistical analysis in section 4 and conclude in section 5.

2. Experimental design

Our experiment consists of three treatments. Treatment OTHER+OWN is a 15 period repeated public good game with varying partners. In each period, participants are randomly and anonymously paired using an absolute stranger matching. Each period participants make two decisions. First, participants choose simultaneously how much of their endowment to contribute to the public good. Each participant's endowment is $e = 3$ and contributions are restricted to $c = 0, 1, 2, 3$. Assume participant i is being matched with participant j. Then, participant i's payoff is given by $\pi_i(c_i, c_j) = 4(e_i - c_i) + 3(c_i + c_j) - 2$.

Second, after participants are informed about choices and payoffs, each participant evaluates the other participant's contribution decision. Participants simultaneously assess each other's decision by assigning between 0 and 10 stars. Participants are explicitly told that 0 stars corresponds to the worst and 10 stars to the best possible evaluation. Participants are rematched and the next period begins. At the beginning of each period but the first, participants receive information about their own and their partner's evaluation.

We decided to use 0 to 10 stars for evaluations to ensure that evaluations are noisy signals. With another scale, say 0–3 stars, an obvious strategy would be to evaluate a contribution of x by assigning x stars, which would make it possible for participants to infer their own evaluations from their own actions.

Treatment OTHER is similar to OTHER+OWN. The only difference is that in OTHER, participants only receive information about their partner's evaluation.

[2] Our definition of indirect reciprocity follows Nowak and Sigmund's definition of downstream indirect reciprocity: i cooperates with j because j has received a good evaluation from k in a previous interaction (see e.g., Nowak and Sigmund, 1998, 2005).

[3] We use conditional cooperation to refer to cooperative behavior driven by the expectation about the partner's cooperativeness. For experimental evidence on conditional cooperation see, e.g., Keser and van Winden (2000), Fischbacher et al. (2001), Gächter (2007) or Chaudhuri's (2011) survey.