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Discriminating strategic reciprocity and acquired trust in the repeated trust-game

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Abstract

In repeated trust-game offers made by investors can be attributed to strategic reciprocation-based behavior. However, when a trustee is loyal, personal trust can build up between players, in the same way that lack of positive reciprocation on the part of trustees can motivate investors' distrust. Acquired personal trust or distrust and strategic reciprocation of the opponent's offers have then a cumulative and convergent influence on behavior in the trust game and are not prima facie distinguishable. We propose an experimental protocol which discriminates between these two determinants of trust. We furthermore show that acquired trust is the mere outcome of anonymous repeated interactions taking place during the experiment in the sense that it does not co-vary with an initial and independent baseline disposition to trust among investors: acquired trust crowds out background trust. Moreover, offers are sensitive to the amount and variance of trustees' returns. High returns-rate contribute to increase acquired trust between the players while the volatility of trustees' counter-offers makes them perceive as opportunistic, triggers investors' strategic behavior and detriments the acquisition of personal trust.

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1. Introduction

In one-shot investment or trust-games (Berg *et al*. 1995) the theoretical expectation is that the investors play strategically and make null offers but we observe in fact frequent positive offers. Offers above the null theoretical equilibrium are then interpreted as demonstrating the investor's altruism (Glaeser *et al.* 2000 Fehr and Gächter 2000, Kanagaratnam *et al.* 2009), kindness (Ashraf *et al.* 2006), calculation (Rotter 1980, Williamson 1993, Hardin 2002 Mc Cabe *et al.* (2003)), his risk aversion (Houser *et al.* 2004, Eckel and Wilson 2004), or, simply, his disposition to trust a partner (Berg 1995). The structure of the one-shot trust game naturally elicits behavior from first movers that is motivated by trust as well as by unconditional altruism (Fehr-Schmidt 1999 and Bolton-Ockenfels 2000) models. Behavior by second movers is motivated by reciprocity as well as unconditional altruism.

In repeated trust games, by contrast, offers made by the investors are theoretically based on rational strategic reciprocation (see Mc Cabe *et al.* (1998) Cochard et al. (2004) and Ostrom and Walker (2005) for a review). But it cannot be excluded that mutual trust builds up between players. Bohnet and Huck (2004) compare the respective effects of reputation intrinsically built during a repeated trust game with exogenous reputation and document the lasting effects of trust built in the short-term repeated trust-game setting.

It is to note that in repeated trust-games strategy and trust are not distinguishable in the sense that fair returns from the trustee may generate both strategic positive reciprocation and induce trust in a more personal and less opportunistic way. Likewise, in the negative case, unfair returns tend to provoke negative reciprocation and induce distrust. In the repeated trust game, then, trust acquired during the sequential trades and strategic motives may constitute distinct factors influencing the investor's decision to trust. However, as the potential impact of these factors converge and fit with the overall theoretical prescription to reciprocate, it may seem difficult to disentangle their relative influence on trusting behavior. We nevertheless propose an experimental and analytical device to measure their relative impact on investors' offers through the repeated trust game.

In a seminal study Andreoni (1988) suggests that the subtraction of the average contributions in a repeated public goods game (same partners are involved all along) from the average contributions in a multiple one-shot version of that game (partners alternate in every period) yields a measure of the relative impact of learning and strategy. We borrow from Andreoni's approach the subtractive methodology and apply it to our two distinct experimental conditions in the trust-game, offering as we shall see a measure of the relative influence of strategy and acquired trust in analyzing investors' behavior. Closer to our own concerns, this type of subtraction was more recently used in order to discriminate between reciprocation and altruistic motives among second-movers of the trust-game and between strategic motives and a basic disposition to trust among first-movers (Cox 2004). Different groups of subjects were assigned different experimental conditions. In particular first-movers in the trust games were alternatively assigned to second-movers that could reciprocate or that could not (counter-offers were blocked), the subtraction between average offers in this two experimental groups isolating other-regarding preferences from strategic trust. Reciprocally, second-movers were

assigned to first-movers that could make offers or had not that possibility: the subtraction between average counter-offers in these two groups thus revealing the proneness of second-movers to act on mere reciprocation or on more altruistic motives.

We propose a manipulation of the informational structure of the trust game in order to distinguish between acquired trust and the influence of strategic motives over its repetition. Cox's methodology used one-shot interactions and provides an inter-individual measure while we look for a within-individual one and aim at a threefold distinction between background impersonal trust, personal trust acquired during repeated interactions, and strategic motives. In a final period of a trust game that has been played under an indefinite horizon by two players, we warn them that during the following five periods the same game will keep on being played with the notable difference that the trustee's returns will not be disclosed any longer to the investor and that this "blind" phase constitutes the end of the game. This manipulation presents several assets in order to screen out between acquired trust and strategic factors in the decision to trust. It is clear that during the blind phase investors anticipate that trustees will have strong motives to defect which should be reflected in investors' offers. If one compares the average offers made by investors in the blind phase with their individual offers in a one-shot game, one obtains a quantitative indication of the level of personal trust acquired during the game by contrast with impersonal generic trust. Furthermore, the difference between average offers in the open repeated trust game and the blind phase retrospectively shows the proper impact of strategic reciprocation in guiding trust-behavior in the trust game.

We present in section 2 the experimental trust game that we submitted to a population that replicated the typical results obtained in past trust game experiments and we detail in the methodological section 3 below by what means and in what terms we can obtain actual measures of the relative impact of background trust, reciprocation-based strategic behavior and acquired trust in investors' offers. We apply our methods and model our data in results section 4. We furthermore analyze, in that section, what particular behavioral patterns of the trustee may influence the investor's decision to trust in the sense that is captured by our experimental device. Section 5 concludes.

2. Experimental design

Procedures

Subjects (93 pairs) were introduced to the experimental economics laboratory at the University of Picardie. Each participant sat in front of an individual computer isolated from other players in the laboratory and could read the experimental instructions on the screen. They had to raise their hands prior to ask a question in case they had doubts about the instructions. They were informed that they would play the trust game, which was described to them on the screen, either in the position of investors or trustees. Trustees and investors were located at two different laboratory premises. They were informed that they were randomly paired with other actual human players located in another room of the laboratory. Our computer network allowed us to randomly associate every investor with one trustee in the other room. The identity of partners was not disclosed. Each investor was endowed with €10 at the beginning of each period and decided to yield a portion of this endowment to the trustee. When invested, the sum was tripled and the amount obtained displayed on the

trustee's screens. The entrusted trustee had then to decide how much he wanted to return to the investor. They successively played the three steps of our experiment.

Step # 1: One-shot anonymous trust game (OSG).

In that step, participants played the one-shot trust game as originally described by Berg *et al.* (1995). Once this single exchange had taken place among the players, every participant was randomly paired with another partner and had known in advance that he would not be paired with the same partner for the second step of the experiment.

Step # 2: Repeated trust-game (LP)

In this step, the trust game was repeated and included 10 periods forming a trust-building or learning-phase (LP), in which counter-offers by trustees were disclosed after each exchange. Pairs of players remained identical during the whole phase, which was played under indefinite temporal horizon, in the sense that participants were not told for how many periods this stage of the game would last.

Step #3: Final blind phase (BP)

Pairs of players engaged in the standard repeated trust game in step #2 played a blind 5-periods phase (BP) in which the nature of counter-offers was left unknown until the end of the experiment. During that stage of the game, therefore, investors had to decide to invest "blindly" in their associated trustee. At the beginning of the LP, participants had not been warned of the upcoming BP. The blind phase, however, is played under commonly known finite horizon, participants being explicitly warned at its onset that it would last for five periods.

Remuneration of participants was implemented by randomly drawing one of the periods of the experiment (OSG, LP or BP). Participants were informed in advance of that incentive procedure which took place at the end of the experiment.

3. Methodological contribution

We purport to measure the relative influence of three potential distinct factors determining offers in our repeated trust-game (LP). In the first place, the strategic reciprocation component of offers can be simply described as the difference between average offers in the BP and average offers in the LP. In the BP, investors have rational motives to lower their offers. The extent to which they do so can be considered a retrospective indication of the impact of strategic reciprocation motives in their trusting behavior in the LP. A second factor determining levels of offers in the LP is trust acquired during the repeated interactions in that phase of the experiment. Average offers in the BP may then be a way to capture the impact of acquired trust in contexts in which it is otherwise strategic to defect. Finally, as already specified, baseline impersonal trust is captured by positive offers in the OSG.

One further methodological asset of our device over the mere observation of end-game effects (Cochard *et al*. 2004; Norman and Wallace (2006)) and progressive free riding phenomena in cooperative games (Fischbacher et al. (2001), Andreoni 1988)) is that our blind phase is not

subject to a fluctuating resort to backward inductive reasoning. We can assign a precise starting point to expected opportunistic behavior. The onset of the blind phase and its potential strategic implications are immediately accessible to the players' mind. Moreover, as it is repeated over five periods, one is in a position to observe whether acquired personal trust or distrust has a lasting effect.

In the following j-exponents refer to pairs of players (investors/trustee: $j=\{1,\ldots, 93\}$), i-indices to phases of the games ($i=\{$ OSG, LP, BP$\}$) and t-indices to the periods of the game ($t=\{1,\ldots, 15\}$ where $t=\{1,\ldots, 10\}$ refers to the LP periods and $t=\{11\ldots 15\}$ to the BP periods. $\bar{xi}$ refers to the average of x in the period i. For instance, if s is the amount of money transferred by an investor to a trustee $\bar{s}^j_{BP}$ refers to the average investment of investor j during the blind phase of the game, namely:

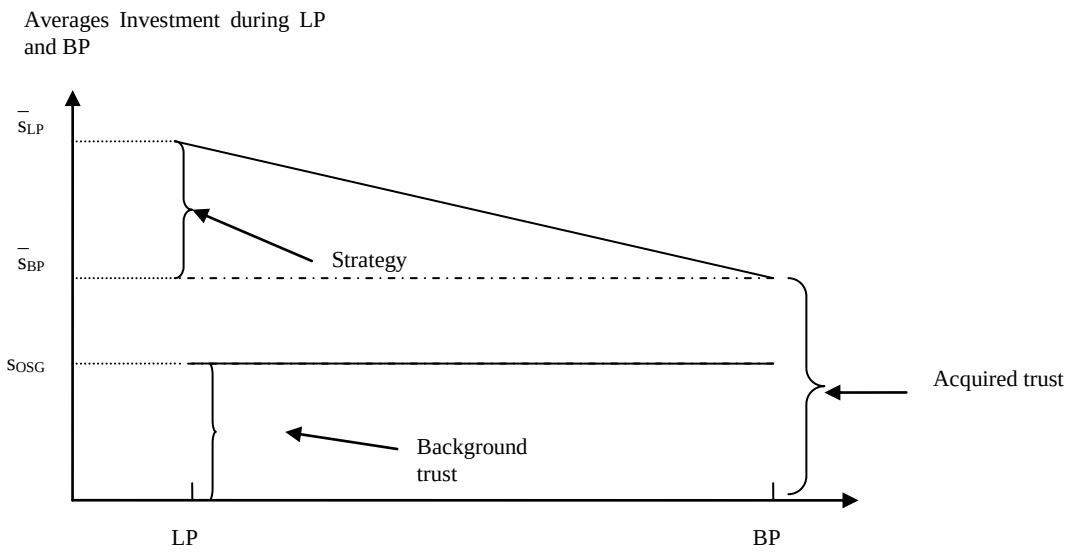
$$\bar{s}^j_{BP} = \sum_{t=11}^{15} \frac{s^j_t}{5}.$$

The three main effects captured through our protocol can then be characterized as:

$$\begin{cases} \text{Strategy}^j = \bar{s}^j_{LP} - \bar{s}^j_{BP} & \forall\, j=\{1,\ldots, 93\} \\ \text{Acquired trust}^j = \bar{s}^j_{BP} & \forall\, j=\{1,\ldots, 93\} \\ \text{baseline impersonal trust} = s^j_{OSG} & \forall\, j=\{1,\ldots, 93\} \end{cases}$$

Figure 2 below describes the average offers by an investor during the LP, BP and OSG. Investments are partitioned according to their determinants in the corresponding phases: strategic reciprocation, acquired trust, and background impersonal trust.

Figure 1. Decomposing investment
into strategy, impersonal trust, and acquired trust



By experimentally isolating the existence of acquired trust, strategically induced reciprocation and exogenous anchored individuals' trusting dispositions, we make an analysis of the relative impact of the strategic and personal components of trusting behavior possible. In particular,

we can examine which of the level of return-rates of counter-offers made by the trustee or of the variability of these counter-offers more closely determine the investor's decision to trust. The question, here, is to know whether trust results from a trade-off between return rates and their variance. We expect that strategic reciprocation more significantly depends on how the trustee is perceived to be opportunistic, because of his return-rate's volatility, than on the average level or generosity of his counter-offers. But differently, acquired trust should be determined both by how the trustee is deemed opportunistic, as seen through the volatility of his returns, and his generosity. We also expect that acquired trust be positively correlated with the investor's offers in the LP and wonder how it may also depend on a baseline level of trust as captured on the OSG.

4. Results

4.1 Overview

During the learning phase the average offer is $\bar{m}_{LP}$ = 6.16€, while participants invest $\bar{m}_{BP}$ = 5.15€ during the blind phase . The average offer in the OSG is 4.85€.

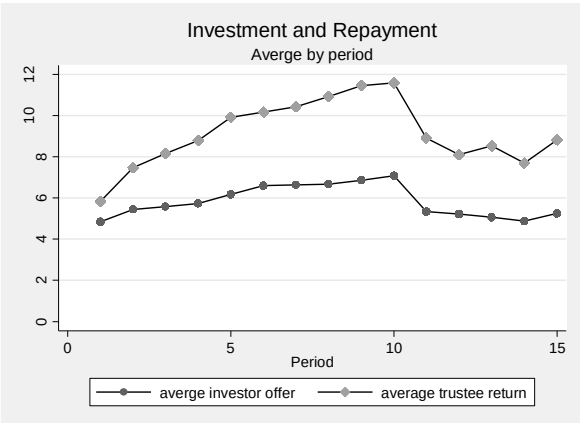


Figure 2: Investment and return

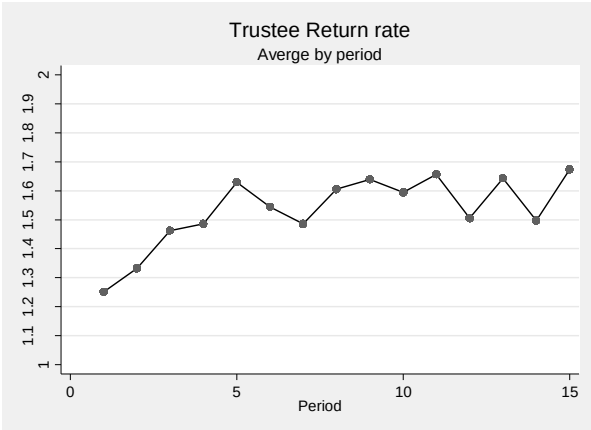


Figure 3: Return rate

Offers decrease at the onset of the blind phase according to theoretical predictions. The difference between LP and BP is significant: the Wilcoxon test on paired data rejected the null hypothesis H0: $\bar{s}_{LP} = \bar{s}_{BP}$ (with p-value = 0.000). This result is in accordance with the theoretical prediction that it is in their interest that investors make positive offers in the LP and refrain from doing so in the BP.

R1: *Average offers in the LP are significantly higher than average offers in the BP.*

Moreover, investment behavior seems to be robust during the BP: offers are stable and there is no end-game effect during that final phase of the experiment (see Table I). Non-parametric Pearson test shows that the difference between average offers during the Blind Phase (periods 11-15) is not significant. These results confirm that the blind phase can be considered to install a controlled and multi-periods end-game effect.

R2. *Investment behavior is stable during the BP*

Table I: « End-BP" effect

Equality of medians test	Pearson (p-value) Number of observations
H0 : $\bar{s}_{11}= \bar{s}_{12}= \bar{s}_{13}= \bar{s}_{14}= \bar{s}_{15}$	0.2264 (0.994) 465
H0 : $\bar{s}_{14}= \bar{s}_{15}$	0.0218 (0.883) 186

4.2 A crowding effect of acquired trust over baseline trust

We surmise that average offers in the BP are jointly explained by average offers in the LP and offers in the OSG. First, the formal structure of the game in the BP is similar to the one in the OSG. In both cases investors may experience an opportunistic partner. Motivations of players in both situations may then be presumed invariant. However, what varies between OSG and BP is the amount of information about a specific trustee that has been acquired by the investor during the LP. Even though the motives during the LP may have been strategic, a specific profile has emerged. It is the impact of this learnt profile on offers in the BP that we wish to measure, in spite of the fact that structurally OSG and BP share similar informational structure.

Using a double censored Tobit, the model (1) below explains average offers in the BP and shows how they depend on background impersonal trust (OSG) and average offers in the LP:

$$\bar{s}_{BP}^{j} = \begin{cases} 0 & \text{if } \bar{s}_{BP}^{j}* \leq 0 \\ \bar{s}_{BP}^{j}* & \text{if } 0 < \bar{s}_{BP}^{j}* < 10 \\ 10 & \text{if } \bar{s}_{BP}^{j}* \geq 10 \end{cases}$$

(1) $$\bar{s}_{BP}^{j}* = \alpha_0 + \alpha_1 \bar{s}_{LP}^{j} + \alpha_2 s_{OSG}^{j} + \varepsilon^{j} \qquad j=\{1,\ldots,93\}$$

where ε is the error-term.

If we admit that trusting behavior in the BP and the OSG has the same determinants (namely baseline generic trust and strategic altruism or reciprocity), if we also consider that the LP brings new relevant information, then the factor α_1 in our model (1) above will significantly differ from 0. We can expect it to be positive in the sense that higher offers in the LP will tend to be followed by higher offers in the BP, and conversely.

Influence of offers in the OSG remains indeterminate. Alternative focus on the factor α_2 is expressed by the two following hypotheses. For a fixed trustee's behavioral pattern, an investor having disclosed a strong impersonal generic disposition to trust by transferring a

large amount of money in the OSG will tend to build up a more important level of trust in the subsequent repeated interactions than a less generous investor. Under that hypothesis, the coefficient α_2 of offers in the OSG should be positive and significant and acquired trust could result from both offers in the LP and offers in the OSG.
Alternatively, one may consider that some substitution occurs between generic background trust and specific and interpersonal acquired trust, the first bearing no specific influence on the second one. Under that hypothesis, the coefficient α_2 of offers in the OSG should not be significant and acquired trust could then simply result from average offers in the LP.

Results of the estimation are given in Table II below where only the average investment in LP is positive and significant. We could have expected a positive correlation between background generic trust and the ability to build-up trust through short-run interactions in the LP, but it happens that the impact of the outcome of these interactions cancels out exogenous social considerations, which is a result confirming Bohnet and Huck (2004). So, in spite of similar information structure in the OSG and the BP, and in spite of the plausible presumption that the same behavioral motives (baseline and strategic trusts) are common to these two experimental settings, we must note the fundamental influence of the LP which tends to substitute personally acquired trust to background trusting dispositions.

R3. *Trust or distrust acquired during the LP crowds background impersonal trust as captured on the OSG out.*

4.3. The determinants of acquired trust

Acquisition of trust depends at least on two behavioral factors which, namely, are the personal benefit one can retrieve from being trustful and the predictability of ongoing interactions respectively perceived through the lens of the level of expected returns and their variance.

Let r be the amount a trustee returns to an investor and $rr = r/s$ the return-rate. The average return-rate in the LP is noted $\overline{rr}$, and its standard deviation σ_{rr}.

$$\begin{cases} \overline{rr} = \sum_{t=1}^{10} \frac{rr_t}{10} \\ \sigma^2{}_{rr} = \sum_{t=1}^{10} \frac{(rr_t - \overline{rr})^2}{10} \end{cases}$$

We use a double censored Tobit (model 2) to estimate the respective influence of return-rates and their standard deviation in the LP over trust acquired during that phase of the game. In particular we expect that acquired trust increases according with the level of trustees' returns and decreases when those returns have higher variance. Statistical results presented in Table II validate our expectations since both the average return-rate and its standard deviation are significant at the 5% level.

$$\overline{s}_{BP}{}^{j} = \begin{cases} 0 & \text{if} \quad \overline{s}_{BP}{}^{j}* \leq 0 \\ \overline{s}_{BP}{}^{j}* & \text{if} \quad 0 < \overline{s}_{BP}{}^{j}* < 10 \end{cases}$$

$$10 \quad \text{if} \quad \bar{s}_{BP}^{j} * \geq 10$$

(2) $$\bar{s}_{BP}^{j*} = \beta_0 + \beta_1 \, \overline{rr}^{j} + \beta_2 \, \sigma^{j}_{rr} + \varepsilon^{j} \qquad j=\{1,\ldots,93\}$$

R4. *Acquired trust will be fostered by the trustee's stable behavior. Acquired trust is increased by higher return-rates in the LP and decreases according to their variance.*

4.4. The determinants of the strategic component of investors' offers

Strategic reciprocity can be defined as a pondered reaction to the partner's behaviour. Its joint determinants are returns (the level of counter-offers) and their variance. Returns are an indication of the profitability of trust. Variance makes salient the risky nature of investments in the trust-game. We expect that within the limits of this strategic apprehension of the game the offers made by the investor increase along with return-rates in the LP and decrease with their variance.

The determinants of the strategic aspect of offers in the LP have been studied in the light of the double censored Tobit (3) below:

$$\text{Strategy}^{j} = \begin{cases} 0 & \text{if} \quad \text{Strategy}^{j*} \leq -10 \\ \text{Strategy}^{j*} & \text{if} \quad -10 < \text{Strategy}^{j*} < 10 \\ 10 & \text{if} \quad \text{Strategy}^{j*} \geq 10 \end{cases}$$

(3) $$\text{Strategy}^{j*} = \gamma_0 + \gamma_1 \, \overline{rr}^{j} + \gamma_2 \, \sigma^{j}_{rr} + \varepsilon^{j} \qquad j=\{1,\ldots,93\}$$

Results given in Table II show that only the standard deviation of return rates is significant to account for the strategic component of offers. The correlation between that strategic component and the standard deviation of offers is also significant[1]. Interestingly the average of return rates is not significant, showing that the most salient feature in the game that determines the investor's decision to behave strategically is his partner's behavioral stability more than his generosity.

R5. *The amounts transferred due to strategic reciprocation during the LP significantly decrease with the volatility of return-rates. On the other hand, it does not depend on the level of return-rates themselves.*

[1] p-values associated with non parametric Spearman correlation tests are respectively 0.304 for the correlation between strategy and $\overline{rr}$ and 0.063 for the correlation between strategy and σ_{rr}.

Table II Models Estimations

Variable	Model 1 coefficient (p-value)	Model 2 coefficient (p-value)	Model 3 coefficient (p-value)
$\bar{s}_{LP}$	0.8568 (0.000)**		
$\bar{s}_{OSG}$	0.027 (0.841)		
$\overline{rr}$		2.6836 (0.037)*	-1.16 (0.181)
σ_{rr}		-4.2061 (0.001)**	-1.70 (0.043)*
Constant	-.01566 (0.825)	3.509 (0.078)*	3.66 (0.008)**
Log Likelihood	-197.95 (0.000)**	-213.82 (0.000)**	-199.74 (0.041)*
Number of observations	93	93	93

* : 5% significant
**: 1% significant
() p-value

5. Conclusion

Results on the blind phase of our experimental protocol offer a precise apprehension of acquired personal trust by comparison, respectively, with undirected (or impersonal) trust as captured on one-shot trust-games and with strategic trust based on reciprocation which is captured through the standard repeated trust game. A result that was made possible through the application of our experimental methodology is that acquired trust is the mere outcome of anonymous repeated interactions taking place during the experiment in the sense that it does not co-vary with an initial and independent level of trust. In other terms, acquired trust crowds out background generic trust.

A second significant result is that offers in the trust game are sensitive to the amount and variance of trustees' returns. High return-rates contribute to increased acquired trust between the players while the volatility of trustees' counter-offers tends to make the latter being perceived as opportunistic, triggers investors' strategic behavior, and detriments the acquisition of personal trust. The use of our methodological device was initially motivated by the difficulty, through the direct analysis of behavior in the standard repeated trust game, to discriminate between the converging effects of pure and strategic trust on the investment decisions. We managed to isolate those relative influences.

A further justification of our approach along the same lines relies on the fact that the variance of trustees' counter-offers has a similar influence on the acquisition of personal trust and on the use of a reciprocation-based strategy. Contributing a method to distinguish between

interactively acquired trust, a more generic disposition to trust, and pure strategic motives in playing the trust game may increase the empirical relevance of game-theory.

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