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Reputations in mixed-role markets: A theory and an experimental test

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ABSTRACT

The traditional understanding of reputation systems is that they secure trust between strangers by publicly calling out cheaters. In modern, online markets, it is increasingly common for providers of a good to also act as consumers, and vice versa. We argue that in such mixed-role markets, reputation systems serve a second important function: They allow providers who lend out their possessions (such as their house, car or tools) to earn reputational credits that can be spent on future borrowing, especially when lending lacks monetary compensation. In an experiment that introduces a new game, "the Lending Game", we show that, consistent with our argument, information on past lending leads subjects to lend to those who have themselves lent before, increasing overall lending. However, when lending is financially compensated, this mechanism of reciprocal lending ceases to operate.

1. Introduction

The Internet opens up the possibility for interaction and economic exchange between strangers all around the world. Online exchange is characterized by anonymity, and strangers often interact without the prospect of future interactions (Kuwabara, 2015; Parigi et al., 2017). Individuals may benefit from exchange mediated by online environments, but with limited information and limited control over the decisions made by others, there is always the threat that one's trust is abused. A seller may not deliver after payment, a buyer may not pay after delivery, and a borrower may not return a lent good in time or intact.

Reputation systems are widely used to overcome trust problems in exchange between strangers (Cook, 2005). These systems inform individuals about past behavior of potential exchange partners. The positive effect on trust of the classic, single-role reputation system in which one actor only acts in one role (e.g. either as provider or as user) is well established in the existing literature (Boero et al., 2009; Bolton et al., 2004; Charness et al., 2011; Duffy et al., 2013; Fehrler and Przepiorka, 2013). However, individuals increasingly act in multiple roles in modern-day exchange, acting as supplier of a good or service in one transaction while being on the receiving end in another (Cova et al., 2011; Ritzer and Jurgenson, 2010). For example, consumer-to-consumer marketplace eBay allows individuals to both buy and sell, peer-to-peer hospitality services Couchsurfing and Airbnb allow home owners to open up their houses to strangers, while staying at others' homes when traveling themselves (Lauterbach et al., 2009), and crowdfunding platform Kickstarter allows individuals to raise funds for their own projects and to fund projects of others.

In such cases where the lines between actors in different roles are blurred, a new type of reputation system emerges. This mixed-role

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reputation system allows individuals to not only examine another individual's past behavior in his or her current role, but also past behavior in other roles. For example, Couchsurfing hosts cannot only view ratings potential guests received from other hosts, but also reviews these potential guests received from other guests when they were host themselves.

Mainstream theory of reputation systems suggests this information is, at best, of secondary importance, because the best indication of whether someone can be trusted is that they have honored the trust they received in the past, not whether they themselves have trusted other people (e.g., Buskens and Raub, 2002). Yet anecdotal evidence suggests that this extra information is actually a very important criterion for platform users when making decisions. For example, on online forums Couchsurfing hosts said: *'One thing that may help is to host, if you're not already. That's the first thing I look for whenever I get a request. If they've hosted before and the review was positive, I almost always accept'* [them as a guest]*'* (Reddit, 2015) and *'One thing I have considered is only hosting people who are themselves active hosts'* (Quora, 2016). Research among Couchsurfing hosts suggests that hosts care about potential guests' past hosting behavior and that it is considered a general principle that one should alternate between surfing and hosting (Geiger, 2015; Geiger and Germelmann, 2015). On Couchsurfing, the number of times a member has surfed and hosted are highly correlated (Lauterbach et al., 2009), consistent with the notion that Couchsurfing users care about a balance between hosting and surfing experiences. The purpose of this manuscript is to develop and experimentally test an explanation for the apparent importance of other-role reputations in modern mixed-role markets.

Not only free platforms such as Couchsurfing use this mixed-role reputation system. Car sharing platform Turo allows car owners to rent out their car to others and shows both reviews from travelers and reviews from car owners in the user profiles of car owners. The distinction between monetized exchange that includes financial remuneration (selling, renting etc.) and non-monetized, free exchange (e.g. lending) is relevant here, because the motivation of the users to participate in exchange is different. In the case of monetized exchange, individuals may decide to take the risk because they believe the monetary benefits outweigh the risk. In free exchange, there are no direct material benefits related to placing trust, so other motivations may play a larger role. Placement of trust, i.e., lending something valuable without financial compensation, is then easily viewed as an act of generosity or kindness. We argue that this difference between paid and free platforms not only leads to an overall difference in trust levels, but also to a difference in the effectiveness of implementing a mixed-role reputation system.

Thus, although mixed-role reputation systems are increasingly common, especially in online exchange, existing theories about single-role reputation systems do not provide an explanation for why and when this extra reputation information affects trust. In the current paper we study markets in which users take multiple roles. We develop a theoretical framework explaining why information about the other role is important when making decisions and how that affects trust at the platform level. We argue that the effect of mixed-role reputation systems is stronger for platforms where goods or services are provided for free than on platforms where users have to pay. We perform a test of the theory in a controlled laboratory experiment in which we compare the effect of the single-role reputation system with the mixed-role reputation system in both paid and free exchange.

2. Theory

In the scenarios we study, individuals alternate between the role of provider and user.

2.1. Game structures of paid and free exchange systems

The classic understanding of how reputation systems help achieve trust in markets can be well explained using the analytical tools of game theory (Kreps, 1996). We use games as abstract representations of markets in which we quantify the incentives for the actors.

2.1.1. Paid exchange systems as a Trust Game

The situation in the direct (paid) exchange is typically represented as a Trust Game (Coleman, 1990; Dasgupta, 1988; Kreps, 1996). The left panel of Fig. 1 shows the structure of a one-shot Trust Game without a reputation system. In this figure, T, R, P and S represent the material payoffs of the actors. In the Trust Game, a "trustor" first chooses whether to place trust or not. If the trustor decides not to place trust, the game is over and both players receive payoff P_i. For example, if a car owner on Turo decides not to rent out the car, the user cannot make use of the car and the car owner will not receive the payment from the guest. If the trustor decides to place trust (i.e., decides to rent out the car), the "trustee" (the car user) can choose to honor the trust he received (i.e., return the good in a good state) or abuse (i.e., not return the good, or not return the good in a good state).[1] If the user honors, both car owner and user are better off than when the request is not accepted, because the car owner receives the payment and the user can drive a car. In that case, both players receive a payoff of R_i that is higher than the payoff P_i that they would receive if no trust was placed. If the user however decides to use the car in a way that induces costs for the owner, e.g. by smoking in the car or by using the car for moving houses, the user benefits more than when he or she would have refrained from smoking or using the car for moving, while the host would have been better off

[1] To facilitate the distinction between trustors and trustees, we refer to the trustors with female pronouns and to the trustees with male pronouns.

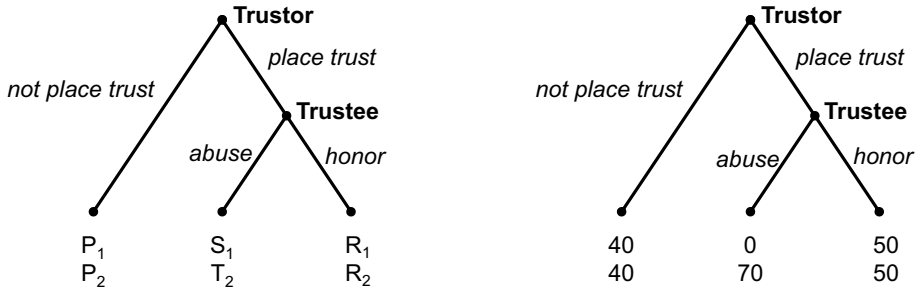

Fig. 1. Left panel: one round of the Trust Game without reputation system, where $R_1 > P_1 > S_1$, $T_2 > R_2 > P_2$ and $P_1 + P_2 > S_1 + T_2$. Right panel: numerical example used in the current experiment.

when the user would not have rented the car at all. In the Trust Game, this incentive structure is represented by the car owner receiving a payoff of S_1 that is smaller than P_1 and the user receiving a payoff T_2 that is larger than R_2.[2,3] A numerical example of the Trust Game is shown in the right panel of Fig. 1.

Under the standard game-theoretic assumptions of rationality and selfishness, trustors in a one-shot Trust Game would anticipate that trustees will always abuse when they get the chance. Trustors would therefore not place trust. Yet this is not a Pareto-optimal outcome: both trustor and trustee would have been better off had the trustor placed trust and the trustee honored.

2.1.2. Free exchange systems as a Lending Game

To characterize the indirect (free) exchange situation, we introduce a new game, the "Lending Game" (Fig. 2 shows a one-shot game without a reputation system). In the Lending Game, just as in the Trust Game, a trustor decides whether to place trust or not. For example, a Peerby user can decide to lend out a good for free to a neighbor or not. Lending out goods is beneficial to the borrower but comes at a cost to the owner of the good.[4] Even if the borrower honors the trust he received (i.e., returns the good in a good state), the owner needs to spend some time and effort arranging a meeting with the borrower and the owner cannot use the good for the time the user is borrowing it. If the borrower abuses the trust he receives (i.e., does not return the good, or does not return the good in a good state) the owner suffers a considerable material loss. In this situation, the trustor is always worse off when she places trust than when she withholds trust, even when the trustee honors the trust he received $(R_1 < P_1)$.

The unique Nash equilibrium for one-shot play of this game is the same as in the Trust Game: the trustor does not place trust. In contrast to the Trust Game, however, this equilibrium is Pareto-optimal: Neither party could have been better off, without the other being worse off. Nonetheless, it does not maximize overall welfare, as the borrower (trustee) could have been made a lot happier at a small price to the owner (trustor).

2.2. Reputation systems

Reputation systems are often mentioned as a very effective means for solving the social dilemmas described above if the trustee expects to face other trustors in the future. These systems collect, aggregate and distribute feedback about trustees' past decisions to trustors (Resnick et al., 2000).[5] Reputation systems are thought to increase trust because they allow trustors to assess the trustworthiness of trustees (*learning*) and because they allow for rewards and punishments (*reciprocity*), thereby providing an incentive for trustees to show trustworthy behavior, and because they allow trustors to conditionally place trust (*control*). We will proceed with describing the learning, reciprocity and control mechanisms in more detail.

First, if we assume that there is variation in the extent to which individuals are willing to give up their own payoff to increase other

[2] We further assume that $P_1 + P_2 > S_1 + T_2$, which avoids that alternating between being abused and abusing results in a higher payoff than not placing or receiving trust at all. Namely, it is implausible that the gains from abusing someone outweigh the material loss and immaterial harm suffered when abused by someone else.

[3] Most platforms for online exchange provide insurance that covers damage that can be proved to be caused by the user of the good. However, when the cause of the damage is unclear (e.g. in case of a small scratch on a car) or when it is hard to immediately detect the damage (e.g. damage to the gears or breaks of a car due to wear and tear) or when it is unclear who is responsible for the repair costs, insurances may not cover the damage and trust plays a role. Then, even with insurance in place, the Trust Game would still accurately represent material incentives on paid platforms with single-role reputation systems.

[4] Online interactions in two-sided markets are often followed by offline interactions which in some cases induce additional (non-material) costs and benefits and informal gift exchange. For exchange, for Couchsurfing guests it is common practice to bring a small gift for the host and to spend some time together. However, the extent to which provider and consumer spend time together differs to a large extent between platforms and is decreasing with technological advantages (e.g. smart locks), we focus on the material costs and benefits that are mediated by the platform.

[5] In many real-life situations, provision of reviews is a social dilemma in itself, because review-writers do not benefit materially from writing the review, while everybody can access them (Diekmann et al., 2014). In the current paper we abstract away from this second dilemma, assuming that reputation information is provided automatically and without costs.

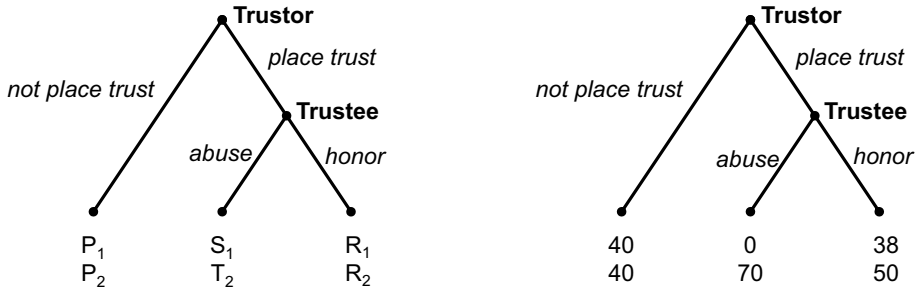

Fig. 2. Left panel: on round of the Lending Game without reputation system, where $R_1 = P_1 > S_1$, $T_2 > R_2 > P_2$ and $P_1 + P_2 > S_1 + T_2$. Right panel: numerical example used in the current experiment.

people's payoffs, trustors can learn through reputation about the strategies and incentives of the trustees. Completely selfish individuals are only driven by the motivation to maximize their own payoff, while completely altruistic individuals only care about other people's payoffs. Most individuals will be somewhere between these two extremes. Trustees will thus differ in the extent to which they are willing to honor the trust they receive, but without any information about the incentives of trustees, trustors do not know which trustees will probably honor and which will likely not (Macy and Skvoretz, 1998). A trustee's reputation may help here. Trustors may use the available information on past trustee behavior to update their beliefs about the probability that the trustee is trustworthy (Buskens, 2003; Cook et al., 2005; Weigelt and Camerer, 1988), meaning that trustee has only weak incentives for abusing trust in a given round. Trustees who have weak incentives for abusing trust are less likely to abuse trust in the future. If the probability that a trustee is trustworthy is high enough, the expected payoff of placing trust is higher than the expected payoff of withholding trust and the trustor will place trust.

An alternative explanation of why reputation information affects trustor behavior is indirect reciprocity. Trustors may be motivated to return helpful and harmful acts in kind, even if this is costly for the reciprocator (Stanca, 2009). In the case of online platforms, individuals often act only a single time with another buyer or seller, so it is often not possible to directly reciprocate a favor (Cabral and Hortaçsu, 2010), but reciprocity may also be indirect (Molm et al., 2007). Evidence of such reciprocal behavior comes, for example, from public goods experiments where people were willing to punish free-riders, even when punishing is costly (Fehr and Gächter, 2000; Kuwabara and Yu, 2017). The meta-analysis by Balliet et al. (2011) shows that giving individuals the possibility to punish and reward others has a positive effect on overall cooperation.

Under the assumption of rationality all players know that trust will only be placed in trustees with a good reputation. Using backward induction, the players will identify the conditions under which cooperating (i.e. place trust and honor) results in a higher payoff than defecting (i.e. withholding and abusing trust). Choosing the cooperative option may be beneficial in the long term, even for selfish individuals that are not intrinsically motivated to be cooperative if having a good reputation is necessary for being trusted in the future. Buskens and Raub (2002) refer to this as the 'control' mechanism. This mechanism predicts that when a reputation system is in place trustors are more willing to trust even trustees lacking any reputation. The prediction that individuals anticipate reputation effects is borne out in numerous studies (Benard, 2013; Buskens and Raub, 2002; Buskens and Weesie, 2000; Charness et al., 2011; Cheshire, 2007; Kroher and Wolbring, 2015; Rooks et al., 2006).

2.2.1. Single-role reputation systems

Single-role reputation systems only display information about the trustee's behavior in the trustee role. When there is no reputation system, the best strategy for egoistic trustees is to always abuse and for egoistic trustors to never place trust. However, a single-role reputation system changes the incentives of trustees in a way that enables the emergence of trust in paid exchange. If egoistic trustors assess the probability that a trustee is trustworthy as high enough, they will place trust in them, because the expected payoff of placing trust is higher than the expected payoff of not placing trust. The reciprocity argument leads to the same prediction, as rational trustors with a preference for reciprocity may perceive trustees who have honored a lot in the past as deserving more trust than an untrustworthy trustee. Likewise, these trustors might want to punish by not placing trust in trustees who have abused in the past. Consequently, in paid exchange, trustors are expected to place more trust in trustees who have honored more in the past. Knowing how trustors will respond to their reputation, trustees will select the option that gives them the highest payoff in the long term. Since their current decisions affect their future outcomes, they may strategically honor to maintain a good reputation (Robbins, 2016), which in turn increases the probability that a trustee will be trustworthy, as assessed by the trustor.

While single-role reputation is expected to affect trustor behavior in paid exchange, this reasoning does not lead to the same predictions for free exchange (or generalized exchange systems). Since providers in this case do not receive financial remuneration, they cannot gain anything by lending out their goods, so, under the standard assumptions of rationality and selfishness, they are not expected to ever do so, even when they are confident that the user would act honorably.

Extensive research shows that single-role reputation systems have a strong, positive impact on trust in the Trust Game (Boero et al.,

2009; Bolton et al., 2004; Charness et al., 2011; Duffy et al., 2013; Fehrler and Przepiorka, 2013) and that general exchange systems can emerge when information about others' past behavior is available (Takahashi, 2000). A large number of studies on reputation systems show that trustors indeed use same-role reputation information as predicted: the more a trustee has honored in the past, the higher the probability that a trustor places trust (Buskens, Raub and van der Veer, 2010; Charness et al., 2011; Duffy et al., 2013), and the higher the prices they can charge (Ba and Pavlou, 2002; Dewally and Ederington, 2006; Dewan et al., 2004; Diekmann et al., 2014; Resnick et al., 2006; Snijders and Zijdeman, 2004; see also the literature review in Diekmann et al., 2014).

2.2.2. Mixed-role reputation systems

Whereas single-role reputation systems only include previous decisions of the trustee in the trustee role, mixed-role reputation systems also convey information about decisions of those trustees made in the trustor role. We argue that trustors will use this extra information when deciding whether to trust a trustee, and more so in the Lending Game. Namely, the decisions individuals make in one role can be assumed to be driven by the same motivations as the decisions that they make in the other role in free exchange, but not in paid exchange. In free exchange both placing trust and honoring lead to a decrease in one's own payoffs, while it has a positive effect on the other player's payoff. Therefore, individuals who are more inclined to give up their own payoff for an increase in the payoff of others should, all else equal, be more likely to both place trust and to honor, because both behaviors entail a cost to oneself, while others benefit. More altruistic trustors may be more willing to take the loss associated with placing trust when the trustee honors. For example, Peerby users who are more likely to treat someone else's goods well may also be more likely to lend their goods to other people.

Experimental evidence indeed suggests that when subjects play both roles, behavior in the trustee role is often related to behavior in the trustor role (Charness et al., 2011; Seinen and Schram, 2006). Other studies have found that an individual's cooperative behavior in one situation is related to that individual's trustworthiness in other situations (Chaudhuri and Gangadharan, 2007; Fehrler and Przepiorka, 2013).

We expect there to be a difference in the effect of the extra reputation information on trust in the Trust Game as compared to the Lending Game. In the multi-round Lending Game with stranger matching, in which there is no material incentive to place trust other than building up credit that may or may not be repaid one day, a history of placing trust in others (while playing in the trustor role) is a particularly strong signal of altruism and an act of generosity. The increased uncertainty in generalized exchange systems (i.e., the Lending Game) makes being generous more risky than in direct exchange systems (i.e., the Trust Game) (Molm, 2010; Molm et al., 2009). Past trustful behavior (while playing in the trustor role) can therefore be considered a stronger signal of future trustworthiness or may evoke stronger reciprocity in the Lending Game than in the Trust Game, and we therefore expect that trustors rely more on this information in the Lending Game than in the Trust Game.

Hypothesis 1a. Trustors are more likely to place trust in trustees who have placed more trust in previous rounds (while playing in the trustor role).

Hypothesis 1b. The positive effect of placing trust in previous rounds (while playing in the trustor role) on being trusted in the present (while playing in the trustee role) is stronger in the Lending Game than in the Trust Game.

In a laboratory experiment by Charness et al. (2011), trustors used the information they received about the trustees' decisions to place or not place trust (while playing in the trustor role). However, the trustors in that experiment did not also receive information about the trustee's behavior in the role of trustee, so it is unclear whether trustors would still have used the other-role information had they also been given same-role information. Other studies have studied the effect of other-role reputation in scenarios outside the realm of trust problems. In the Helping Game or Image Scoring Game, where a donor can choose to give a gift to a receiver or not, after which the game ends without a choice for the recipient, donors were found to give more to receivers who had helped more in the past and helping rates were higher when donors were able to learn about past behavior of receivers than when no reputation system was in place (Bolton et al., 2005; Engelmann and Fischbacher, 2009; Seinen and Schram, 2006). Other studies have described the emergence and importance of reciprocity in generalized exchange situations in the field, such as the Kula Ring (Malinowski, 1922) and in simulation studies (Takahashi and Mashima, 2003).

A mixed-role reputation system allows players to invest in their reputation by placing more trust. If opportunistic trustors believe that their trust will be reciprocated in the future if they place more trust in the present, they may place trust with the intention to evoke this reciprocity. Consequently, when information about past trustor behavior is public, trustors will be more inclined to place trust, even when they are not sure about the motives of the trustee.

Hypothesis 2a. Both in the Trust Game and in the Lending Game, more trust is placed under a mixed-role reputation system than under a single-role reputation system.

Because past trustful behavior (in the trustor role) can be considered a stronger signal of future trustworthiness (in the trustee role) in the Lending Game than in the Trust Game, we expect that mixed-role reputation systems should increase trust levels more in the former than in the latter. Previous research on control mechanisms has shown that trustees may indeed seek to increase the probability of receiving trust by making generous choices in other, unrelated situations (Elfenbein et al., 2012; Fehrler and Przepiorka, 2013).

Hypothesis 2b. Mixed-role reputation systems increase trust (i.e. the decision of the trustor to place trust) more in the Lending Game than in the Trust Game.

By using games as abstract representations of markets, we reduce the differences between free and paid exchange to monetary differences and we assume that the incentives for trustors to place trust in paid exchange are larger than in free exchange. We acknowledge that this dichotomy may be too simplistic in real-life situations, because other, non-monetary incentives have been found

to play a larger role in free exchange than in paid exchange (Frey and Oberholzer-Gee, 1997). Nonetheless, our study is general in the sense that it tests the differential effect of reputation systems across settings that differ in the extent to which the benefits of trusting offset the costs, regardless of the monetary or nonmonetary origins of these costs and benefits. We do not deny other differences, but merely seek to theoretically and experimentally isolate the lack of immediate gains from lending in free exchange systems as an important trigger of reciprocal behavior.

3. Experiment

The experiment was conducted at Utrecht University, the Netherlands between November 29th, 2017 and December 12th, 2017. Four pilot sessions were organized on November 15 and 16, 2017. Using a laboratory experiment allows us to study reputation in isolation and to make inferences about causality. Subjects were students of Utrecht University and were recruited using the internet recruitment system ORSEE (Greiner, 2015). All laboratory sessions were computerized using Z-tree 3.6.7 (Fischbacher, 2007). The subjects received printed instructions in English. There were 228 subjects in total, divided over twelve sessions. Each session consisted of two or three matching groups of eight, ten or twelve subjects each. After reading the instructions and before the start of the experiment, subjects had to answer some questions to test their comprehension of the instructions. At the end of the session subjects completed a short survey that included demographic questions, a question on their experience with game theory and questions on subjects' motivations and beliefs about other participants.

Each session took about 60 min (including the time for reading instructions). The average payment was 8.89 euro (100 points were equivalent to 0.60 euro). There were 156 (68.4%) subjects identifying as female, 69 (30.3%) identifying as male, and one subject indicating 'other gender'. Age ranged from 18 to 66 and was on average 23.4 (SD = 6.0).

The participants were informed that the session consisted of 36 rounds. At the beginning of each round, half of the participants were assigned the role of trustor (role A) and half of the participants were assigned the role of trustee (role B). We arranged the draws such that each person was a trustor six times and a trustee six times in each block of 12 rounds (cf. Charness et al., 2011).[6] At the end of the session, each subject had played 18 times in the trustor role and 18 times in the trustee role. This procedure ensured that the number of times all subjects acted in the roles of trustor and trustee did not vary too much at any point in time, but at the same time that subjects did not know for sure what role they would play in the next round. The participants were randomly and anonymously matched in pairs within their matching group at the beginning of each round. They knew they were divided in two or three different groups (depending on the number of participants in the session) and they knew they only interacted with the people in their group. No communication between the participants was allowed during the experiment.

At the end of the round, after the players made their decisions, both players were informed about their own choice and payoff of that round, the choice and payoff of their partner in that round and their own total payoff.

The experiment had a 2 (Trust Game versus Lending Game) by 2 (single-role reputation versus mixed-role reputation) design. There were three sessions in each of the conditions, for a total of 12 sessions. In the Trust Game, the trustor chose at the start of each round between RIGHT (not place trust) and DOWN (place trust). If the trustor chose RIGHT, the round was over and both players received a payoff of 40. If the trustor chose DOWN, the trustee had to make a choice between RIGHT (abuse) and DOWN (honor). If trustee chose to abuse, the trustor received 0 and the trustee received 70. If the trustee chose to honor, both players received a payoff of 50. The only difference between the Lending Game and the Trust Game was the payoff of the trustor if the trustee decided to honor. Instead of 50, the trustor received a payoff of 38 in the Lending Game when the trustee honored. Appendix A contains the instructions for the participants in the different conditions.

In the single-role reputation conditions, before making a choice, the trustor was informed about the total number of decisions the trustee made in the trustee role and the number of times the trustee chose to honor in the past (while playing as a trustee). In the mixed-role reputation condition, the trustor was also informed about the number of past decisions trustee had made as trustor and the number of times he had placed trust (while playing as a trustor). Note that trustees received no information about the trustor's past behavior in any of the conditions.

4. Analysis and results

4.1. Dependent variable

The dependent variable in our analyses is trust, which is operationalized as the decision of the trustor to place trust or not. This variable does not consider behavior of the trustee, i.e. the decision to honor or abuse.

4.2. Independent variables

Our first independent variable is the treatment to which a subject was assigned: Trust Game with single-role reputation (TG, SRR) or mixed-role reputation (TG, MRR) or Lending Game with single-role reputation (LG, SRR) or mixed-role reputation (LG, MRR).

[6] Lotteries at the beginning of each round determined which subjects in a matching group were to play in the role of trustor. The probability that a subject's lot was drawn decreased with the number of times that subject acted in the trustor role in previous rounds in the same block and increased with the number of times the other subjects acted in the trustor role in the block.

Next, we constructed variables for the reputation based on behavior in the trustor role and the reputation based on behavior in the trustee role. We constructed two variables per type of reputation information: reputation availability and reputation score. The former is a dichotomous variable indicating whether the trustee already made decisions in the relevant role ('Made trustee decision' and 'Made trustor decision'). This allows us to evaluate the effect of not having a reputation vs having a positive or a negative reputation. The second variable reflects the fraction of decisions in the trustee (trustor) role in which the player chose the prosocial option in the relevant roles: honor in the trustee role ('Honor rate history') and place in the trustor role ('Place rate history').

4.3. Control variables

We control for the personal experiences of the trustor. After every round and in every experimental condition, all subjects are informed about the decision in the current round of their current interaction partner. This information about the past experiences of the trustor is summarized in two variables. The first variable 'Experienced trustfulness', reflects how often a trustor was trusted by others, as a fraction of the total number of times she acted in the trustee role in earlier rounds. Likewise, the variable 'Experienced trustworthiness' reflected the number of times the partner of a trustor honored as a fraction of the total number of times she placed trust in earlier rounds. We also control for round number.

4.4. Analytical strategy

To test our Hypothesis about individual-level behavior (hypotheses 1a and 1b), we ran multilevel logistic regressions with trust as the dependent variable and with random intercepts for subjects and groups to accommodate the multi-level structure of the data.

To test Hypothesis 1a we ran the analysis separately for the four conditions (models 1 to 4 in Table 2). We included the relevant reputation variables as independent variables: the models for the single-role reputation conditions only included the reputation variables for past behavior in the trustee role, while the models for the mixed-role condition also included the variables for past behavior in the trustor role. We controlled for the personal experiences for the trustor. The model did not converge for the Trust Game with single-role reputation, so instead we performed a multilevel regression with only random intercepts for subjects in that condition.

To test Hypothesis 1b, we performed two multilevel logistic regressions on the mixed-role reputation condition only (models 5 and 6 in Table 2). Game type (TG or LG), round number, two personal experience indicators and the four reputation variables are included as predictor variables.

To test Hypothesis 2a about the differences in trust between the four conditions, we use Wilcoxon rank-sum tests that treat each matching group as one observation to compare the trust rates between the condition. The results of these tests are reported in section 4.5. As a second test of hypothesis 2a and to test hypothesis 2b, we again use the multilevel logistic regression approach, which also allowed us to test the interaction between game type and reputation type. Game type (Trust Game versus Lending Game) and reputation type (single-role versus mixed-role reputation) are included as independent variables, as well as the interaction between the two. Round number is included as a main effect and as an interaction with reputation condition. The results of this regression are reported in model 7 in Table 2. The conclusions from the rank-sum tests are the same as those of the regressions.

We additionally ran a number of analyses with the decision of the trustee (honor or abuse) as the dependent variable. A description of these analyses and the results can be found in Appendix B.

4.5. Descriptive statistics and results rank-sum tests

Table 1 shows the average rates of trust (i.e. fraction of interactions in which the trustor placed trust), trustworthiness (i.e. fraction of interactions in which the trustee honored trust, if the trustor placed trust). And the 'success rate' per condition: the fraction of interactions in which trust is placed and honored. The Wilcoxon rank-sum test shows that, in line with our assumption, the trust rate is significantly higher in the Trust Game than in the Lending Game ($z = 4.135$, $p < .001$). There is no significant overall difference in the trust rate between the single-role reputation condition and the mixed-role reputation condition ($z = -0.626$, $p = .531$), rejecting Hypothesis 2a. When analyzing the two game types separately, we find that there is no significant difference between the two reputation conditions when only looking at the Trust Game ($z = 0.000$, $p = 1.000$), but in the Lending Game, the trust rate is higher in the mixed-role reputation condition than in the single-role reputation condition ($z = -2.074$, $p = .038$), consistent with hypothesis 2b.

Table 1
Trust and trustworthiness rate, by condition (standard deviations in parenthesis).

Condition		N	Trust rate (SD)	N	Trustworthiness rate (SD)	N	Rate of both combined, by pair (SD)
Trust Game	Single-role	2160	.217 (.412)	468	.767 (.423)	1080	.332 (.471)
	Mixed-role	1944	.207 (.406)	404	.599 (.491)	972	.249 (.250)
	Total	4104	.212 (.409)	872	.689 (.463)	2052	.293 (.455)
Lending Game	Single-role	1944	.056 (.230)	109	.459 (.501)	972	.051 (.221)
	Mixed-role	2160	.100 (.300)	216	.690 (.464)	1080	.138 (.345)
	Total	4104	.079 (.270)	325	.612 (.488)	2052	.097 (.296)
Total		8208	.146 (.353)	1197	.668 (.471)	4104	.195 (.396)

Table 2
Determinants of trust.

Independent variables	Model 1: TG, SRR	Model 2: TG, MRR	Model 3: LG, SRR	Model 4: LG, MRR	Model 5: MRR	Model 6: MRR	Model 7: All conditions
Constant	−1.106 (0.339)	−0.652 (0.417)	−3.481 (0.462)	−2.992 (0.430)	−0.763 (0.329)	−1.533 (0.363)	0.107 (0.220)
Lending Game (LG, ref. cat. = TG)	–	–	–	–	−1.281*** (0.266)	−1.186*** (0.338)	−2.583*** (0.301)
Mixed-role reputation (MRR, ref. cat. = SRR)	–	–	–	–	–	–	−0.085 (0.304)
LG* MRR	–	–	–	–	–	–	1.198** (0.396)
Round number	−0.023** (0.007)	−0.034 (0.008)	−0.040** (0.013)	−0.023** (0.009)	−0.032*** (0.006)	−0.031*** (0.006)	−0.026*** (0.006)
MRR* Round number	–	–	–	–	–	–	−0.005 (0.008)
Made trustee decision	−1.108*** (0.257)	−1.207*** (0.335)	0.491 (0.311)	−0.785** (0.300)	−0.753*** (0.203)	−0.149 (0.225)	–
Honor rate history	2.134*** (0.244)	1.654*** (0.270)	0.048 (0.389)	1.684*** (0.311)	1.282*** (0.183)	0.839** (0.266)	–
Made trustor decision	–	−0.194 (0.442)	–	−0.055 (0.393)	−0.354 (0.300)	0.298 (0.364)	–
Place rate history	–	0.534 (0.327)	–	0.766 (0.406)	0.668** (0.247)	−0.429 (0.514)	–
Experienced trustfulness	−2.288 (2.476)	2.225 (2.638)	−1.599 (1.031)	1.031 (0.922)	−1.514 (1.279)	−1.752 (1.408)	–
Experienced trustworthiness	1.449*** (0.290)	1.903*** (0.355)	3.410*** (0.566)	2.457*** (0.329)	2.122*** (0.235)	2.564*** (0.252)	–
Place rate history* LG	–	–	–	–	–	−1.039 (0.665)	–
N	1080	972	972	1080	2052	2052	4104
LL	−620.895	−513.134	−241.063	−419.861	−955.633	−970.141	−1995.384

*Indicates significance at $p = .05$ (two-tailed tests).
**Indicates significance at $p = .01$ (two-tailed tests).
***Indicates significance at $p = .001$ (two-tailed tests).
Standard errors are in parentheses.

- TG refers to Trust Game, LG refers to Lending Game.
- SRR refers to single-role reputation system and MRR to mixed-role reputation system.
- Made trustee decision (Made trustor decision) indicates whether the trustee has made a decision in the trustee (trustor) role yet.
- Honor rate history (Place rate history) indicates the rate at which the trustee has honored (placed) trust in the past.
- Experienced trustfulness (Experienced trustworthiness) is the rate at which the trustor experienced trust placed (honored).

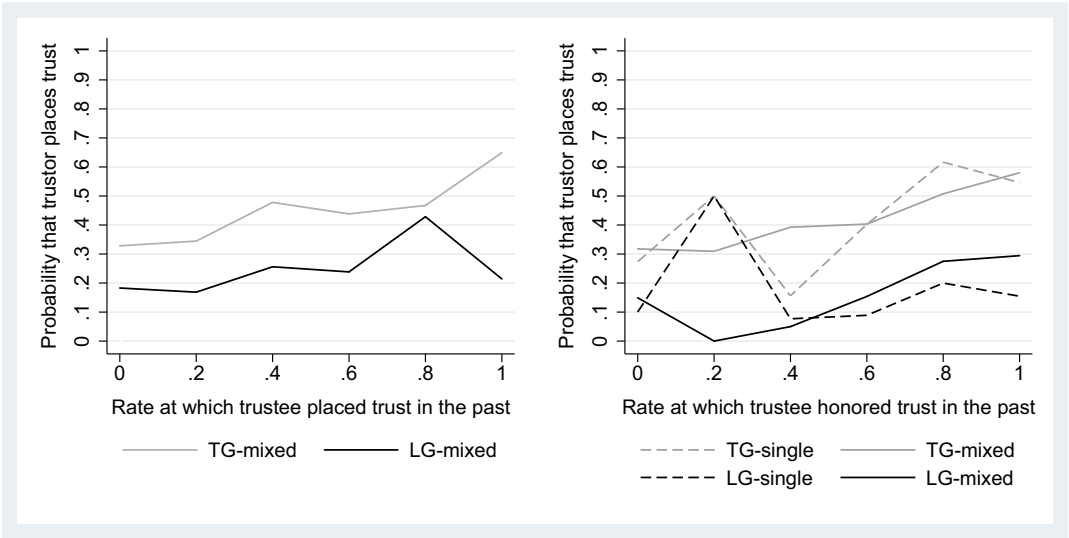

Fig. 3. Relation between previous decisions made by the trustee and the probability that trust is placed by the trustor in the current round. Left panel: previous decisions made by the trustee in the trustor role (place versus not place trust) on the x-axis. Right panel: previous decisions made by the trustee in the trustee role (honor versus abuse) on the x-axis.

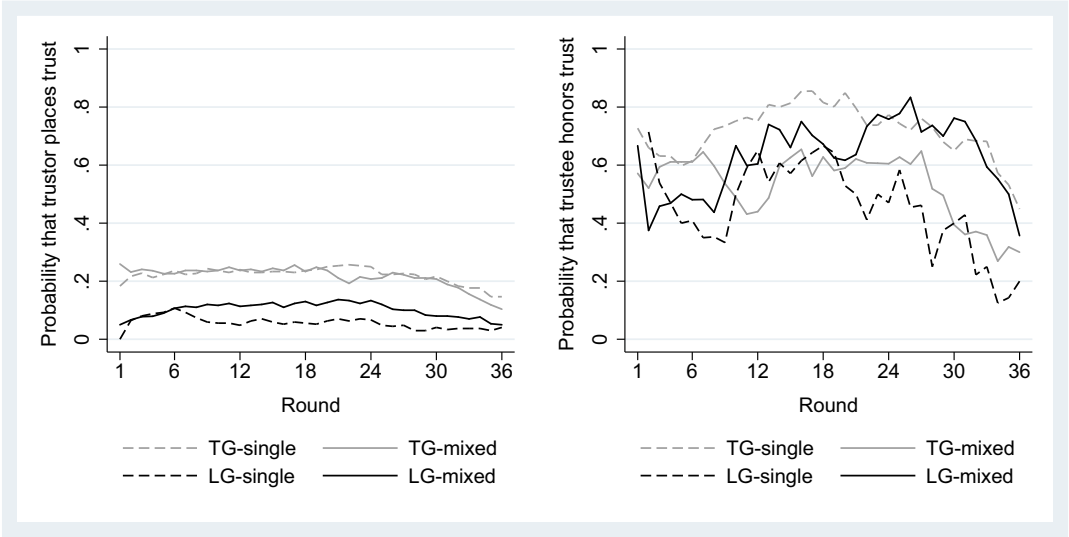

Fig. 4. Left panel: probability that the trustor places trust over the rounds per condition. Right panel: probability that the trustee honors over the rounds per condition. Moving average over five rounds.

Fig. 3 shows how the trustee's previous decisions and the probability that the trustor places trust in the current round are related. We hypothesized that the more a trustee has placed trust in the past (while playing in the trustor role), the higher the likelihood that the trustor placed trust in the trustee (Hypothesis 1b). The figure suggests that this is indeed the case.

Fig. 4 shows how the trust rate changes over time in the various conditions (left panel) and how the trustworthiness rate changes over time (right panel). Both panels show the "end game effect", the familiar tendency for trust placement on honoring to decrease as the known end of the session is approached.

4.6. Results regressions: determinants of trust

4.6.1. Individual trustor decisions

Contrary to what we hypothesized (H1a), we find that the trustee's historical trust rate ('Place rate history') does not significantly affect the probability that a trustor placed trust in the mixed-role reputation conditions if we separately look at the Trust Game and the Lending Game (models 2 and 4 in Table 2). This means that trustors are not more likely to place more trust in trustees who have placed more trust in the past (while playing in the trustor role). However, these tests may lack the necessary power, because when we combine the two games in one analysis, we find that the historical trust rate significantly predicts trustor behavior (model 5 in Table 2), supporting Hypothesis 1a. A 0.1 increase in the fraction of trust placed on average leads to an increase of 0.01 in the probability that the trustor places trust in both the Trust Game and the Lending Game.

The effect of the historical fraction of trust placed by the trustee (while playing in the trustor role) on the probability that a trustor places trust is not stronger in the Lending Game than in the Trust Game ('Place rate history * LG', model 6 in Table 2), so we reject Hypothesis 1b.

The coefficients for availability of first-mover role reputation ('Made trustor decision') are not significant, also not when we combine the Trust Game and the Lending Game ($b = -0.354$, $z = -1.18$, $p = .239$). Because all trustees have played in the trustor role after the sixth round of the game, this coefficient is based on the first six rounds only, so we cannot conclude that in all rounds of the game having no reputation and having a bad reputation have a similar effect on the probability of receiving trust.

In all four conditions except the Lending Game with single-role reputation information, a trustee's historical trustworthiness rate ('Honor rate history') has a significant effect on the trustor's decision whether to place trust. Trustors more often place trust in trustees who have honored more in the past (while playing in the trustee role). If the fraction with which a trustee chose to honor in the past (while playing in the trustee role) increases with 0.1, the probability that a trustor placed trust on average increases with 0.04 and 0.03 in the Trust Game with single-role and mixed-role reputation respectively, and with 0.02 in the Lending Game with mixed-role reputation. While the coefficient of reputation score is positive, the coefficient of having a trustee reputation score ('Made trustor decision') is negative and significant in the same three conditions. This means that trustees who have abused relatively often (while playing in the trustee role) are trusted less often than trustees who have not had the chance to choose between honoring and abusing trust.

The rate at which a trustor has experienced trust ('Experienced trustfulness') does not significantly affect the probability of placing

trust in any of the conditions, but the more trustworthiness the trustor has experienced ('Experienced trustworthiness'), the higher the probability of placing trust. In both Trust Games the probability that a trustor places trust increases with about 0.03 with every 0.1 increase in the rate of experienced trustworthiness. In the Lending Game with single-role reputation this probability increases with 0.01 with every 0.1 increase in the rate and in the Lending Game with mixed-role reputation the probability increases with 0.03.

4.6.2. Overall trust rate

Confirming the results of the rank-sum test, the regression shows that the probability that a trustor placed trust is 0.35 higher in the Trust Game than in the Lending Game ('LG', model 7 in Table 2). And that there is no effect of type of reputation system in the Trust Game (rejecting Hypothesis 2a). The interaction between game type and reputation system type ('LG * MRR') is significant, providing further support for hypothesis 2b. In a separate analysis for two game types, we find that after controlling for round number, in the Lending Game the probability that trust is placed is 0.10 higher in the mixed-role reputation condition than in the single-role reputation condition ($b = 1.129$, $z = 2.81$, $p = .005$), but that the effect of reputation system type is not significant in the Trust Game ($b = -0.154$, $z = -0.62$, $p = .537$).

5. Discussion

The focus of this paper has been on the increasingly common scenario in which individuals are sometimes provider and sometimes user of a borrowed good (e.g. eBay, Couchsurfing, Kickstarter). We have argued that in these settings, a new form of reputation building emerges: individuals lend out valuable property to unknown others, risking exploitation, in the expectation that when they themselves call on help that requires another person's willingness to trust them, they will more likely receive it themselves. This argument was largely supported in a laboratory study. We found that, indeed, mixed-role reputation systems increased trust levels, and only for scenarios of lending, not letting. We also found evidence that providers are more likely to place trust in users who themselves have placed more trust in the past. We expected the effect of the mixed-role reputation system in paid exchange to be smaller, and in practice we found no effect at all.

The paper thus provides an explanation for the numerous examples of free platforms that function well and attract both borrowers and lenders. Why would lenders suffer a sure loss if they do not get anything in return? Of course, the non-material rewards, other-regarding preferences and social aspects of these exchanges assumed away in narrowly formulated game-theoretic models may well be part of the explanation (e.g. Grybaitė and Stankevičienė, 2016; Hamari et al., 2015; Hars and Ou, 2002). Altruists just generously share their property with others, at the risk of being taken advantage of. We readily acknowledge that there are other contextual factors that affect willingness to rent or lent. The aim of this study was not to realistically model free and paid exchange systems, but to test the differential effect of reputation systems on trust in a setting in which the benefits of trusting offset the costs versus a one where they do not. We propose that in addition to sheer goodness, mixed-role reputation systems play an important role in facilitating free exchange. Namely, they do not only provide information on the provider's behavior in the provider role, but also on that provider's behavior in the user role. This extension of the classic, single-role reputation system allows providers to get something in return for their generosity, explaining why even purely egoistic providers would lend out their goods. Our findings confirm our theoretical claim that the norm of reciprocal lending emerges in settings where lending does not provide an immediate payout and not in those where it does.

While the results of the experiment are in line with our theory that other-role reputation information helps trustors to identify trustworthy trustees, we acknowledge that there may be alternative explanations that could explain this finding. One interesting alternative explanation was suggested by a reviewer and also points to the possibility for reciprocation in mixed-role reputation systems, but operates through a somewhat different mechanism. Namely, perhaps the extra reputation information may change the structure of the game in a way that makes it worthwhile even for purely egoistic trustors to play a tit-for-tat strategy (i.e. conditionally cooperate) if all others do the same. According to this argument, a single-role reputation system is a necessary and sufficient condition for the emergence of trust in paid exchange, but not in free exchange. Under the assumption that all trustors in the Lending Game are selfish, they can maximize their payoff by cooperating conditionally. While knowing that a trustee is probably trustworthy is enough motivation to place trust in paid exchange, this is not the case in free exchange. In free exchange, trust may emerge if trustors condition their decision on the past behavior of the trustee in the trustor role. If all trustors follow this strategy, being trustful will result in receiving more trust in the future and can thus be a better strategy than never placing trust. While this argument explains why trustors would place trust in free exchange when there is a mixed-role reputation system, it raises the question why trustors would condition their decision on the trustee's decision in the trustor role. If placing trust is good for an individual's reputation, and if the reputational benefits are larger than the costs of cooperating, why would trustors not always do so, regardless of the reputation of the trustee. A game-theoretic analysis may formally specify whether and how this may exactly work, which we leave for future research. Further experimental research would be needed to test if trustors in practice adopt such a strategy.

Why did we find no effect of mixed-role reputation systems on trust in paid exchange, even if we predicted to find a positive effect, albeit smaller? This might have to do with the overall trust levels in our experiment, which were low compared to other experiments on the Trust Game and the Helping Game with reputation systems (Boero et al., 2009; Bolton et al., 2005; Buskens et al., 2010; Charness et al., 2011; Seinen and Schram, 2006). We predicted that the other-role information would only matter if the trustee placed enough trust in the past, and when the trustor assessed the probability that the trustee is trustworthy to be low. The relatively low trust rate suggests that there were very few occasions in which these conditions were applicable, meaning that the extra information was of little added value and thus did not change overall trust levels.

Two other questions that remain unanswered are why the trust rate was so low in this experiment, and why the reliance of the

providers on the extra reputation information was limited. It may be that experimental subjects' bounded rationality limits their ability to fully comprehend the consequences of their choices. Knowing why trustees who have honored more trust in the past will be more trustworthy is cognitively less demanding, as it requires understanding fewer steps than understanding why one should place more trust in trustful providers, or why placing trust in the present may have consequences for the rate at which one will be trusted in the past.

These open questions notwithstanding, altogether, our findings suggest that in modern, Internet-enabled marketplaces, reputation systems allow individuals to not only develop a classic reputation for someone who *can* be trusted, but also to become known as someone who has paid their dues to the community, and therefore *deserves* to be trusted.

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Appendix A. Instructions for participants

Differences between the conditions are marked with an indented, underlined reference to the relevant conditions.

Welcome and thank you for coming!

Please read the following instructions carefully. Please do not communicate with other participants. Turn off your phone and put it away. Also, you may not use any function of the computer that is not necessary for carrying out the experiment. Thank you very much for your participation. If at any point you have questions, raise your hand and we will assist you.

In this experiment you can earn money by scoring 'points' for certain decisions. These points will at the end of the experiment be exchanged for money. The number of points you score depends on your decisions and on the decisions of others. For every 100 points you score in the experiment, you will receive €0.60 (total amount rounded to €0.50).

These instructions are the same for all participants in the room. All of the payments are real and all participants are present in this room. All information that you read about in this study is truthful and real. No other participant will be able to link your decisions to your identity or get to know your name or earnings. After everybody has read the instructions, there will be a quiz in which you can make sure that you understand everything correctly. Then, we turn to the next stage during which you can score points by playing several rounds of a game. At the end of the session you will be asked to answer a short survey.

Description of the game

The game proceeds in rounds and is played in groups of 6, 8 or 10 participants (depending on the total number of participants in the session). At the beginning of each round, half of the participants in your group is assigned to role A and half of the participants is assigned to role B. Then, you are randomly matched with another participant in the other role (if you are assigned to role A, you are matched to a participant with role B and vice versa). In case you are by chance matched multiple times with the same other participant, neither you nor the other participant knows this.

Fig. A1 shows the basic interaction situation. Player A starts and chooses between RIGHT and DOWN. If player A chooses RIGHT, player A and player B both receive 40 points. If player A chooses DOWN, player B has to make a decision. If player B also chooses DOWN,

Trust Game condition: player A and player B both receive 50 points.

Lending Game condition: player A receives 36 points and player B receives 50 points.

If player B chooses RIGHT, player A receives 0 points and player B receives 70 points.

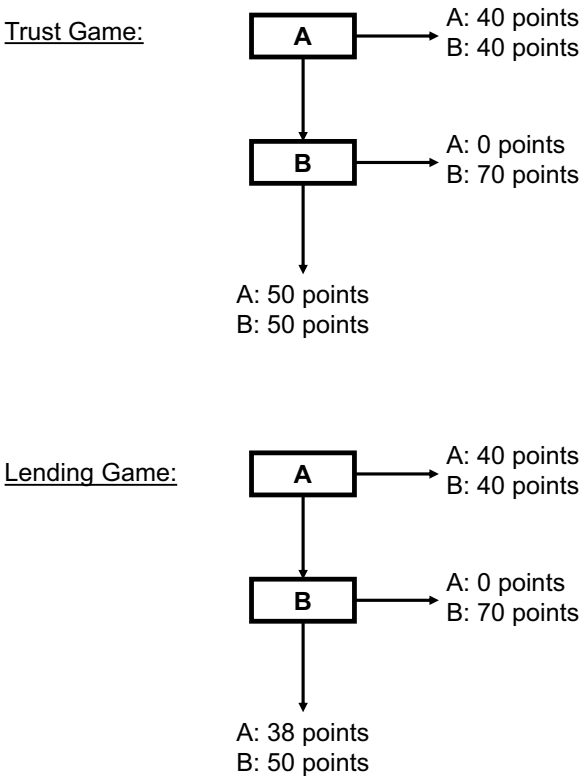

Fig. 1.

The duration of the game

The game lasts for 36 rounds. You will be assigned to role A 18 times and to role B also 18 times. However, your role may change every round and the order in which you are playing in role A and role B is determined randomly.

The computer interface

Figs. A2–A4 show examples of the computer interface. On top of the screen you can see the number of the current round, your role in this round and the number of times you have already played in each of the roles. At the bottom of the screen you can see the outcomes of previous rounds. Use the scroll bar to scroll back to earlier rounds.

Fig. 2 shows the decision screen of player A.

Single-role reputation condition: At the beginning of every round, all players A are informed about the previous decisions in role B of the player B they are matched with.

Mixed-role reputation condition: At the beginning of every round, all players A are informed about the previous decisions in role A and B of the player B they are matched with.

This information is shown in the left panel.

Single-role reputation condition: Player B in the example of Fig. 2 has made 5 decisions in role B and chose 2 times RIGHT and 3 times DOWN in this role.

Mixed-role reputation condition: Player B in the example of Fig. 2 has made 3 decisions in role A and chose 2 times RIGHT and 1 times DOWN in this role. Player B also chose 2 times RIGHT and 1 time DOWN in role B in the example.

In the right panel you can indicate your decision for RIGHT or DOWN. Make your decision by clicking with your mouse on the corresponding arrow. When you click on one of the arrows, the arrow will turn bold and blue and an 'OK'-button appears. Please click the 'OK'-button to proceed.

Fig. 3 shows an example of the interface of the decision screen of player B. You will only see this screen if the player in role A that you are matched with chooses DOWN. You can decide between RIGHT and DOWN by clicking with your mouse on the corresponding arrow. When you click on one of the arrows, the arrow will turn bold and blue and an 'OK'-button appears. Please click the 'OK'-button to proceed.

After every round, you can see the decisions and number of points scored by you and by the other participant in the current round. The other participant can also see your decision and the number of points scored by you in the current round. You also see the sum of your points in all rounds. You also see the sum of your points in all rounds. Figure 1 shows an example of this screen. Please click the 'OK'-button to proceed to the next round.

Quiz

You have finished reading the instructions. Feel free to have another look at the parts you found difficult to understand. Please turn to the computer and answer a few questions that help you evaluate your understanding of the game. You cannot score (or lose) points by answering these questions. The goal is only to make sure that you understand everything correctly. If you have questions, please raise your hand. Otherwise, turn to the computer and click "OK.

Appendix B. Results: determinants of trustworthiness

B.1 Analytical strategy

We performed rank-sum tests and five multilevel logistic regressions to see whether there are differences in the level of trustworthiness between conditions. In the regressions we include the decision of the trustee (honor trust or not) as the dependent variable. In each analysis, we included random intercepts for subjects and groups. The results of these regressions are in Table B1. First, we did a regression pooling all conditions (model 1 in Table B1), with game type, reputation type, the interaction between the two and round number as independent variables. The next four models (models 2 through 5) regress the decision of the trustee on the round number and four variables indicating whether that trustee made a decision as a trustee and as a trustor ('Made trustee decision' and 'Made trustor decision) and the trustee's historical trustworthiness rate and trust rate ('Honor rate history' and 'Place rate history'.

B.2 Descriptive statistics and results rank-sum tests

In the Trust Game, significantly more trust is honored in the single-role reputation condition than in the mixed-role reputation condition ($z = 2.722$, $p = .007$), while in the Lending Game, the trustworthiness rate is higher in the mixed-role reputation condition than in the single-role reputation condition ($z = -2.286$, $p = .022$). There is no overall difference in trustworthiness rate between the Trust Game and the Lending Game ($z = 1.360$, $p = .174$).

A Wilcoxon rank-sum test shows that the success rate is significantly higher in the Trust Game than in the Lending Game ($z = 3.891$, $p < .001$) and that there is no overall significant effect of reputation type ($z = -0.327$, $p = .744$). In the Trust Game, there is no significant difference in the success rate between the single-role reputation condition and the mixed-role reputation condition ($z = 1.363$, $p = .173$). In the Lending Game, the success rate is higher in the mixed-role reputation condition than in the single-role reputation condition ($z = -2.575$, $p = .010$).

B.3 Individual trustee decision

In later rounds trustees become less and less likely to honor trust, although this effect is only significant in the Trust Game and not in the Lending Game. On average, the probability that a trustee honors trust decreases with 0.07 per ten rounds. We find that a trustee's previous decisions in the trustee role ('Honor rate history') predict the trustee's honoring decision in both Trust Games and in the Lending Game in the single-role reputation condition. With every 0.1 increase in the trustee's historical trustworthiness rate, the probability that a trustee honors trust increases with 0.03 and 0.04 in the Trust Game with single-role reputation and mixed-role reputation respectively. In the Lending Game with single-role reputation, the probability that a trustee honors trust increases with 0.05 with every 0.1 increase in the trustee's historical trustworthiness rate. The trustee's previous decisions in the trustor role ('Place rate history') have a significant and positive effect on the probability that a trustee will honor trust in both games with mixed-role reputation. With every 0.1 increase in the trustee's historical trust rate, the probability that trustee honors trust increases with 0.04 in both games with mixed-role reputation. In the games with single-role reputation the trustee's historical trust rate is not a significant predictor of the trustee's decision.

B.4 Overall trustworthiness rate

Model 1 in Table B1 shows that more trust is honored in the Trust Game than in the Lending Game ('LG') in the single-role reputation condition. On average, the probability that a trustee honors trust is 0.09 higher in the Trust Game than in the Lending Game with single-role reputation. By comparison, in the mixed-role reputation condition we find that the trustworthiness rate does not significantly differ between the Trust Game and the Lending Game ($b = 0.388$, $z = 0.95$, $p = .341$).

Confirming the results of the rank-sum test, we find that the interaction between game type and reputation system type ('LG * MRR') is significant: in the Trust Game the probability that trust is honored is 0.17 higher in the single-role reputation condition than in the mixed-role reputation condition, but in the Lending Game the probability that trust is honored is 0.14 higher in the mixed-role reputation condition ($b = 1.062$, $z = 1.97$, $p = .049$).

Table B1
Determinants of trustworthiness in the different conditions.

Independent variables	Model 1: All conditions	Model 2: TG, SRR	Model 3: TG, MRR	Model 4: LG, SRR	Model 5: LG, MRR
Constant	1.981 (0.328)	1.825 (0.573)	0.464 (0.530)	0.099 (1.431)	2.500 (0.967)
Lending Game (LG, ref. cat. = TG)	−1.661** (0.481)	–	–	–	–
Mixed-role reputation (MRR, ref. cat. = SRR)	−1.060* (0.429)	–	–	–	–
LG * MRR	2.048** (0.666)	–	–	–	–
Round number	−0.048*** (0.009)	−0.031** (0.012)	−0.050*** (0.014)	−0.044 (−0.029)	−0.004 (0.026)
Made trustee decision	–	0.049 (0.426)	−1.058* (0.459)	−1.668 (0.854)	1.625* (0.783)
Honor rate history	–	1.766*** (0.392)	1.998*** (0.574)	3.243* (1.131)	0.648 (1.007)
Made trustor decision	–	−1.400* (0.598)	−0.180*** (0.578)	−0.173 (1.499)	−3.890*** (0.904)
Place rate history	–	0.299 (0.430)	1.924** (0.547)	3.822 (3.269)	2.639* (1.213)
N	1197	468	404	109	216
LL	−649.192	−233.104	−219.668	−57.022	−100.110

*Indicates significance at $p = .05$ (two-tailed tests).
**Indicates significance at $p = .01$ (two-tailed tests).
***Indicates significance at $p = .001$ (two-tailed tests).
Standard errors are in parentheses.

- TG refers to Trust Game, LG refers to Lending Game.
- SRR refers to single-role reputation system and MRR to mixed-role reputation system.
- Made trustee decision (Made trustor decision) indicates whether the trustee has made a decision in the trustee (trustor) role yet.
- Honor rate history (Place rate history) indicates the rate at which the trustee has honored (placed) trust in the past.
- Made trustee decision (Made trustor decision) indicates whether the trustee has made a decision in the trustee (trustor) role yet.
- Honor rate history (Place rate history) indicates the rate at which the trustee has honored (placed) trust in the past.

Interestingly, we found that not only trust levels were higher under mixed-role than single-role reputation conditions in the Lending Game, but levels at which trust was honored were also higher. One possible explanation for these additional beneficial effects of mixed-role reputation systems is that the increased trust rate may have made it more worthwhile to invest in a reputation. The more frequently trust is placed, the larger the chance that a user with a good reputation receives trust, so the more it pays off to have a good reputation. These findings stand in stark contrast to what we found for paid service provision scenarios, where trust was honored *less* so under a mixed-role reputation regime than in a single-role reputation system.

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