Gossip as an alternative for direct observation in games of indirect reciprocity

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Communication about social topics is abundant in human societies, and many functions have been attributed to such gossiping. One of these proposed functions is the management of reputations. Reputation by itself has been shown to have a strong influence on cooperation dynamics in games of indirect reciprocity, and this notion helps to explain the observed high level of cooperation in humans. Here we designed a game to test a widespread assumption that gossip functions as a vector for the transmission of social information. This empirical study (with 14 groups of nine students each) focuses on the composition of gossip, information transfer by gossip, and the behavior based on gossip information. We show that gossip has a strong influence on the resulting behavior even when participants have access to the original information (i.e., direct observation) as well as gossip about the same information. Thus, it is evident that gossip has a strong manipulative potential. Furthermore, gossip about cooperative individuals is more positive than gossip about uncooperative individuals, gossip comments transmit social information successfully, and cooperation levels are higher when people encounter positive compared with negative gossip.

cooperation | reputation | language | manipulation

The use of language in human societies has been widely investigated, and several studies have shown that most conversations are about social information (1–4). Commonly, such communication about social topics, especially of third parties, is called gossip (5–7). Thus, gossip is regarded as an important phenomenon (1, 8–12). In recent years, it has received increasing attention (7) from disciplines such as economics, sociolinguistics, psychology, anthropology, and evolutionary biology.

The functions attributed to gossip are as diverse as the disciplines engaged in its study. Gluckman (8) proposed gossip as a tool for social control to hold the community together by preserving its morals and values and controlling competing cliques and aspiring individuals. A study on Californian ranchers, for instance, supported this view (13). Through a series of interviews, Ellickson showed that, in this small-scale society, group norms were enforced by gossip. Later findings corroborated this hypothesis further by showing that self-serving, compared with group-serving, gossip is highly disapproved of (14), as well as by documenting the use of gossip to reward group beneficial behavior and deride violations of group norms (15).

Baumeister *et al.* (16) used questionnaires to show that gossip is a means of cultural learning. About two thirds of the participants stated that they learned something from gossip that was useful for their own lives. This finding suggests that gossip is a way of communicating rules and other formal information (11). Among the best-known views about gossip is Dunbar's (17–19) social grooming hypothesis, according to which language has evolved to cope with the increasing size of social groups resulting in an increasing number of social connections. Therein, language (and thus gossip) functions as a mechanism for social bonding by increasing the potential number of interaction partners. The effect of strengthening social bonds also was discussed by Noon and Delbridge (11) in the context of business organization. They state that gossip can aid the coordination of organizations by maintaining social networks within that organization through periods when this coordination is not required for the operation of the company.

Other authors have stressed the use of gossip to promote self-interest and individual benefits (3, 9, 20). It was found that participants were mainly interested in information about people of the same age and gender (20). In addition, negative information about high-status people (e.g., professors) and positive information about friends were especially valuable and likely to be passed on to others. These findings support an evolutionary perspective about gossip, according to which people, among other things, try to enhance their own status by damaging the reputation and status of higher ranked members of the social group. Therein, gossip serves as an important means to gather reputation-relevant information about others (21, 22) and, furthermore, to manage one's own reputation by spreading positive gossip about oneself.

Reputation, however, has been shown to have an important effect on cooperation dynamics in human societies. Recently, it was found that reputation can solve the "tragedy of the commons." This social dilemma, described by Hardin (23), refers to the fact that a public resource will be overused if everybody is free to do so. Milinski, Semmann, and Krambeck (24) showed in an experiment with students that the opportunity to build up a reputation prevented a public good from being overused. This finding was applied to the global climate problem, where students could invest in climate protection anonymously in one treatment and while being observed in another (25). When the investment in a pool for climate protection had reputational consequences (by being observed by others), donations were substantially higher than in anonymous rounds.

These studies support the view that the presence of reputations has a strong effect on the maintenance of high-level cooperation. Reputation can be acquired through indirect reciprocity (26). Accordingly, people who help others gain reputation will thus be helped, whereas those who refuse to help will lose reputation. This dynamic leads to the evolution of cooperation if partners' reputations are known. Nowak and Sigmund (27) showed by computer simulations of evolution that discriminating cooperators (i.e., individuals who base their decision of whether to help on the partner's reputation) eventually dominate the population. Because many authors have been investigating indirect reciprocity theoretically with computer-generated agents competing for prevalence (28–35), it is accepted as a major mechanism leading to cooperation (36).

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Experimental studies confirmed that humans cooperate through indirect reciprocity (24, 37–41). However, these dynamics rely on incomplete information. Computer agents base their decisions on scores reflecting past behavior of their artificial partners, and participants of experimental studies were presented with similar scores or directly with past decisions of their partners. Clearly, the acquisition of knowledge about others' reputation is important. Nowak and Sigmund (27) suggested that only a fraction of the population may have the opportunity to directly observe an interaction between two specific individuals. Incorporating respective parameters, the outcome of their computer simulations depended on the probability with which a given individual witnessed another's decision, as well as on group size. The larger the group (and, therefore, the less likely interactions were to be observed), the lower the level of cooperation.

Although human societies tend to be large groups, they show a remarkably high level of cooperation. We assume that there is abundant information transfer to compensate for low levels of direct observation. There is widespread belief among anthropologists and evolutionary biologists that gossip can serve this function (4, 27, 30, 33, 42).

Here we combine cooperation games based on reputation with the possibility to gossip about other group members. We examine whether gossip transfers information successfully in such a context and whether it can maintain cooperation by indirect reciprocity. In this study, gossip refers to short comments of participants about other players in the experimental setup. This gossip is based on direct observation, and we expect them to be positive when a cooperative player is observed and negative when an uncooperative player is observed. Furthermore, to be a functional vector of social information, gossip should not only reflect the quality of observed behavior (i.e., cooperation vs. defection), but also needs to be comprehensible. A given gossip intended by the author to be a positive statement also should be perceived as such by other members of the group. Therefore, we expect high correlation between one's own and others' ratings (positive or negative) of gossip comments. Furthermore, we test whether gossip has an effect in a situation where the respective group member also is directly observed. Especially, we focus on conflicting information between gossip and direct observations. In these situations, participants see cooperative decisions of another player, but also can read a negative gossip about that person. Our prediction is that, in such cases, gossip is ignored.

Results

Students played a computer game in groups of nine (see *Materials and Methods* for details). They started with six "observer" (i.e., with access to past decisions of the potential recipient) indirect reciprocity rounds (block A) to create a history of their cooperation behavior [see also supporting information (SI) Fig. 5]. These were followed with gossip rounds in which participants wrote a short gossip about other players' decision behavior. These gossips were then the only information about the potential recipient in further indirect reciprocity rounds. Afterward, the students again played six observer indirect reciprocity rounds (block B) and two gossip rounds as before. However, the following indirect reciprocity rounds showed a mixture of information (gossip and past decisions, or gossip and a comment about the author) (Fig. 1) to the active player. Finally, the participants played another three observer indirect reciprocity rounds (block C). At the end, each participant had to rate each gossip he or she encountered during the game on a scale from 1 (negative) to 7 (positive).

In all three blocks of observer indirect reciprocity rounds (A, B, and C), the cooperation was on a high level (means in percent/SD: A, 66/12.6; B, 65/15.8; C, 68/17.9) and did not rise or fall significantly (paired t test: A and B, $n = 14$, $t = 0.1496$, $P = 0.882$; B and C, $n = 14$, $t = -0.354$, $P = 0.726$).

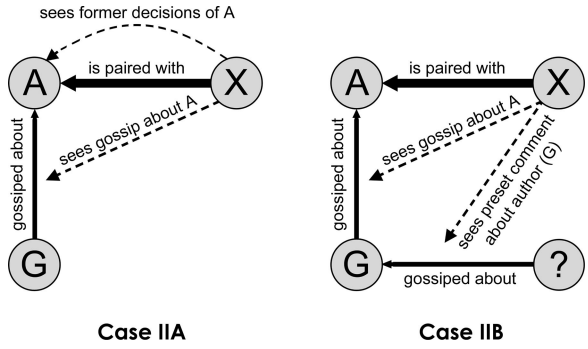

Fig. 1. Schematic overview of the two round types in the block special rounds II, cases IIA and IIB. The X represents the focus players, A is the potential recipient, and G is another player who gossiped about A earlier in the game (thin arrows). Thick arrows indicate pairing of players (X and A). Dotted arrows indicate the information X had access to before making his decision. Question mark represents another player who gossiped about G. However, in these special rounds, the respective gossip was replaced with preset comments.

To analyze general giving behavior based on direct observation, decisions of those rounds in which individuals were provided with six former decisions of another player were taken into account (special rounds I). We grouped each individual player according to the number of YES decisions she saw in this round (i.e., 0, 1, 2, . . . or 6) and calculated a cooperation level for each group (i.e., the number of players who decided YES in this round divided by the total number of players in the group). The resulting data show a significant correlation between the number of YESs observed and the resulting cooperation level as percentage [$y = 8.6x + 27.4$, $r^2 = 0.86$, $F\,(1,5) = 30.78$, $P < 0.005$] (Fig. 2). This result is to be expected in an indirect reciprocity game and shows that the design of the game allows for normal indirect reciprocity dynamics to work (37).

The same analysis was done for rounds in which the players only had access to one third (i.e., two former decisions) of the same information. Would a third of all former decisions reliably mirror the actual decisions? The actual number of YES decisions (of six) was correlated with the number of YES decisions displayed (of two). There was a highly significant correlation [$y = 0.33x + 0.07$, $r^2 = 0.54$, $F\,(1,124) = 145$, $P \ll 0.0001$], which means the random selection of two decisions effectively mirrored the original behavior of the player. Consequently, as before, the players were again grouped dependent on the number of YES

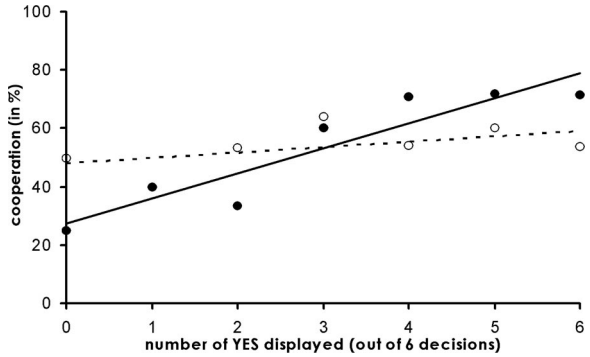

Fig. 2. Elicited cooperation dependent on observed cooperation. Filled circles and line show the percentage of players cooperating and regression line [$y = 8.6x + 27.4$, $r^2 = 0.86$, $F\,(1,5) = 30.78$, $P < 0.005$] dependent on how many YES decisions they saw out of six decisions of their partner. Open circles and dotted line [$y = 0.02x + 0.48$, $r^2 = 0.29$, $F\,(1,5) = 2.028$, $P = 0.21$] represent the resulting cooperation after the original information (x axis) was transmitted by gossip.

decisions provided, resulting in three groups (0, 1, or 2 times YES displayed). A correlation with the respective cooperation level, however, failed to be significant [$y = 9.7x + 54.3$, $r^2 = 0.95$, F (1,1) = 18.56, $P = 0.15$].

To analyze the use of gossip, we pooled the rounds in which players had access to six former decisions of another player and then had to write a gossip about that player. The pooled data showed that the more YES decisions were observed, the better the rating of the resulting gossip by its author [$y = 0.57x + 2.57$, $r^2 = 0.96$, F (1,5) = 108.4, $P < 0.0005$]. This analysis, which was done on an individual level, was justified by the fact that individuals knew the ratings cannot be used in the game and the explicit statement that the ratings should not be given strategically. The same was found for those cases where gossip was only based on two former decisions [$y = 0.75x + 3.55$, $r^2 = 0.9975$, F (1,1) = 394.1, $P = 0.032$].

Furthermore, the author's rating of a gossip was significantly correlated with the subsequent rating of the same gossip by a player encountering it later in the game. This finding was true when gossip was based on 100% information (i.e., six former decisions) [$y = 0.27x + 2.98$, $r^2 = 0.10$, F (1,124) = 13.15, $P < 0.0005$], as well as when it was only based on 33% information (i.e., two former decisions) [$y = 0.27x + 2.95$, $r^2 = 0.05$, F (1,124) = 7.162, $P < 0.01$].

While investigating participants' reactions to gossip, we grouped players according to their ratings of an encountered gossip. Thus, seven groups (gossip ratings from 1–7) were obtained; we calculated the cooperation level as before (number of players deciding YES divided by total number of players in the respective group). We found a significant correlation for both cases: gossip based on 100% information [$y = 5.7x + 33.2$, $r^2 = 0.61$, F (1,5) = 7.69, $P = 0.039$] and gossip based on 33% information [$y = 9.2x + 18.7$, $r^2 = 0.88$, F (1,5) = 35.86, $P < 0.005$].

To directly analyze the effect of gossip, we compared cooperation levels in rounds where the decision is based on direct observation with cooperation levels in rounds where the decision is only based on gossip (about the same information). Therefore, we used the same grouping of individuals as before (i.e., according to the number of YES decisions displayed) and correlated the resulting amount of cooperation with the resulting cooperation these groups received in rounds where the decision is only based on gossip. The resulting regression is not significant [$y = 0.02x + 0.48$, $r^2 = 0.29$, F (1,5) = 2.028, $P = 0.21$] (Fig. 2). Fig. 2 shows a larger difference between the two regression lines in the extremes than in an intermediate cooperation level. This finding suggests that the transfer by gossip processes the original information in a way that positive and negative gossip are qualified as less extreme. To investigate this effect, the resulting cooperation (after information transfer by gossip) is compared with the expected cooperation (taken from decisions of the same players based on direct observation). The analysis documents a significant correlation [$y = -6.8x + 20.6$, $r^2 = 0.72$, F(1,5) = 12.74, $P = 0.016$] (Fig. 3). If the observed cooperation is low (0 on the x axis in Fig. 3), the elicited cooperation after information transfer by gossip is higher than expected and vice versa for high observed cooperation levels (e.g., 6 on the x axis in Fig. 3).

Last, we analyzed preset gossip and its effect in rounds where participants had access to direct information and preset gossip about their partner (case IIA in Fig. 1). The preset gossip intended to be positive was rated significantly higher (mean 6.0 +/− SE 0.12) than preset gossip intended to be negative [mean 2.6 +/− SE 0.17; paired t test; t (13) = 12.58, $P \ll 0.0001$]. Group-level analysis of the cooperation behavior in these two rounds (direct observation with positive gossip/direct observation with negative gossip) showed a strong effect of the added gossip statement despite access to direct information. Comparing the cooperation in the round with positive added gossip

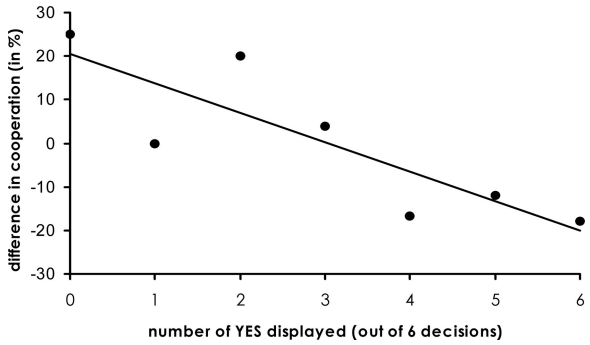

Fig. 3. Difference between cooperation based on direct observation and cooperation based on gossip. This graph shows the difference between the elicited cooperation level by gossip minus the cooperation level based on direct observation (i.e., expected cooperation). The x axis represents the actual number of YES decisions (of six) from the potential recipient. Positive values indicate that players cooperated more with gossip information than expected, and negative values document a lower cooperation level than expected [$y = -6.8x + 20.6$, $r^2 = 0.72$, F (1,5) = 12.74, $P = 0.016$].

(mean 75%) with the cooperation in the case where negative gossip was added (mean 50%) yielded a significant difference [paired t test; t (13) = 4.85, $P < 0.0005$] (Fig. 4). Furthermore, with reference to the cooperation level of the respective round without any added gossip information (mean 62%), there was a significant increase in cooperation in the positive gossip round [paired t test; t (13) = 3.64, $P < 0.005$] and a decrease in cooperation in the negative gossip round [paired t test; t (13) = 2.27, $P = 0.04$].

The situation presents itself differently, however, if we look at rounds in which students were provided with a gossip statement about a potential recipient and a preset comment about the author of this gossip statement (case IIB in Fig. 1). Although our preset comments were again significantly different from each other [mean rating of positive comment, 6.0 +/− SE 0.18; mean rating of negative comment, 2.4 +/− SE 0.16; paired t test; t (13) = 12.53, $P \ll 0.0001$], there was no significant effect on the cooperation level in these two rounds [paired t test; t (13) = 1.02, $P = 0.33$] (Fig. 4). Consequently, no difference in cooperation levels was found in comparison to the respective round without any added comment [mean cooperation in no preset comment, 56%; positive preset comment vs. no added comment, t (13) =

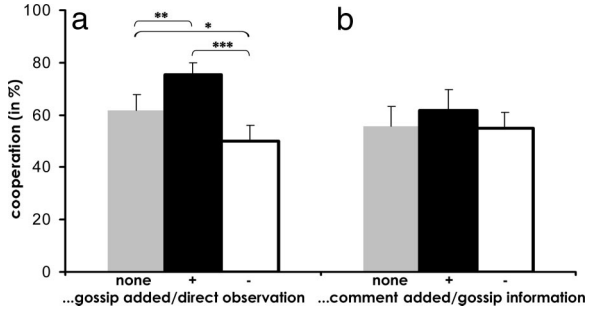

Fig. 4. Cooperation levels of rounds with added preset gossip/comments. (*a*) Bars represent mean cooperation levels (+SE) of rounds in which players were provided with six former decisions (direct observation) of another player without (none, gray bar) or with preset positive (+, dark bar) or negative (−, light bar) gossip pretendedly being about the same decisions (case IIA in Fig. 1). (*b*) Mean cooperation levels (+SE) of rounds in which players were provided with gossip about their potential recipient and without (none, gray bar) or with a preset positive (+, dark bar) or negative (−, light bar) comment pretendedly being about the author of the gossip (case IIB in Fig. 1). *, $P < 0.05$; **, $P < 0.01$; ***, $P < 0.001$.

1.33, $P = 0.21$; negative preset comment vs. no added comment, t (13) = 0.23, $P = 0.82$]. To further test the absence of an effect, we conducted a power analysis for these rounds assuming the same effect size as found in the rounds combining preset comment and direct observation. The calculated power for a sample size of 14 and an effect size of 25.40% (+/− SD 19.70%) of a paired t test is 0.9935. This result indicates that our sample size was large enough to detect a similarly strong effect.

In summary, third-party observers of social interactions gave truthful gossip about the potential donor of such an interaction. This written information was perceived by others as intended and, thus, transmitted the original information successfully. Furthermore, people acted according to the quality of a given gossip statement. However, when directly compared, the expected and observed cooperation after information transfer by gossip differed. Further analysis documented a dampening effect of this transmission in a sense that originally negative behavior is not acted on as negatively and vice versa for positive behavior. In addition, we showed that gossip strongly influenced a player's behavior even if she had access to real information about her game partner by direct observation. This finding was not the case, however, when the gossip statement was a second-order comment (i.e., a comment about the gossip author).

Discussion

In our experiment, we followed the sequence of gossip composition, gossip transfer, and resulting behavior (these direct effects are summarized in SI Table 1). For gossip to function, people first need to truthfully describe other people's behavior. These statements should be unambiguous and generally comprehensible. People encountering these comments should assign them the quality (positive or negative) intended by the author. Last, when hearing (or, as in our experiment, reading) such gossip, people should act accordingly, which means that they would need to cooperate with people about whom they heard positive gossip and defect otherwise. The participants of our study acted as expected. The higher the cooperation of a player they had observed, the more positive was the gossip they wrote. This finding indicates that gossip is used by a third-party observer to truthfully transmit information to a potential recipient. Apparently, the author had the intention to spread this information in the population despite not having any immediate (or monetary) benefit from it. Obviously, this outcome would be expected if the gossiper would risk his reputation by gossiping dishonestly. Concerning transmission of gossip information, we found that positive comments (as rated by the authors) were rated higher by other players than negative comments. Thus, people believe in gossip, and gossip, in turn, is an efficient vector for information transfer. Last, people reading positive gossip about their partner were more likely to cooperate than those reading negative gossip. Accordingly, language provides individuals with access to information about others without the need for direct observation. As speculated by many proponents of indirect reciprocity theory (27, 29, 30), we found that gossip is a possible means of information transmission among individuals.

A further test to see whether gossip serves as a means of transmission of social information about other group members is the comparison of behavior based on direct observation, with the respective behavior based on gossip information (see SI Table 1). Here we found that transmission by gossip had a dampening effect on the cooperation levels compared with acting on direct observation. The more extreme a gossip was, the less impact it had on the reader (see SI Table 1). This finding was apparent despite successful intermediate steps, as explained earlier, which could be due to the fact that people tend to question extreme gossip statements more than less extreme ones. Therefore, we would expect the documented strong effect (changes of 18–25% in the extremes) (Fig. 3) of decreased cooperation based on gossip, compared with direct observation of a cooperative individual, and, respectively, an increase of cooperation by gossip in the group observing uncooperative individuals.

In the present study, individuals had access to only one gossip statement about another person. People may sometimes have access to gossip about the same person from different sources. Such access to multiple sources could reduce the dampening effect. If individuals hear several gossip comments about another person, the mean quality of these gossips (very bad, bad, neutral, good, very good, etc.) might reflect the original behavior much more precisely than a single comment. In line with this assumption is a recent finding of Hess and Hagen (43), who studied the psychology of gossip. In their study, participants had to scale the believability of given gossip in a (written) scenario about their working environment. According to the experimental condition, the participants read the same information from up to four sources. Hess and Hagen found an increase in believability with an increasing number of sources.

Surprisingly, the hypothesis that gossip has no effect if an individual has access to direct information (i.e., observation) clearly has to be rejected (see SI Table 1); 44% of all participants changed their decision in the respective rounds (case IIA in Fig. 1). Of these players, 79% said YES in the round with added positive gossip and NO in the round with negative gossip, although they were informed that the gossip was precisely about the direct information they saw. Thus, gossip has a strong manipulative potential that could be used by cheaters to change the reputation of others or even change their own. This finding suggests that humans are used to basing their decisions on gossip, rumors, or other spoken information. Such a strategy could be successful in an environment where ample gossip/information focusing on friends or other people known to the individual is available and where direct observation is potentially less common than indirect information about others. In such a world, individuals gather a lot of information indirectly by gossip from different sources. The resulting picture of any person with whom the individual is in social contact would be much more refined than the picture based on the small amount of direct observation of these people.

In accordance with a previous series of experiments (38), second-order information (here further information about the source of information) had no significant impact on an individual's behavior. More precisely, it did not matter whether there was additional information about the author of given gossip available (case IIB in Fig. 1 and SI Table 1). A power analysis showed that our sample size was large enough to potentially detect a similarly strong effect as found in rounds with first-order direct and gossip information. Thus, there is strong evidence that people do not take into account whether the source of information is a cooperative player. First, this finding could be due to the fact that second-order information might be too demanding for the working memory anyway (44). Second, people do not think that cooperative players are more honest in the role of gossipers. This notion supports the view that a person's acts are taken into account irrespective of whether the person is in good or bad standing (38).

A limitation of this study is the fact that participants could not interact further with gossip authors. In natural situations, the possibility to ask for more details about the gossip target might result in a more detailed picture of that individual than a single statement could ever give. However, Eder and Enke (5) found that evaluative statements are rarely challenged. Thus, we would not expect a change in the essence of this information (i.e., from negative to positive). If an individual hears something bad about another person, talking about the gossip with the gossipmonger would not change the content into something good about the

other person However, it might adjust the degree from very negative to slightly negative.

Our results suggest that it may be worthwhile to study the manipulative potential of gossip in more detail in the future. Controlling free riders is a major problem in theories explaining the evolution of human cooperation, and Enquist and Leimar (42) found that gossip counteracts free riding in their mathematical model. However, if cheaters are successful in altering their reputation in the population by gossiping, this result might be difficult to achieve. The question remains how individuals detect liars.

Materials and Methods

This experiment was conducted at the Universities of Kiel and Münster, Germany, as well as Vienna, Austria, where 126 first-semester biology students played a computer-based game in 14 groups of nine subjects each. The sessions took place from November 2006 to January 2007. Each participant was seated in front of an individual laptop between opaque partitions. All nine experimental computers were connected to a server. Each computer, including the server, ran the experimental program as an application program under Windows XP and recorded each decision of the respective player. The server recorded the entire game (i.e., all decisions of all players and the contents of each individual screen). Before the start of the game, a short oral introduction guaranteed the following points: Participants knew how to operate the computer and knew about their total anonymity during and after the game (in particular, they were provided with their earnings in a way that would not reveal their identity).

At the beginning of the game, introduction pages explained the rules of the game. These pages were not turned until each participant clicked on an OK button. The following information was given to the students. They were endowed with starting money of 10 Euro each. Participants were anonymous and provided with a pseudonym that was only used for the payoff at the end of the game. To ensure anonymity, they were not allowed to talk to each other or draw attention toward themselves. For each round, they were assigned a partner by the computer.

The game consisted of 27 rounds (see SI Fig. 5). In the first six rounds, they had to decide whether to give (click YES) or not to give (click NO) a preset amount of their money (donor, −1.25 Euro; recipient, +2.00 Euro) to their game partner. To facilitate the decision, they were provided with all former decisions of the potential receiver. During these first rounds, each participant was paired with two other players and interacted with each three times alternately (without explicitly knowing).

After the first introduction and the first six indirect reciprocity rounds, the students played two gossip rounds with the same partner (rounds 7 and 8). In such rounds, they saw all six or one third (i.e., two in a random sequence) of the former decisions of another anonymous participant and had to give any comment they wanted (within a 50-character limit). They were informed that this comment could be the only information a player might have in the following rounds of the game on which to base his YES/NO decision. The sequence of these two different kinds of gossip rounds was alternated across players to control for any sequence effects.

After these gossip rounds, a first block of four connected rounds was played (rounds 9 to 12; special rounds I in SI Fig. 5). In these four rounds, players saw either all six or one third (i.e., two in a random sequence) of the former decisions of another player or they saw gossip about this player (based on either all six or two former rounds).

This block was followed by six more observer indirect reciprocity rounds (rounds 13–18). Here the participants could observe all past YES/NO decisions of their potential recipient, except the decisions from the first six rounds at the beginning of the game. Thus, they have information about their game partners from just after the gossip rounds (starting with round 9).

As before, these observer indirect reciprocity rounds were followed by another two gossip rounds with the same partner (one with access to six past decisions and the other with access to two past decisions). The decisions shown to the participants were drawn from rounds 13 to 18 (i.e., the second block of six observer indirect reciprocity rounds).

In rounds 21 to 24, a second block of four connected rounds followed. In these special rounds II (see SI Fig. 5), preset statements were used as supplement information. These statements were taken from preliminary sessions and were as follows: "ein richtig toller typ" ("a really cool guy"; positive), "übler geizkragen" ("nasty miser"; negative), "spendabler spieler!" ("generous player!"; positive), and "ein sehr unkooperativer spieler" ("a very uncooperative player"; negative). (Note that the missing capitalization in the original German statements was done purposively to mimic comments typed by students during the game.)

In case IIA, such preset gossips were paired with six former real decisions of another player (Fig. 1) to investigate whether people would still pay attention to gossip information despite having access to the original and real information. Each student played one round with a positive preset gossip and another round with negative preset gossip, in addition to identical direct information. It was explicitly stated that the gossip was about the information they saw.

In case IIB, preset statements functioned as a comment about the author of gossip concerning the actual game partner. The focus player was paired with a player A and saw gossip about that player A. In addition, the focus player was shown one of the preset comments, and it was explained that this gossip is a comment about the author of the gossip about player A (Fig. 1). This round served to investigate whether participants paid attention to whether the gossip they read (i.e., gossip about A) was written by a "nice" (positive preset comment) or "bad" (negative preset comment) player.

In both blocks (special rounds I and II), the different types of round were ordered randomly for each player to control for any sequence effect. Moreover, to exclude upstream reciprocity (33), that is, any effect based on whether participants earned money in previous rounds, the payoff from special rounds I and II was shown only after the entire blocks. Participants were informed about all of these round types (gossip rounds, special rounds I, special rounds II) before the respective rounds by further introduction pages.

The monetary part of the game was ended with three observer indirect reciprocity rounds. Here participants had access to past decisions starting with round 21 to ensure that the previous decisions (rounds 21–24) still had reputational consequences. After that the game was over, but participants were asked to rate every comment they had given themselves, as well as those they had encountered. Each student had to assign a number between 1 (very negative) and 7 (very positive) to 10 different comments. An introduction page defining the scale was shown beforehand. Thus, each of the four preset gossip statements was rated by every student, and two comments of each player were rated twice: by the author as well as by another player.

Finally, all students were paid off with their exact earnings in Euro after the game ended (mean payoff was 21.05 Euro). To ascertain anonymity, envelopes with the players' pseudonyms were used as described in Semmann *et al.* (40).

To exclude direct reciprocity during the entire game, pairings were designed in a way that no potential donor of A was a former potential recipient of A. In addition, players who already played indirect reciprocity rounds with each other (in the role of donor or recipient) never gossiped about the other; thus, the gossiper was always a third-party observer. Furthermore, our design did

not permit any standing strategy in the game (27, 28, 45). There was no information provided to decide whether a single decision was justified or unjustified.

All data were analyzed by using an *R* statistical package (version 2.3.1) for Windows XP. If not stated otherwise, data were tested for normality using a Shapiro–Wilk test to justify *t* tests, which were then conducted two-sidedly. Furthermore, the analyses were done on group level, except for those cases where individual-level analyses are explicitly justified in the text.

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