Indirect Reciprocity: A Field Experiment

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Abstract:
Indirect reciprocity involves cooperative acts towards strangers, either in response to their kindness to third parties (downstream) or after receiving kindness from others oneself (upstream). It is considered to be important for the evolution of cooperative behavior amongst humans. Though it has been widely studied theoretically, the empirical evidence of indirect reciprocity has thus far been limited and based solely on behavior in laboratory experiments. In this paper, we provide the first evidence from a natural field experiment. This is conducted in an international online community with over 5 million members, where members can repeatedly ask and offer services to each other, free of charge. For the purpose of this study we created several new member profiles, which differ only in terms of their serving history. Half of the profiles have a history of serving other members, whereas the other half has a neutral history. We then sent out a large number of service requests to different members from all over the world. We observe that a service request is more likely to be rewarded for those with a profile history of offering the service (to third parties) in the past. This provides clear evidence of (downstream) indirect reciprocity. Our results cannot be attributed to reputational effects concerning one's trustworthiness as a service user. We find no support for upstream indirect reciprocity, however.

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1. Introduction

In modern economies the increasing importance of online commerce has lead to a mushrooming of interactions amongst strangers. This leads to a growing need for mechanisms that govern these interactions. In particular, many transactions require mutual trust and cooperation to succeed. In this respect, interactions amongst strangers are no different than many other economic interactions; they heavily rely on implicit contracts (Arrow 1974). This is especially the case when actions are taken sequentially and one actor incurs costs before obtaining the benefits. In long-lasting relationships, direct reciprocity in give-and-take interactions has long been established as a mechanism that supports cooperation (e.g., Fehr et al. 1993). Other mechanisms are needed to support cooperation amongst strangers, however (Bolton et al. 2005). The past 15 years have shown an increased awareness that indirect reciprocity may provide precisely such a mechanism, in the sense that strategies involving indirect reciprocity can evolve under evolutionary pressures and result in a cooperative steady state (Nowak and Sigmund 2005). Evidence of its importance stems from both theoretical analysis (Nowak and Sigmund 1998) and laboratory experiments (Wedekind and Milinksi 2000, Seinen and Schram 2006). To the best of our knowledge, there is no clear statistical evidence from the field, however. We fill this gap and provide data from a field experiment explicitly designed to test for the occurrence of indirect reciprocity in a natural field setting.

Whereas direct reciprocity involves two actors where one directly rewards (punishes) kind (unkind) actions by the other, indirect reciprocity involves a third party. The three actors interact in either of two ways. First, in *upstream indirect reciprocity* an individual B who has been treated kindly (unkindly) by individual A reciprocates by being kind (unkind) to a third individual, C. In *downstream indirect reciprocity*, B reciprocates A because A was kind (unkind) to C in the past. Theoretically, both are considered to be important in the evolution of cooperation amongst humans (Nowak and Sigmund 1998, 2005). Moreover, laboratory experiments have shown that people behave in the way the theory predicts (Seinen and Schram, 2006; Greiner and Levati, 2005; Engelmann and

Fischbacher, 2009; Ule et al. 2009). To date, however, there is no firm evidence from the field that humans behave in this way.

Our natural field experiment is conducted in an international online community with (at the time of the experiment) 5.5 million members in 97.000 cities worldwide.[1] These members provide each other with a free but costly service when traveling. A traveler can request this service from all members that are able to offer it. S/he does so by sending a service request. If a service request is accepted, s/he receives the service without payment. Hence, the service provider endures a cost for the benefit of the traveler. All members can repeatedly be matched with different others, either as a provider or as a traveler. These characteristics make this community very suitable for studying indirect reciprocal behavior.

Downstream reciprocity predicts that the probability of having a service request accepted is higher for those who have previously provided to others, than for those who have not. This would confirm the laboratory findings and provide empirical field evidence in favor of the theory of indirect reciprocity. To study this prediction, we created several new profiles on the online community. Half of these profiles signal a history of providing the service to others ('service profiles'), whereas the other half does not ('neutral profiles'). In all other aspects, the profiles are identical. With these profiles, we sent a total of 189 service requests to different community members worldwide. Their responses were used in the analysis.

Note that this experimental setup was designed to study downstream reciprocity (as is the case for most laboratory experiments). Though limited, public information in the community also allows for studying upstream reciprocity. In particular, we are able to construct a proxy variable that indicates the extent to which the receivers of our service requests had themselves enjoyed services by others in the past. Upstream reciprocity predicts a positive correlation between this proxy and acceptance of our service request.

Our results provide clear evidence of downstream reciprocity in the field. Out of all answers received to the service requests, service profiles had a significantly higher

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[1] This community prefers not to participate in academic research and is therefore not named in this paper. More information will be sent in private communication, upon request.

acceptance rate than neutral profiles. Furthermore, service profiles were more likely to receive any response at all. We will argue that, by design, these effects cannot be attributed to a traveler's reputation of being a trustworthy recipient of the service, but only to her/his reputation of providing the service. Our evidence is thus the first that unequivocally shows the occurrence of downstream indirect reciprocity in the field. We find no evidence of upstream reciprocity, however. Hence, we were unable to replicate in the field the laboratory evidence for this behavior (Greiner and Levati, 2005).

The remainder of this paper is organized as follows. Section 2 provides a brief overview of the literature on reciprocity. Section 3 describes the experimental design and methods used to answer the research question. Section 4 presents the results and section 5 summarizes, concludes and provides suggestions for further research.

2. Direct and Indirect Reciprocity

Originally, direct reciprocity was discussed mainly in other disciplines than economics (Gouldner, 1960; Trivers, 1971 and 1985; Boorman and Levitt, 1980; Brown et al., 1982). Following the rise in the field of Experimental Economics in the 1980s, economists started to recognize the importance of direct reciprocity in many economic interactions. Laboratory control enabled a careful isolation of this behavior in a variety of games. These include the investment game (Berg et al., 1995; Dufwenberg et al., 2001), prisoners' dilemma (Andreoni and Miller, 1993; Cooper et al., 1996; Rand et al., 2009), gift exchange game (Gächter and Falk, 2002) and public good games (Brandts and Schram, 2000; Fehr and Gächter, 2002). Most experimental studies reporting directly reciprocal behavior utilize data from the laboratory (Roth et al., 1991; Fehr et al., 1993 and 1998; Cooper et al., 1996; Gächter and Falk, 2002; Dufwenberg et al., 2001; Fehr and Gächter, 2002). Further support comes from the field (Falk, 2007).

Early on, the biologist Trivers noted the possibility of a 'generalised altruism', where "individuals …. may respond to an altruistic act that benefits themselves by acting altruistically toward a third individual uninvolved in the initial interaction" (Trivers 1971:53). Later, Alexander (1987) introduced the term 'indirect reciprocity' and stressed

that reputations provide the links between individuals that can allow indirect reciprocity to work. Agent-based simulations of strategies that allow individuals to condition their cooperative behavior on a partner's reputation ('image score') show that indirectly reciprocal strategies can be evolutionarily stable (Nowak and Sigmund 1998). One of the driving forces is that having a good reputation may pay if it invokes future cooperative behavior by third parties. This theoretical result is generally considered to be a milestone in understanding the evolution of human cooperation. Though the specific results found by Nowak and Sigmund have been argued to crucially depend on the set of strategies allowed (Leimar and Hammerstein 2001), it is now widely believed that indirect reciprocity plays a key role in human cooperation (for more detailed discussions, see Nowak and Sigmund 2005 or Ohtsuki and Iwasa 2006).

Early laboratory evidence of indirect reciprocity is provided by Kahneman et al. (1986), who detect downstream reciprocity in an ultimatum game where subjects were given information about their partners' previous choices vis-à-vis a third party. Other experiments were designed after Nowak and Sigmund (1998) had established the evolutionary importance of indirect reciprocity. Evidence shows that people invest more in a public good game after they learn that the recipient has recently made a donation to a charitable institution (Milinski et al., 2002). Such downstream reciprocity has also been observed in the investment game (Güth et al, 2001; Dufwenberg et al., 2001) and the repeated helping game[2] (Bolton et al., 2005; Seinen and Schram, 2006; Engelman and Fischbacher, 2009). Upstream reciprocity is found by Greiner and Levati (2005) where subjects grouped in cyclical networks participated in an investment game (Berg et al., 1995).

All in all, there is a rich theoretical literature on the important role that reputation and indirect reciprocity play in the evolution of human cooperation, and there is ample evidence from laboratory experiments with human subjects that individuals use

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[2] In the repeated helping game, a large group of individuals is repeatedly and anonymously matched into donor-recipient pairs. Donors decide whether or not to incur a cost c to give the recipient a benefit b, with $b>c$. To study the occurrence of indirect reciprocity, donors are given information about (some of) the recipient's previous decisions when they were in the role of donor. For more details, see Seinen and Schram (2006).

indirectly reciprocal strategies. However, evidence using natural data from a controlled field setting is still missing. Without such data, the external validity of previous results remains unclear.

3. Experimental Design and Method

3.1. The Online Community

The community we use for our experiment offers a field environment that is characterized by all the elements necessary to enable indirect reciprocity. In particular, members are asked to endure costs to offer a service without any benefits other than a gain in reputation that is (only) relevant within the community. All 5.5 million members have their own profile. These profiles are public and contain basic personal information, pictures and references left by other members. A traveler can request the service from any member that is able to provide it, by sending out a service request to such a member. A request can be answered with 'yes', 'maybe' or 'no'. An accepted request is an offer to provide the service free of charge. The provider can thus decide whether or not to help the traveler. When helping, the provider endures costs in terms of time, effort, and in many cases money. Typically, these costs are lower than the benefit for the traveler. Members repeatedly interact, either as a traveler or as a provider. All of these characteristics fulfill the standard assumptions of the repeated helping game (Nowak and Sigmund 1998), in which laboratory subjects show clear evidence of indirect reciprocity (Seinen and Schram 2006).

Since providing the service to other members is not in one's direct self-interest, standard assumptions in economic theory applied to self-interested decision makers predict that people would do no such thing. However, the website is an enormous success and the number of total services offered exceeds 5 million. Furthermore, most interactions are indirect, meaning that traveler and provider usually meet each other only once. Direct reciprocity can therefore not explain the observed activity either. It is conceivable that providers offer the service because of other-regarding preferences. We

will see below that our results allow us to reject this explanation of the choices observed in our experiment, however.

Apparently some other mechanism is driving cooperation in this community. Because the benefits of receiving the service exceed the costs of providing it, it can be beneficial to provide the service to others, if this increases the probability of receiving the service as a traveler sometime in the future. This is the case if having a reputation of providing the service increases the probability that a provider will offer the service to you later on; in other words, if indirect reciprocity is involved. Note that it is not a reputation of being a good person in general or a trustworthy community member that drives indirect reciprocity. Instead, the reputation is about having served others in the past. Our design allows us to explicitly isolate the latter type of reputation.

It follows that in order to condition on somebody's serving history, information about this history is needed. In this community a member's profile contains two indicators that reveal her history in terms of providing and receiving the service. The first is a self-provided indication of her experience in both respects. Because there is no check on the truth of this statement, the second indicator is more reliable. It uses references that are left on the profile after an interaction has taken place. On every profile, all references are displayed that have been received from or written to other members. Importantly, the profile also shows whether a reference was left by a provider, a traveler or by a 'neutral' party. A neutral party was not involved in a service interaction with the member concerned but can be a friend that is also a member, for example to inform the community that the person concerned is reliable and trustworthy. This results in a better reputation, but not in terms of a history of service provision. Only a reference left by a traveler signals that a member has provided the service in the past and thus affects one's reputation in this respect. The number of references left by travelers is therefore a good indicator of how much help has been offered in the past. This, together with a member's stated experience, is the available information about a member's history. Information on the number of times service was denied is not available.

In sum, members repeatedly make choices on whether or not to help other members, where the cost of helping is lower than the benefit of receiving help. There is little room for direct reciprocity, since most members interact only once with the same partner. All members can be either a provider or a traveler. And lastly, when deciding on whether or not to help a certain member, information is available that reveals this member's past in terms of helping others. Because of these characteristics, this community is perfectly suited to study indirect reciprocity in a field setting.

3.2. Design

For the purpose of this experiment, eight new profiles were created on the online community. These were designed such that they either signal a past of service provision (a serving history), or a neutral history. We varied these profiles across gender and nationality. The latter distinguished between Dutch and Israeli profiles.[3] This gives four traveler types, and for each we created a serving history and a neutral history. As explained above, there are two elements on a profile that indicate a member's history. One is the self-stated experience and the other is the number of references left by travelers. On the serving profiles, we formulated the self-stated experience as follows:[4]

> "I've only [provided service] so far. I love to meet different people this way and exchange information and experiences about our cities and cultures."

On the neutral profiles, it reads almost exactly the same:

> "I have no […] experience yet. I'd love to meet different people this way and exchange information and experiences about our cities and cultures."

Furthermore, we created for each profile type ten references. Ten existing members that were asked to participate in the experiment in this way posted these references on the created profiles. These members were aware of the purpose of the experiment. They

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[3] We chose Israeli and Dutch nationalities for our travelers because both nations have a reputation for traveling a lot while the cultures are seen as very distinct. This allows us to check whether responses to service requests differ depending on the background of the traveler.

[4] Throughout this paper, in order to avoid revealing the online community, we replace identifying phrases by neutral terms in square brackets ([…]).

were also carefully instructed on what reference to leave on which profile. All serving profiles were given references from travelers and all neutral profiles received neutral references. No profile was given the same reference more than once and no reference was written by the same person more than once (not even on different profiles[5]) and all serving (neutral) profiles were given exactly the same ten references. Note that the latter will not affect service providers' decisions, because each received a request from only one profile.

Participating members made no mistakes in following the instructions. The process thus yielded twenty distinct references, ten of which were written on behalf of a 'traveler' and ten in the name of a 'neutral friend', i.e. by someone claiming no interaction as a member. The two sets of ten references were paired, with the same words used within each pair. For example, one of the references left by a traveler is:

> "*Peter is a very good [provider]. He is welcoming, knows a lot about Amsterdam and is fun to hang out with.*"

The neutral reference of this pair is:

> "*Daniel is a very good person. He is welcoming, knows a lot about Amsterdam and is fun to hang out with.*"

The ten reference pairs used are given in Appendix 1. All serving profiles received the first reference of a pair and all neutral profiles received the second. In this way, the serving profiles are given the same positive reputation as the neutral profiles, with the only difference being that their references also signal that they have provided the service to others in the past, which is not the case for the neutral profiles.

Other than these signals about past provision, the serving profiles do not differ from the neutral profiles (see Appendix 2 for an overview of all text written on the profiles). One exception is the profile picture. Since the community regulations do not allow duplicate profiles or fake identities, real identities had to be used for all eight experimental profiles. Eight individuals (four men, four women, crossed with four Israeli and four Dutch) who were not yet a member were asked to participate in this

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[5] Since references for other members are displayed on a profile, it might be suspicious if a member left identical references on more than one profile.

experiment by giving permission to use their real name and picture to create a profile. All pictures were taken from a distance, minimizing the possible effects of appearance (see Appendix 3 for the pictures that were used). There were two individuals in each of the gender/nationality combination, one was randomly assigned to a serving profile, the other received a neutral profile.

All profiles were used to randomly send out a large number of service requests to different members worldwide. Selection of the members that received a request was randomized over a restricted subset of all community members. In particular, only members that had a status denoting that their availability to offer the service was 'yes' or 'maybe' could be sent a service request. As a result, only these members could be selected. A second restriction, imposed by us, is that the last time a member had logged in, was no longer than two weeks prior to the selection. This was done to increase the probability that the requests would be read within a reasonable time frame. Under these two restrictions, 189 members were randomly selected and each was randomly allocated to receive a request from either a service profile or from a neutral profile (with equal probabilities).[6] This ensures that possible treatment effects are not affected by specific characteristics of the members concerned (see Appendix 4 for statistical evidence).

The service request sent is exactly the same for serving profiles and neutral profiles, except that the serving profiles again signal their history of service provision, whereas the neutral profiles signal their neutral history. The requests are displayed in Appendix 5. When sending a service request, there are several fields that need to be filled out. Amongst other things, one has to indicate "why I would like to meet you". This field is mandatory and the request cannot be sent if fewer than 100 characters have been written. It is suggested that one provides personal comments that show that one

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[6] Requests were sent between May 8 and May 13, 2013 for service provision starting May 22nd. We originally considered sending out more requests later. On May 14, the eight experimental profiles were deleted by the community webmaster, however, for using the community for other purposes than is intended. Because we had alternated the requests sent across profiles, at the time of removal sufficient data had been collected for all profiles to test our hypotheses. Also, after all data had been collected, we debriefed all providers that we had approached by sending an email that briefly explained the project and their role therein. Not one objected to this.

has actually read the provider's profile. Since it could seem suspicious if nothing personal were written here, this field could not be identical for all requests. However, to keep the messages alike among all requests, one specific sentence is used, with some words adapted to refer to the provider's profile. The sentence that was used reads as follows:

"You seem like a really nice person and some statements on your profile like.............. and..............and................sound like me!"

Examples of what could be written on the dots are *"that you are into sports and modern art"* or *"that your philosophy is to live day by day"*. Thus, the requests were written such that all approached providers read the same basic message and the same personal sentence with three elements that referred to their own profile. Again, the only difference across requests is that serving profiles signal a history of helping others, whereas neutral profiles do not.

Table 1 shows how the 189 requests were distributed across the eight experimental profiles. 96 requests were sent from serving profiles and 93 from neutral profiles. Also within each category, the number of requests sent is balanced between the serving and neutral profiles.

Table 1: Service requests sent

		Female & Dutch	Male & Dutch	Female & Israëli	Male & Israëli	Total
History type:	Provision	30	28	19	19	96
	Neutral	30	25	19	19	93
	Total	60	53	38	38	189

Notes. Cells show per profile the number of requests were been sent.

Note that this experimental design aims to investigate downstream reciprocity, i.e., an increasing probability of receiving help (as a traveler), as more help has been *offered by oneself*. It is more difficult to use a design like this to investigate upstream reciprocity, i.e., an increasing probability as more help has been *received by the individual to whom a request has been sent*. There is no clear information about existing members' history in terms of traveling, since these profiles are not especially created to signal their past. Nevertheless, there are some indicators that reveal a members' past in terms of

traveling, which allow us to develop a proxy that indicates this history. This proxy is determined by the number of references left by previous service providers on the profile of the member who has been approached with a request. Such a reference indicates that service has been received from this referee. To test for upstream reciprocity, we investigate the correlation between this proxy and the probability that a service request sent to this member will be rewarded.

3.3. Hypotheses

Our experiment has been especially designed to study downstream reciprocal behavior. In particular, such behavior yields the hypothesis:

Hypothesis 1 (downstream reciprocity)

A service request sent from a serving profile has a higher probability of being rewarded than a service request sent from a neutral profile.

To test for upstream reciprocity, we use the proxy for the provider's history of travel:

Hypothesis 2 (upstream reciprocity)

A service request sent to provider X is has a higher probability of being rewarded, the higher is the number of references from other providers on X's profile.

We test these hypotheses in the following section.

4. Results

To start, Table 2 provides an overview of responses to our service requests, for all of the profiles we created. It shows the response rates, and the answer to the service request. A response can be 'yes', 'maybe' or 'no'. A member that replied to be willing to provide the service for at least part of the time requested is reported as a 'yes'. A member that replied that no service could be provided is reported as a 'no'. Other answers, such as *"I*

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Table 2: Data Overview

| | Dutch | | | | Israeli | | | | All | |
| | Female | | Male | | Female | | Male | | | |
	Serv.	Neutr.	Serv.	Neutr.	Serv.	Neutr.	Serv.	Neutr.	Serv.	Neutr.
#requests	30	30	28	25	19	19	19	19	96	93
#responses	16	6	14	11	11	12	10	9	51	38
resp. rate	53.3%	20.0%	50.0%	44.0%	57.9%	63.2%	52.6%	47.4%	53.1%	40.9%
# yes	8	1	7	3	4	5	8	3	27	12
# maybe	3	3	2	2	4	3	1	1	10	9
% yes/req	26.7%	3.3%	25.0%	12.0%	21.1%	26.3%	42.1%	15.8%	28.1%	12.9%
% yes/resp	50.0%	16.7%	50.0%	27.3%	36.4%	41.7%	80.0%	33.3%	52.9%	31.6%
% no/resp	31.3%	33.3%	35.7%	54.5%	27.3%	33.3%	10.0%	55.6%	27.5%	44.7%

Notes. Columns distinguish between the profile types created, "Serv." = serving profile; "Neutr." = neutral profile. In addition: "resp. rate" = #responses/#requests*100%; # yes is number of offers to provide the service; # maybe = number of responses that kept open the possibility of providing the service (but did not yet offer it); "% yes/req" = #yes/#requests*100%; "%yes/resp" = #yes/#responses*100%; "%no/resp" = (#responses–#yes–#maybe)/ #responses*100%.

don't know yet", "let me come back to you in a few days" or "Can you tell me a little bit more about yourself first? I might be able to serve you", are reported as a 'maybe'. Only the first reply is reported, meaning that a 'maybe' can never turn into a 'yes' or a 'no'.

The aggregate response rate across all requests is 47% and higher for requests sent from serving profiles than from neutral profiles. Moreover, Israeli profiles (55%) are responded to more often than Dutch profiles (42%) while differences between men (48%) and women (46%) are small.[7] Of course, response rates may have been higher if the webmaster had not withdrawn the profiles we created. Given that we alternated the profiles of the requests sent, the time that the members has to respond was equal across profiles and this bias will therefore not affect our comparisons.[8]

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[7] We provide statistical evidence of differences across profiles, below.
[8] The average number of days that requests had been out when the profiles were deleted varies from 3.4 for Dutch men with a service profile to 4.9 for Israeli women with a service profile. The difference between service and neutral profiles within the same nationality/gender was 0.5 days for both Dutch and Israeli women, 0 for Israeli men and 0.6 for Dutch men. These differences are statistically insignificant.

Table 2 provides a first indication of (downstream) indirect reciprocity in our data. In aggregate, serving profiles receive 12.2 %-points more responses, such responses are 21.3%-points more likely to offer the service (i.e., are 'yes') and are 17.2%-points less likely to reject outright ('no'). A request sent out by a serving profile has a 28.1% probability of being accepted straight away, compared to only 12.9% for neutral profiles. This indicates that downstream reciprocity plays a role in this field environment. A past of helping others is rewarded by third parties. These third parties are not only more inclined to respond, but also more willing to offer help.

For a more formal analysis we use probit regression models and test hypotheses 1 and 2. To start, column 2 of Table 3 investigates the determinants of service providers' decisions on whether or not to respond to a service request. The results provide strong support for the observation that a request sent by a member who has previously provided the service to others is more likely to receive (any kind of) a response than an otherwise identical member without this history.[9] Hence a first indication of indirect reciprocity is observed: people are more likely to receive a response if they have helped third parties in the past. The results also show that Israeli woman are 24.5%-points more likely to receive a positive response than Dutch women; an effect that is statistically significant at the 5%-level. Other pairwise differences between profile types are not significant at the 10%-level. Exploring why Israeli women are more likely to receive a response is beyond the scope of this paper, however.

Columns 3 and 4 of table 3 consider the probability of receiving a positive response, conditional on receiving any response at all. They differ in how they treat the response 'maybe'. In column 3, this is considered a rejection of the request and in column 4 we treat it as a positive reply. Both models provide very strong statistical evidence in favor of hypothesis 1 (downstream reciprocity). The marginal effects show that, conditional on receiving any response at all, the probability of receiving help is 25.0%-points (column 3)

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[9] This result does not depend on inclusion of provider characteristics in the regression. If these are dropped, the estimated marginal effect drops to 12.6%, but remains significant (z=2.02**). It does require correcting for profile types, however: a regression with only the variable "service profile" yields a marginal effect of 12.3%, with z=1.37(n.s.).

Table 3: Determinants of Providers' Decisions

	Respond		Yes		Yes or Maybe	
serving profile	0.152	2.18**	0.250	2.69***	0.229	3.23***
profile type[#]						
Dutch man	0.126	1.11	0.084	0.84	0.001	0.03
Israeli woman	0.245	2.19**	0.070	0.52	0.076	1.09
Israeli man	0.142	1.36	0.285	2.88***	0.094	1.10
provider characteristics						
male	0.134	1.91*	−0.076	0.53	0.069	0.49
age/100	−0.558	0.41	−0.008	0.00	2.273	1.01
#providers' references	−0.004	0.39	−0.021	1.48	−0.023	1.67*
#travelers' references	−0.007	0.72	0.006	0.55	−0.003	0.33
#friends	−0.007	1.64	0.005	1.05	0.008	1.37
able to provide	−0.017	0.29	−0.000	0.01	0.038	0.36
days	0.031	1.48	0.020	0.67	0.069	1.80*
#observations	189		89		89	

Notes. The first number in a cell denotes the marginal effect of the variable depicted in the row, in a probit regression explaining the dependent variable distinguished by the column; the second number gives the corresponding z-value. We use robust standard errors clustered at the profile type (eight clusters).
"Respond"=1 if the provider sent any response at all and 0, otherwise. "Yes"=1 if, conditional on responding at all, the provider agreed to provide the service, and 0, otherwise. "Yes or Maybe"=1 if, conditional on responding at all, the provider agreed to provide or kept the option open (i.e., s/he did not reject the request), and 0, otherwise. "Serving profile" = 1(0) if the request was from a serving (neutral) profile. "Profile type" is a set of dummy variables indicating the gender/country background of the profile that sent the request (marginal effects are relative to Dutch women). "Provider characteristics" are obtained from the profile of the community member to whom the request was sent. "#providers' references" denotes the number of references left by other members that have previously provided the service to the member to whom we sent a service request. "#travelers' references" denotes the number of references left by other members that have previously received the service from the member to whom we sent a service request. "#friends" denotes the number of friends on the profile of the member to whom we sent a service request. "able to provide" = 1 (0) if the profile indicates the availability to offer the service as "yes" ("maybe") (recall that no request can be sent to a member indicating "no"). "Days" indicates the number of days between submission of the request and the day for which the service was requested.
*(**,***) denotes statistical significance at the 10(5-,1-)% level.

or 22.9%-points (column 4) higher if it was sent by someone with a history of helping others than if it was sent by someone with otherwise the same characteristics and reputation, but without the helping history.[10] This is strong statistical evidence from the field that humans exhibit indirectly reciprocal behavior. The other result that stands out

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[10] This result does not depend on including other independent variables. Regressions with only "service profile" yield marginal effects of 21.4%-points (z=2.58***) for column 3 and 17.3%-points (z=2.31**) for column 4.

is that Israeli men are 28.5%-points more likely to receive a "yes" in response to their request than Dutch women (significant at the 1%-level). The 20.1%-point difference with Dutch men is also statistically significant (at the 5%-level). Once again, it is beyond the scope of this paper to explain such differences across profile types. Finally, note that the distinct responses to the two profiles rule out other-regarding preferences as an explanation for member's willingness to provide the service to strangers. We know of no model of social preferences that would make this distinction.

The results for the "serving profile" variable in all three regressions provide strong statistical support for hypothesis 1 and are therefore evidence of downstream indirect reciprocity. Of course one can also combine the response decision of column 2 with either of the decisions in columns 3 and 4 (i.e., classify non responses as a 'no'). This gives further support to the hypothesis: for columns 2/3 combined the marginal effect of having a serving profile is estimated to be 0.175 (z=3.42***) and for 2/4 it is 0.195 (z=3.50***). This shows that also the unconditional probability of receiving help is significantly higher for serving profiles than for neutral profiles. Similar support is obtained if the response "maybe" is treated as a separate variable and an ordered probit regression is conducted.[11]

To evaluate hypothesis 2 (upstream reciprocity) we consider the variable that measures the number of references left by service providers on the profiles of the members to whom we sent a service request ("#providers' references"). Recall that this is used as a proxy for a member's past traveling behavior. A positive coefficient for this variable would indicate that the willingness to respond positively to our service request is increasing with the number of times that a member has received service from others in the past, i.e., it would provide evidence of upstream reciprocity. Our results show no such effect. In fact, all three coefficients are negative, one of them significantly so at the 10%-level. One possible reason is that members with many references left by service providers tend to use the community to receive services and are less inclined to offer them. Notice that this is in sharp contrast to upstream reciprocity.

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[11] Details are available from the authors upon request.

5. Concluding Discussion

Our results provide clear evidence of downstream reciprocity. To the best of our knowledge this is the first solid evidence from the field. Our experimental design allowed us to control the history of the helping behavior of individuals that asked strangers for help. Keeping all other characteristics equal (including the reputation of being 'kind'), we were able to show that a history of helping strongly increases the probability of a positive response to a request for help. This probability was unrelated to the amount of help previously received by the person to whom the request was sent, however. We thus found no support for upstream indirect reciprocity.

This evidence from the field has important implications for understanding cooperative behavior. It confirms previous laboratory findings and provides further support to the idea developed in theoretical biology that indirect reciprocity is a mechanism that supports cooperation amongst strangers. Given the increasing number of economic interactions between strangers (e.g., because of the growth in online commerce), indirect reciprocity may therefore also be important in establishing trustworthiness in transactions that involve incomplete contracts. It implies, for example, that an individual engaged in a transaction with a stranger is more likely to be treated fairly if she herself has a history of acting fairly in trades with strangers. If indirect reciprocity does play this role, then this points to institutions that will help in fostering further cooperation. In particular, an individual A, deciding on whether to act cooperatively to some other person B, would require a reputation mechanism that specifically indicates B's previous behavior in situations comparable to A's current decision.

Note that the information about an individual's reputation that is needed to enable indirect reciprocity is much more specific than, e.g., a reputation indicating what kind of person B is. In that respect, information about the individuals in our serving profiles was the same as in our neutral profiles. The information is also not about previous choices an individual made when in the same situation as now. The latter could be used to update the probability about how this individual will act in the current transaction. In

our design, this would be possible if we added references from other service providers to our profiles, our profile being the service recipient. The member to whom we sent a service request could use these references to judge how the traveler would behave if our request were granted. Because this would interfere with the information about previous behavior of our profile as a service provider (which is needed to enable indirect reciprocity), we chose not to add such service references. This allowed us to isolate the effects of information about the history of service provision.

An interesting next step would be to investigate various reputation mechanisms in the field to study the effects of distinct information about individuals' history of helping on the development of indirect reciprocity. One can think of variations in the length of history; mixtures of information about on the one hand direct encounters between two parties and on the other a history concerning third parties; second-order information about why someone did or did not help strangers in the past (which would allow for so-called 'standing strategies'; Sugden 1986; Ule et al. 2009); etc. A different path of research could investigate further the reasons for the lack of upstream reciprocity in our field setting. Though such responses to one's own history are thought to be important in the evolution of cooperation (Nowak and Sigmund 2005), our data show no evidence at all that humans behave in this way. It would be interesting to investigate whether there are environments more favorable to upstream reciprocity than the online community that we have investigated.

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Appendices

Appendix 1: References

In this appendix, phrases in the references that identify the specific online community used have been replaced by neutral phrases in […]. The complete original references are available from the authors, for private investigation. All references are given in pairs, below. An existing member was asked to leave a reference at a profile we created; either as a previous service recipient or as a friend. The response we gave from the profiles is given below the reference. Words in {} were adjusted to fit the specific person.

Pair	reference from service recipient *response from 'our' serving profile*	reference from friend *response from 'our' neutral profile*
1	I [used {name}'s service] and I had a great time. {He/she} told me a lot about the city, which was very interesting. {name} is a good [service provider]! *We had a lot of fun together and I really enjoyed [providing the service to {name}] !*	(Name) is a good person, we always have a great time. He/she can tell a lot about {city} and is very interesting. *{name} is a very nice person and a lot of fun to hang out with.*
2	We had a lot of fun getting to know each other and talking about our cities and cultures. Good [service provider], nice {guy/girl} and definitely recommendable! *{name} was a nice [service recipient], I'd recommend {him/her} to other [members of the community]!*	Neutral) (Name) and I are friends and always have a lot of fun together, I would definitely recommend him/her to other *[members of the community]*! *{name} is a good friend and I'd recommend him/her to other [members of the community] as well!*
3	{Name} is a very good [service provider]. {He/she} is welcoming, knows a lot about {city} and is fun to hang out with. *It was definitely worth getting to know {name}. [Providing the service to] {him/her} has been great.*	{Name} is a very good person. {He/she} is welcoming, knows a lot about (city) and is fun to hang out with. *{name} and I always have a lot of fun hanging out. {He/She} is a very good person and I'm sure it'll be fun [Providing the service to] {him/her.}*
4	Very open, interesting, fun person to hang out with. {He/she} has been a very good service provider] to me. *{name} was a great guest. Very friendly, interesting and open minded.*	Very open, interesting, fun person to hang out with. {He/she} is a good friend of mine. *{name} and I are friends and I'd say{ he/she} is a person that is definitely worth getting to know, so if you [provide the service to] {him/her} I'd say do it!*
5	I [received the service from] {name} and it was great getting to know each other. Whenever {name} had time, {he/she} would explore the city with me and show me nice places where you don't usually come as a tourist. *It was interesting and fun showing {name} around in the city. We had a great time.*	It's great to know {name} and to hang out with {him/her}. {He/she} can also show [travelers] places where you don't usually come as a tourist. *{name} would for sure be a great [service provider or traveler], {he/she} is a very nice and fun person.*

6	Nice {guy/girl}, good [service provider]. I had a good time using {name's} service]!	Nice {guy/girl}, good friend. I think you'll have a good time [using the service of] {name} or [providing the service to {him/her}.
	Very friendly, enthusiastic {girl/guy} and a good [service recipient]!	*{name} is a good friend of mine and I would definitely recommend her/him to all [members], because I'm sure you'll have a good time with {her/him}!*
7	I [used {name's} service] and I had a great time. It was a very pleasant [experience] and I feel like I experienced {city} in a way I otherwise wouldn't have. {Name} was a great [service provider]!	{Name} is a great friend and we always have a great time! {He/she} can give you an experience of (city) that you'd otherwise not have.
	{Name} and I had fun exploring {city} together and getting to know each other!	*{Name} and I have been friends for a while and {he/she} is a great person, friendly and open.*
8	I'd say {name} is a very good [service provider], who makes you feel very welcome. It was a very pleasant [travel] experience and I really liked {city} too.	{Name} is very welcoming and a very good friend. Always pleasant experiences in {city} with him/her.
	{Name} has been a great [service recipient], I enjoyed [providing the service to] {him/her} a lot.	*I'm sure [providing the service to] or [receiving the service from] {name} is a great experience, {he/she} is a good friend of mine.*
9	{Name} and I had a good click and we had fun exploring {city} and learning from each other's cultures. {He/she} is a very nice, interesting and fun person to hang around with!	{He/she} is a very nice, interesting and fun person to hang around with! We have a good click and it's fun to learn from each other.
	{Name} is very open for other cultures and it was a great experience showing {him/her} around here and getting to know {him/her}!	*Always a good time with {name} and good conversations!*
10	I asked {name} pretty last minute to [provide the service to] me and {he/she} was very helpful, welcoming and friendly. I'm really glad I [received the service from] {name} cause it made my {city}'s experience a lot more exciting and fun!	{Name} is very helpful, welcoming and friendly. Hanging out together is always fun and exciting.
	It was my pleasure [providing the service to] {name}. Glad I could help and get to know you!	*{Name} is a good friend and we always have a good time together.*

Appendix 2; **Text on the Created Profiles.**
This appendix provides an overview of the texts entered on the profiles that we created on the online community. References that identify the specific online community used have again been replaced by neutral phrases in […]. Again, precise texts used are available upon request in private correspondence.

Personal Description
I would describe myself as being friendly, easy-going and positive. I like traveling and sports. I'm still in university at the moment, but will start working next year hopefully.

How I Participate in [this community]
For serving profiles:
I've only [provided the service] so far. I love to meet different people this way and exchange information and experiences about our cities and cultures.
For neutral profiles:
I have no [traveling] experience yet. I'd love to meet different people this way and exchange information and experiences about our cities and cultures.

Interests
I like sports, traveling and reading.

One Amazing Thing I've Seen or Done
I saw the Grand Canyon, that was amazing.

Opinion on the [online community] Project
I really like the idea!

Appendix 3: Pictures used for the Profiles.

	Female & Dutch	Male & Dutch	Female & Israeli	Male & Israeli
Serving profile				
Neutral profile				

Appendix 4. **Member Characteristics**
This appendix provides evidence that characteristics of members that were selected to receive a service request, are uncorrelated with the type of profile that was used to send

the request. To test this, we ran a probit regression of the profile type (a dummy variable equal to 1(0) for a serving (neutral) profile) on the available characteristics of the members that are selected to receive a request. Table A1 gives the marginal effects derived from this regression.

Table A1: Probit Regression

	Serving Profile	
male	0.028	0.34
age/100	0.006	0.54
#providers' references	0.001	0.09
#travelers' references	0.011	1.21
#friends	−0.008	1.75*
able to provide	−0.055	0.70
days	0.002	0.07
#observations	189	

Notes. The first number in a cell denotes the marginal effect derived from the probit regression of the variable depicted in the row; the second number gives the corresponding z-value. "Serving profile" = 1(0) if the request was sent from a serving (neutral) profile. The gender and age refer to the member who received the request. "#providers' references" denotes the number of references left by other members that have previously provided the service to the member to whom we sent a service request. "#travelers' references" denotes the number of references left by other members that have previously received the service from the member to whom we sent a service request. "#friends" denotes the number of friends on the profile of the member to whom we sent a service request. "able to provide" = 1 (0) if the profile indicates the availability to offer the service as "yes" ("maybe") (recall that no request can be sent to a member indicating "no"). "Days" indicates the number of days between submission of the request and the day for which the service was requested.
*denotes statistical significance at the 10% level.

The results show very small effects of members' characteristics on whether the request is received from a serving profile or a neutral profile. One out of the seven independent variables is statistically significant at the 10%-level, but even here the marginal effect is very small (0.8 %-points).

Appendix 5: **Service Requests**
The following service requests were sent from the two profile types. As before, we replace phrases that identify the specific online community by neutral phrases in […] and precise texts are available upon request. Words in {} were adjusted to fit the specific person.

Hi …………!
How are you? I'll introduce myself: My name is Floortje, I'm 24 years old and I'm from {country}. I love to travel, and I'm an outdoorsy! I'm pretty new to [this community], but I have [provided the service] a number of times already, as you can see on my profile. I really like to meet people through [community] experiences. Pretty soon I'll be traveling to your city and I'm really excited. I'd love to [use your service] during my stay there. I'll arrive May 22 and leave around May 26. Do you think you could [provide the service to me]? It's ok if you can't [provide it every day]. I hope to hear from you, and I hope we will meet shortly!
Thank you in advance and best regards,
{Name}

Hi …………!
How are you? I'll introduce myself: My name is Floor, I'm 24 years old and I'm from {country}. I love to travel, and I'm an outdoorsy! I'm pretty new to [this community], so I haven't [provided or received the service] yet, as you can see on my profile. I'd really like to meet people through [community] experiences. Pretty soon I'll be traveling to your city and I'm really excited. I'd love to [use your service] during my stay there. I'll arrive May 22 and leave around May 26. Do you think you could provide the service to me]? It's ok if you can't [provide it every day]. I hope to hear from you, and I hope we will meet shortly!
Thank you in advance and best regards,
(Name)