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Reciprocity in a social network: evidence from a natural field experiment

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Abstract

I use a natural field experiment to test for the presence of reciprocity in the context of a social network. Over the course of a year, I randomly sent birthday greetings to the online friends of a Facebook user. I find that sending a birthday greeting to a Facebook friend causes an increase of 50 percent in the probability that the friend will reciprocate when the birthday of the sender arrives. I also find that the tendency to reciprocate is decreasing in time. The likelihood that a birthday congratulation will be reciprocated increases by almost three times as much when the birthday of the sender is one month away than when it is six months away.

Facebook's birthday feature is a seemingly small but cleverly gracious component of the digital universe. When you join the massive site, you enter in the date you were born, leaving off the year if you choose. You don't do this because you are a birthday-fanatic who expects weeks of flowers. You do it because well, you're also entering in where you went to college and whether you like "Rescue Me," so why not your birthday?

And then the day arrives. Alerted to its imminence, and then to its arrival, Facebook friends have been conspicuously urged on their own pages this way: "Joe Jones. It's his birthday. Say happy birthday." To honor this command, they need only click "Say happy birthday" and type a few characters. It takes effort and misanthropy to refuse.

- Virginia Heffernan, *The New York Times*[1]

1   Introduction

As of June 30, 2016, Facebook had 1.71 billion monthly users, or around 23 percent of the world's population[2]. There is evidence that relationships on Facebook are socially and psychologically important to the participants (Wilson et al., 2012), many of whom exchange birthday greetings through the website. For example, Greitemeyer et al. (2014) surveyed college students about the number of greetings that they had received on their most recent birthday. Controlling for age, sex, and number of Facebook friends, the students who reported more birthday greetings scored higher in standard psychological measures of self-esteem and of perceived control over their lives, and lower on a measure of loneliness. The results support the intuition that social interaction on Facebook, and specifically birthday greetings, can mirror offline interpersonal relationships. They have the potential of affecting the fulfillment of the "four fundamental human needs: need to belong, need to maintain reasonably high self-esteem, need to perceive a sufficient amount of personal control over one's social environment, and need to be recognized as existing in a meaningful way" (Greitemeyer et al., 2014). Because of Facebook's widespread use and the significance attached by users to their online relationships, this platform is an ideal environment to test hypotheses about people's social behavior in a non-laboratory, everyday context.

In this paper, I explore the question of whether reciprocating behavior - often observed in laboratory experiments, but not extensively documented through natural field experiments - is a characteristic of online interpersonal relationships. The setting of the experiment is Facebook.

Over the course of a year, I randomly sent birthday greetings to the friends of a Facebook user. Because individuals derive psychic benefits from a birthday greeting, and the natural way to reciprocate this gesture is to congratulate well-wishers when their birthday arrives, I expect that randomly sending a birthday greeting to a friend will increase the likelihood of being congratulated by him or her on one's birthday. I find evidence consistent with a preference for reciprocity: congratulating a friend on their birthday caused an increase of

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[1]http://opinionator.blogs.nytimes.com/2011/08/14/the-social-economics-of-a-facebook-birthday/ (Last accessed: May 20, 2014)

[2]http://newsroom.fb.com/company-info/ (Last accessed: August 24, 2016)

nearly 50 percent in the probability that the friend would send a birthday greeting. Moreover, I find that the likelihood that a birthday congratulation will be reciprocated declines as more time elapses between receiving it and giving it. The probability of having one's birthday greeting reciprocated increases by nearly three times as much when the sender's birthday is a month away than when it is six months into the future.

The results provide empirical support for the idea that reciprocity matters when thinking about real-life human behavior. Traditional economic notions of rationality, which call for modeling people as maximizing a measure of utility that depends exclusively on material consumption or statically on the utility functions of others, fall short of explaining a wide range of phenomena related to reciprocity (Sobel, 2005). Take the following example: an aggrieved lover's utility function does not depend on the former beloved's utility in the same way that it did before a breakup. Her utility function may continue to have his utility as an argument, but it will now decrease rather than increase in this variable. This insight has many applications. For instance, vote-buying in developing countries seems to rely on voters' intrinsic preference for reciprocating the gifts provided by the vote buyer (Finan and Schechter, 2012). Preferences are not necessarily static, and other people's actions toward us can change them because we like to be nice to those who are nice to us and mean to those who treat us meanly.

Most of the empirical evidence for reciprocating behavior comes from the laboratory. Artefactual experiments[3] such as these are problematic in two ways. Subjects may want to please the experimenter, reacting to the treatment in the way they think he or she wants them to react, thus leading to spurious conclusions (List, 2011). Moreover, it is rarely obvious whether the behaviors observed in a laboratory setting will transfer to the natural environment of the subjects. These problems can be overcome using natural field experiments, in which subjects are in their natural environment, unaware that they have been randomly assigned to a treatment or control group by the experimenter. This paper contributes to the literature that demonstrates the existence of reciprocating behavior on the field (e.g., Gneezy and List, 2006; Kube et al., 2012). Much of this literature looks at how workers increase their productivity in response to gifts from their employer.

By focusing on reciprocity in informal social relationships rather than contractual ones, I tap into a different but crucial type of interaction that is at the basis of other kinds of economic relations. For example, informal social networks play an important role in job searches (Ioannides and Loury, 2004), migration decisions (Munshi, 2003; Mckenzie and Rapoport, 2007), informal insurance in traditional villages (Townsend, 1994) - even when it is mediated by modern technology (Jack and Suri, 2014) - , and the diffusion of information about microfinance in developing countries (Banerjee et al., 2013), among others. Finally, I make a novel contribution to the large and growing literature about Facebook, which spans several social sciences (Wilson et al., 2012).

Naturally, there are important limitations to the results presented here: the costs of sending birthday greetings on Facebook are close to zero, and where reciprocity is more costly one might expect that it would be less frequent. At the same time, reciprocity in several economically relevant relationships - whether mediated by online social networks or not - is also nearly cost-free: forwarding a friend's resume to a potential employer in response

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[3]I use the categories proposed by List (2011) to classify experiments

to a kind gesture from that friend, or conveying information about migration destinations or financial opportunities has little or no cost. The results presented here would apply most directly to settings of that nature.

There are two more sections in this paper. The next one describes the experimental design, and the final one presents and discusses the results.

2 Experimental design

I examine the probability of receiving a birthday greeting from a friend on one's Facebook *timeline*, conditional on having congratulated the friend on his or her birthday.

There is one treatment group and a control group. The treatment consisted of posting a birthday greeting on a person's timeline, starting in May of 2014 (when the birthday of the Facebook user took place) and ending in May of 2015.

Participants were chosen for the experiment if they had revealed their date of birth on Facebook and if social convention allowed for either congratulating them or not on their birthday[4]. This left a total of 308 experimental subjects. They were arranged by date of birth, and bins with two individuals were created. The first individual in each bin was assigned to the treatment(control) group with probability of 0.5, and the other user was assigned to the control(treatment) group. Descriptive data on gender, educational attainment, and marital status were collected from profile information and complemented with information known from personal interaction. Birthday greeting history, number of Facebook friends, and duration of Facebook friendship were collected exclusively from profile information. However, only data on whether birthday congratulations were sent or received, gender, and days before the user's birthday were available for all participants.

3 Results

Table 1 summarizes the data. The user was congratulated by 20 percent of his Facebook friends. Because some users restrict postings on their timeline, not every single individual who was originally assigned to the treatment group received a greeting: only 46 percent of the subjects did. 41 percent had been congratulated by the user on at least once between 2007 and 2014. In turn, 37 percent of the user's friends had congratulated him at least once between 2007 and 2014 (the percentage of friends who congratulated him on any given year fluctuated between 14 and 21 percent). The subjects have on average 584 friends of their own. Those who reveal their age (less than half of the sample) are on average 34 years old. The average birthdate takes place 181 days before the user's, and he has been Facebook friends with each individual around 6 years on average. Roughly 47 percent of his friends are married, and 49 percent are male. Most are college graduates, almost half have graduate degrees, and 22 percent have obtained research doctorates.

The results of the experiment are shown in Table 2. The first column shows the OLS estimate of equation 1:

$$greeting_i = \alpha + \beta T_i + e_i \tag{1}$$

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[4]E.g., the user could not randomize birthday greetings to his parents.

where $greeting_i$ is an indicator variable for whether individual i sent a birthday greeting to the user, T_i is an indicator for whether the user congratulated i on his or her birthday, and e_i is a random error term. β is the causal effect of sending a birthday greeting to i on the probability that i will reciprocate the greeting. The second column gives the OLS estimate of equation 2:

$$greeting_i = \alpha + \beta T_i + \mathbf{X}_i'\gamma + e_i \tag{2}$$

where $\mathbf{X}_i$ is a vector of controls included to increase the efficiency of the estimate of β. The third column includes in $\mathbf{X}_i$ interactions of the treatment with the controls in order to look at heterogeneous effects. I only include control variables that are available for the entire sample, and robust standard errors are used throughout.

In (1) and (2), the point estimates of β are 8 and 7 percentage points respectively. Roughly 17 percent of the control group congratulated the user, so β is quite large by comparison: it implies that the probability of receiving a birthday greeting increases by 46 percent as a result of congratulating someone on their birthday. The effect is statistically significant at the 10 percent level. Column (2) shows that having congratulated i at some point in the past is associated with an increase of 8 percentage points in the probability of receiving a birthday greeting from them. The strongest predictor, by far, of whether i will send a birthday greeting is their having done so in the past. It is associated with a 33 percentage point higher likelihood of sending good wishes, and it is significant at the 1 percent level. Male friends were also 10 percentage points more likely to send a birthday greeting.

Column (3) looks at the interactions between the treatment and the various control variables. In this specification, the coefficient on T_i triples in size and it becomes significant at the 5 percent level. This is easily explained by the inclusion of the interaction between the treatment and the number of days between sending a birthday greeting to i and the birthday of the user, which is negative and also significant at the 5 percent level. Either memory of a birthday greeting fades with time, or the desire to reciprocate is strongest when the opportunity to do so is closer in time, or both. The estimates imply that congratulating someone whose birthday takes place 6 months before that of the user leads to an increase of 8 percentage points in the probability of receiving a birthday greeting from them; by contrast, if their birthday takes place a month before the user's birthday, the likelihood goes up by 21 percentage points, nearly three times more.

Table 3 contains estimates of the analogous probit models; for these, I report the marginal effects evaluated at the sample means and I use robust standard errors. The results are by and large consistent with the OLS estimates.

The Facebook user's friends could have displayed reciprocity in ways other than sending a public greeting on the user's birthday. For example, they could have sent messages through the platform's private messaging function. I collected information on private messages in order to check whether this affected the results, and re-estimated the models using the sum of public and private birthday greetings as the dependent variable. There were only 3 private birthday greetings out of a total of 66, and the estimates do not appreciably change.

The results provide evidence of a preference for reciprocity in the context of informal social networks. I also find that the tendency to reciprocate is strongest the shorter the time elapsed between receiving a birthday congratulation and having the opportunity to send one

in return.

The implications of the experiment in its own narrow context are clear: if someone is interested in getting birthday congratulations from their Facebook friends, they should congratulate them, especially the ones who have a birthday shortly before theirs. The more interesting question, however, is that of external validity: what may the results imply for other kinds of interpersonal relationships, whether online or offline?

It seems reasonable to extrapolate the insights from the experiment to extended social networks in settings in which reciprocity is not costly. To the extent that Facebook reflects relationships in the "real" world, including family, friends, and acquaintances within the network, it seems reasonable to conclude that the results can apply to offline interactions as well. But it would not be sensible to conclude from this experiment, for example, that purchasing an expensive gift for a friend would tend to result in receiving an expensive gift in return. Drawing conclusions about reciprocity when the cost of reciprocating is high would be a stretch. Nevertheless, plenty of economically valuable things can be cost-free for the giver and for the reciprocator. An example would be job referrals, which can happen through friends of Facebook friends, through other online social networks such as LinkedIn, or by emailing a friend's resume to an employer in order to return a similar favor. Valuable information too can be selectively - and cheaply - conveyed to friends who have been "nice" in the past: if someone has shared advice on refinancing student loans, or on applying for funding of some kind, it is free to send along similar information. In general, then, it makes sense to conclude that wherever information or other low-cost goods can be shared with one's social networks - online or offline - reciprocity can play an important role.

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Table 1: Descriptive Statistics

VARIABLES	(1) N	(2) mean	(3) s.d.
Sent greeting after treatment	308	0.205	0.404
Treated	308	0.461	0.499
Greetings received as counted by FB the next day	270	61.67	52.35
Number of Friends	273	583.9	471.6
Was congratulated in the past	308	0.412	0.493
Sent congratulations in the past	308	0.373	0.484
Age	134	33.57	8.662
Birthday is x Days Before User's Birthday	308	180.8	99.39
Years of Facebook Friendship	303	5.696	2.084
Married	294	0.466	0.500
Male	308	0.490	0.501
High School Degree	293	0.0307	0.173
Some college	293	0.00683	0.0825
Bachelor's Degree	293	0.451	0.498
Master's Degree	293	0.222	0.416
Professional Doctorate	293	0.0546	0.228
Research Doctorate	293	0.235	0.425

Table 2: OLS Estimates of the Effect of Sending a Birthday Greeting on the Probability Receiving One

Dependent Variable is Whether a Birthday Greeting Was Received	(1)	(2)	(3)
Treated	0.0778*	0.0730*	0.241**
	(0.0465)	(0.0427)	(0.0960)
Was congratulated in the past		0.0836*	0.133**
		(0.0449)	(0.0576)
Sent congratulations in the past		0.326***	0.305***
		(0.0500)	(0.0653)
Birthday is x Days Before User's Birthday		-0.000238	0.000171
		(0.000216)	(0.000277)
Male		0.0978**	0.0793
		(0.0416)	(0.0512)
Treated × Was congratulated in the past			-0.115
			(0.0894)
Treated × Sent congratulations in the past			0.0424
			(0.0998)
Treated × Birthday is x Days Before User's Birthday			-0.000890**
			(0.000438)
Treated × Male			0.0525
			(0.0840)
Constant	0.169***	0.00983	-0.0648
	(0.0292)	(0.0457)	(0.0537)
Observations	308	308	308
R-squared	0.009	0.201	0.219

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Probit Estimates of the Effect of Sending a Birthday Greeting on the Probability Receiving One

Dependent Variable is Whether a Birthday Greeting Was Received	(1)	(2)	(3)
Treated	0.0778*	0.0795*	0.335***
	(0.0465)	(0.0440)	(0.117)
Was congratulated in the past		0.0838*	0.146**
		(0.0446)	(0.0644)
Sent congratulations in the past		0.330***	0.354***
		(0.0507)	(0.0719)
Birthday is x Days Before User's Birthday		-0.000198	0.000259
		(0.000209)	(0.000292)
Male		0.108**	0.115*
		(0.0434)	(0.0599)
Treated × Was congratulated in the past			-0.101*
			(0.0557)
Treated × Sent congratulations in the past			-0.0360
			(0.0734)
Treated × Birthday is x Days Before User's Birthday			-0.000845**
			(0.000415)
Treated × Male			-0.00388
			(0.0797)
Observations	308	308	308

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1