

The Use of Reciprocity to Build Reputation in Electronically Mediated Social Networks

Yasuaki Sakamoto

Elliot Sadlon

Jeffrey V. Nickerson

Stevens Institute of Technology

Introduction and Predictions: People contribute content to online communities and as a result of their contributions they gain reputation. Reputation is supposed to emerge from the fair opinions of others. But reputation can instead become a goal that participants actively seek. By exchanging praise, members of an online community may purposefully ratchet up their reputations.

As a rule, people engage in cooperative behavior that helps an inside group achieve reputation status above that of an outside group (cf. Axelrod, 1997). In electronically mediated social networks, *information* is the medium of exchange, and it can be directed toward other individuals to create an inside relationship. For example, pairs of eBay vendors reciprocally praise each other's products, so that both vendors can increase their reputations (Brown and Morgan, 2006; Dellarocas et al., 2004).

Although reciprocity has been observed in many experimental economic experiments (e.g., Axelrod, 1984; Camerer, 2002), there have been comparatively few studies that operationalize and measure reciprocity in natural settings (Yakubovich, 2001), perhaps because the tracing of gifting activity is sometimes difficult. Electronically mediated social networks provide us the data to examine these mechanisms of reciprocity.

We predict that users will take advantages of the affordances – the possibilities for action – of socially mediated networks in order to bolster their reputations. We study Digg, a news aggregator, because the site provides an example of peer production: users effectively decide which stories will become popular. We look at the affordances that the website provides. We show how these affordances can be mobilized and appropriated to promote certain reciprocal behaviors. We focus on why and how reciprocal behaviors emerge and how effective they are.

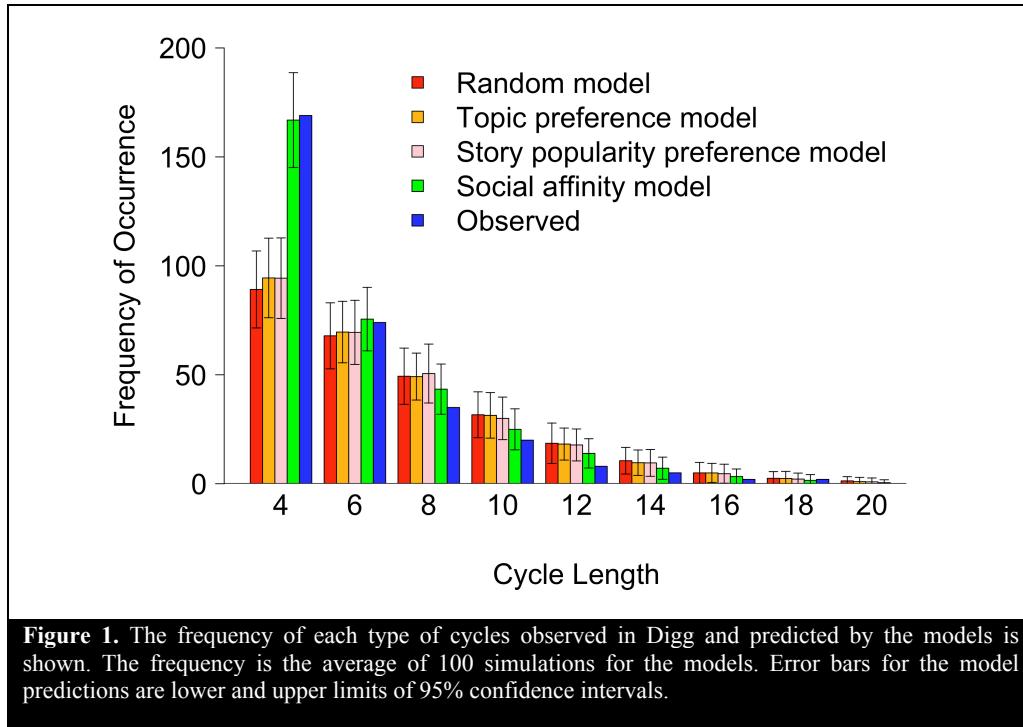
In Digg, web stories are posted at the rate of about one every ten seconds by users. The more active users “digg” or “bury” the stories to vote for or against them. Users can digg the same story only once. Through the process of user voting, stories move into a state of either high popularity or obscurity. Once the stories gain a certain number of supporters within a certain timeframe, they are promoted to the front page of Digg. Thus, users act as editors, culling stories (Sakamoto and Nickerson 2009; Sadlon et al. 2008, Sakamoto et al. 2008).

Abstracting away the details of Digg, we find that contributors provide information gifts to others, anticipating reciprocal gifts that will improve their reputations. For example, if Ann praises the content Bill submits, then Bill praises the content Ann submits. Thus, we expect to find examples of such mutual praise.

We test our theory by looking for cycles in the bipartite graph of people and content. If two individuals reciprocate directly, they form a short cycle with each other, mediated through the content. A computational model, which incorporates a social condition that underlies direct reciprocation, can fit the observed frequency of length-four cycles in Digg, a peer production news aggregator in which users vote for news they like. The observed results are inconsistent with the predictions of three plausible alternative models – one that assumes random voting behavior, another that incorporates users' preferences for content topics, and a third that considers the early popularity of content. Our results suggest that contributors reciprocate directly with others to gain positive reputation: They mobilize their social networks by using the technologies-

at-hand. The contribution of this work to the information systems literature is a predictive theory of how peer production unfolds.

Results: From a set of 100,000 submissions we randomly sampled 100 active users and their 1,789 submissions. Figure 1 summarizes the frequencies of observed cycles in Digg and those in model simulations. We observed a large number of shorter-length cycles and a few longer-length cycles in Digg. As can be seen in Figure 1, whereas the social affinity model was able to closely fit the frequencies of different types of cycles observed, the other models could not. The root-mean-squared difference between observed and model predicted frequencies of cycles was much lower for the social affinity model (3.21) than the other three models (22.21 for random, 20.78 for topic preference, 20.81 for the story popularity preference model).



The *random*, *topic preference*, and *story popularity preference* models each failed to account for the high frequency of length-four cycles, in contrast to the successful social affinity model. These results indicate that the length-four cycles in the graph do not result from random digging or because people share interests and some stories are inherently more attractive than others. Instead, these cycles likely result when people reciprocate with others. Taken together, the results from our cycle analyses and simulations suggest that the frequent occurrence of length-four cycles is indicative of direct reciprocity. All four models were able to correctly predict the frequency of the longer-length cycles, and thus we cannot attribute their presence to one theory or another, although the simplest possible explanation is that they occur randomly.

It is surprising that the random model is indistinguishable from the topic preference model and story popularity preference model in accounting for the length-four cycle data observed in Digg. These three models may lead to similar patterns of prediction because of individual differences in people's preferences. One possible reason why the topic preference model fails to account for the observed results is that there are so many stories under each topic, and thus two users sharing topic preference do not make a difference in the overall pattern. The failure of the story popularity preference model suggests that although some users may be better than others at identifying stories that attract other users' attention, they may develop their own niche, leading to

a lack of shared interests. Indeed, we have noticed that submitters dominate in a particular story category, and focus almost all their attention to actions that, consciously or not, preserve their domination (Sadlon et al. 2009).

Conclusions: We found that the content of a submitted story matters less than the name of the person submitting the story, and that a relatively small percentage of people dominate the site. At the time of our study, participants of the site appeared to have successfully appropriated social networking technologies to recruit others to vote for their contributions.

There is a finding that deserves future study: the same affordances that make gaming the system possible also make monitoring behavior possible, and both Digg and other users can monitor the activities to punish or shame those who violate the norms of the network. This monitoring is a double-edged sword: norms can be enforced through the power of publication, and the users of social network technology do have the power to disseminate opinions widely. But, unlike the established press, blog-based monitoring can be anonymous, making it difficult to separate investigative reports from vendettas.

Our work may apply to other sites also. There are at the time of writing three large competitors to Digg, named [Reddit](#), [Mixx](#), and [StumbleUpon](#). They all have incentive structures: Reddit has *karma* and *comment karma*, Mixx has *karma points*, and StumbleUpon has *favs*. Moving farther afield, Wikipedia uses barnstars, a form of incentive for contributors. Our theory predicts that this incentive will distort behavior: as users seek to acquire the barnstars, they will recruit social networks in new and unexpected ways. Likewise, the mechanisms we explain here may apply to many different websites and online communities. For example, networks of standard makers (Nickerson and zur Muehlen 2006) may also appropriate social networks to create momentum for a particular standard.

The emerging character in this story is automation. Users of Digg automated their intent to reciprocate and gain high repute: they built bots to automatically vote for stories they hadn't read, and to monitor the behavior of those who they expected to reciprocate. On the other side, both owners of the web site and outraged participants built monitors to detect these anti-social behaviors.

The bots are here to stay, and they will play many roles: machines that recruit friends, as well as machines that detect such behavior. How will these undeniably powerful and increasingly automated peer production networks evolve? We are in the early stage of an information gift society that is far from equilibrium, accelerating.

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