Experimental Study of Informal Rewards in Peer Production

Michael Restivo*, Arnout van de Rijt

Department of Sociology, State University of New York at Stony Brook, New York, New York, United States of America

Abstract

We test the effects of informal rewards in online peer production. Using a randomized, experimental design, we assigned editing awards or “barnstars” to a subset of the 1% most productive Wikipedia contributors. Comparison with the control group shows that receiving a barnstar increases productivity by 60% and makes contributors six times more likely to receive additional barnstars from other community members, revealing that informal rewards significantly impact individual effort.

Methods

This study’s research protocol was approved by the Committees on Research Involving Human Subjects (IRB) at the State University of New York at Stony Brook (CORIHS #2011-1394). Because the experiment presented only minimal risks to subjects, the IRB committee determined that obtaining prior informed consent from participants was not required. Confidentiality of personally-identifiable information has been maintained in strict accordance with Human Subjects Committee requirements for privacy safeguards.

We designed our experiment to test the hypothesis that informal rewards have a reinforcing effect on volunteer work effort. We performed our experiment on a random sample of 200 active contributors from among the 1% most productive editors who had never been awarded a barnstar from another user. To construct our sampling frame, we obtained a list of active Wikipedia contributors – defined as any user who performed at least 1 edit (modification to the English Wikipedia project) in the 30-day window prior to the start of the experiment. We ranked this population of 144,120 contributors by their total number of edits, after which we screened into our sampling frame the top 1% of users and discarded the remaining. Next, we eliminated any high-volume contributors who had previously received a barnstar or had elevated administrative privileges in the community. We then took a uniformly random sample of 200 users and through random assignment either awarded a barnstar (100 cases) or withheld the award in the control group (100 cases). Finally, we observed all 200 subjects’ actions for 90 days.

After the observation period ended, we compared contributors’ productivity (article modifications) and peer recognition (additional barnstars received from other users) across conditions. To account for between-subject differences in pre-treatment productivity, we calculated cumulative productivity on any day as the running total number of article modifications divided by the number of article modifications in the 30-day pre-treatment period. To test the null hypothesis that post-treatment productivity would be equal across conditions, we employed a measure of...
central tendency (median) and a non-parametric test (Mann-Whitney U test) that are robust to outliers and distributional skew. To test for an experimental effect in subsequent peer recognition, we performed a Pearson chi-square test ($\chi^2$).

Results and Discussion

In both groups, median productivity was lower after the treatment, which can be attributed to regression toward the mean – resulting from our sampling the 1% most productive users – as well as to general turnover in the contributor population. However, users who received a barnstar exhibited greater sustained productivity and were less likely to discontinue contributing. Of 19 users who made zero edits in the post-experiment observation period, only five received the experimental treatment ($\chi^2 = 4.711$, df = 1, p = 0.030).

We also find significant between-group differences in productivity: receiving a barnstar increased median productivity by 60% compared to the control group (Mann-Whitney U-test: $z = 3.222$, p = 0.001), shown in Figure 1. Other tests (median test, Student’s T test) also yield significant differences between conditions (p<0.01). The magnitude of this difference remained approximately constant over the course of the 90-day observation period, suggesting that the barnstars we awarded had a sustained effect on productivity. In addition to exhibiting greater productivity, subjects in the experimental condition were significantly more likely to receive additional rewards from other contributors. Twelve experimental subjects were subsequently awarded one or more barnstars from other contributors, compared to two subjects in the control group ($\chi^2 = 7.681$, df = 1, p = 0.006). These twelve individuals exhibited no greater productivity prior to receiving the additional barnstars when compared to others in the experimental condition (Mann-Whitney U-test: $z = .743$, p = 0.450). For this test, productivity was calculated as the total number of edits up to day 0, when the first additional barnstar was awarded. The result of the test remains unchanged when productivity is calculated up to day 92, when the last additional barnstar was awarded (Mann-Whitney U-test: $z = .796$, p = 0.426). This suggests that cumulative advantage [14,15] in the allocation of informal rewards operates through a mechanism of enhanced social prestige in the community and not increased merit.

The findings demonstrate that even though informal rewards are free to give and carry no immediate material benefits, they have a substantial positive effect on the productivity of Wikipedia contributors. Our findings indicate that this beneficial effect can become self-reinforcing as reward-receiving accumulates for recipients. Together, these results suggest that the facilitating role of informal rewards in peer production systems derives from their ability to stimulate individual effort as well as contribute to an accrual of social recognition. While previous scholars suggest that the intensity of informal rewards in peer production is low [6], the present research quantifies their magnitude and indicates that informal rewards may play a key role in sustaining volunteer effort.

Acknowledgments

We thank Damon Centola for helpful discussion, Ori Heffetz, Michael Macy, Ian Roxborough, Michael Schwartz and anonymous reviewers for useful comments, Ljuban Jaksic for technical assistance, and the Wikimedia Foundation for facilitating access to public Wikipedia data.

Author Contributions

Conceived and designed the experiments: MR AR. Performed the experiments: MR. Analyzed the data: MR AR. Contributed reagents/materials/analysis tools: MR AR. Wrote the paper: MR AR.

References

1. Benkler Y (2007) Coase’s Penguin, or, Linux and “The Nature of the Firm.” Yale Law Journal 112: 369–446.
2. Raymond E (1999) The Cathedral and the Bazaar. Knowledge, Technology & Policy 12: 23–49. doi:10.1007/s12130-999-1026-0.
3. Voss J (2005) Measuring Wikipedia. In: Proceedings of the 10th international conference of the International Society for Scientometrics and Informetrics. Stockholm, Sweden.
4. Olson M (1965) The Logic of Collective Action: Public Goods and the Theory of Groups. Cambridge, MA: Harvard University Press.
5. von Krogh G, von Hippel E (2006) The Promise of Research on Open Source Software. Management Science 52: 975–983.
6. Demil B, Lecocq X (2006) Neither Market nor Hierarchy nor Network: The Emergence of Bazaar Governance. Organization Studies 27: 1447–1466. doi:10.1177/0170840606067250.
7. Forte A, Bruckman A (2005) Why Do People Write for Wikipedia? Incentives to Contribute to Open-Content Publishing. In: GROUP 05: Sustaining Community: The role and design of incentive mechanisms in online systems. Sanibel Island, FL: GROUP 05.
8. Wikimedia Foundation (2011) Wikipedia Editors Study: Results from the Editor Survey, April 2011. Available: http: //upload.wikimedia.org/wikipedia/commons/5/51/Editor_Survey_Report_April_2011.pdf. Accessed 2011 August 1.
9. Ellingsen T, Johannesson M (2008) Pride and Prejudice: The Human Side of Incentive Theory. American Economic Review 98: 990–1008. doi:10.1257/aer.98.3.990.
10. Willer R (2009) Groups Reward Individual Sacrifice: The Status Solution to the Collective Action Problem. American Sociological Review 74: 23–43. doi:10.1177/000312240907400102.
11. Stewart D (2005) Social Status in an Open-Source Community. American Sociological Review 70: 623–642. doi:10.1177/000312240506700505.
12. Hilbe C, Sigmund K (2010) Incentives and Opportunism: From the Carrot to the Stick. Proceedings Biological Sciences/The Royal Society 277: 2427–2433. doi:10.1098/rspb.2010.0065.
13. Szolnoki A, Perc M (2010) Reward and Cooperation in the Spatial Public Goods Game. Europhysics Letters 92: 38003. doi:10.1209/0295-5075/92/38003.
14. Merton RK (1968) The Matthew Effect in Science. Science 159: 56–1.
15. DiPrete TA, Eirich GM (2006) Cumulative Advantage as a Mechanism For Inequality: A Review of Theoretical and Empirical Developments. Annual Review of Sociology 32: 271–297. doi:10.1146/annurev.soc.32.061604.123127.