

# How Gamification Affects Software Developers: Cautionary Evidence from a Natural Experiment on GitHub

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**Abstract:** We examine how the behavior of software developers changes in response to removing gamification elements from GitHub, an online platform for collaborative programming. We find that the unannounced removal of daily activity streak counters from the user profile pages was followed by significant changes in behavior. Long-running streaks of activity were abandoned and became less common. Weekend activity decreased and days in which developers made a single contribution became less common. Synchronization of streaking behavior in the platform's social network also decreased, suggesting that gamification is a powerful channel for social influence. Software developers that were publicly pursuing a goal to make contributions for 100 days in a row abandon this quest following the removal of the streak counter. Our findings provide evidence for the significant impact of gamification on the behavior of developers. They urge caution: gamification can steer the behavior in unexpected and unwanted directions.

**Keywords:** gamification; behavior; software engineering, natural experiment; GitHub

## Summary of Research

In our work published at ICSE 2021 [MSW21], we exploited an unexpected user interface design change on GitHub, the largest platform for collaborative software development, to study how gamification can influence user behavior in the context of software development. From one day to the next in May 2016 streak counters, measuring both current and all-time best counts of how many days in a row a user had made a contribution on GitHub, were removed from all user profiles without warning. This presented a unique opportunity to compare user behavior before and after the change, from which we can estimate the effect of streak counters on user behavior.

A large and growing literature indicates that gamification works: people respond to badges, points, and rankings in digital settings [HKS14]. In some contexts, achievements on gamified platforms have real labor market value, as they are thought to be credible signals of expertise and know-how [Ku21]. Yet although gamification is increasingly deployed on online platforms to steer individuals toward certain kinds of activity, there relatively little previous work on the potential negative effects of this phenomenon, especially in software development. What is known is that gamification can incentivize overwork and even dishonesty [WO14].

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We found evidence that the counters were influencing user behavior in a variety of ways. Users were significantly more likely to maintain long streaks of uninterrupted activity when these streaks were reported on their profiles. After the counters were removed, very long streaks of months of uninterrupted activity became much more rare. There was even a small but significant drop of weekend activity on the whole. We also found a significant drop-out rate among developers who had adopted a 100-days of code challenge, immediately following the change.

An additional observation suggests that individuals did care about their streaks for the sake of the signal: prior to the design change it was common for developers on long streaks to have many single contribution days. We interpret their statistical overrepresentation as evidence that developers were making a minimal effort just to keep their streaks alive. This kind of behavior is even more troublesome in light of our last finding: that developers tended to imitate the streaking behavior of their neighbors in GitHub's social network when counters were visible. This suggests that the behavioral consequences of gamification extend beyond the individual, effecting groups of people. We concluded our study with a reflection on these results and a recommendation that platform designers consider the use of gamification carefully.

### **Data availability**

This work is based on the GHTorrent database<sup>3</sup> from June 2019. We explain the data processing in our GitHub repository<sup>4</sup> and provide all scripts to recreate our database. Processed data is available on Zenodo<sup>5</sup>. A video summary is available on YouTube<sup>6</sup>.

### **Literaturverzeichnis**

- [HKS14] Hamari, Juh; Koivisto, Jonna; Sarsa, Harri: Does gamification work?—a literature review of empirical studies on gamification. In: 2014 47th Hawaii international conference on system sciences. Ieee, S. 3025–3034, 2014.
- [Ku21] Kuttal, Sandeep Kaur; Chen, Xiaofan; Wang, Zhendong; Balali, Sogol; Sarma, Anita: Visual Resume: Exploring developers' online contributions for hiring. Information and Software Technology, S. 106633, 2021.
- [MSW21] Moldon, Lukas; Strohmaier, Markus; Wachs, Johannes: How gamification affects software developers: Cautionary evidence from a natural experiment on github. In: 2021 IEEE/ACM 43rd International Conference on Software Engineering (ICSE). IEEE, S. 549–561, 2021.
- [WO14] Welsh, David T; Ordóñez, Lisa D: The dark side of consecutive high performance goals: Linking goal setting, depletion, and unethical behavior. Organizational Behavior and Human Decision Processes, 123(2):79–89, 2014.

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<sup>3</sup> <https://ghtorrent.org/downloads.html>

<sup>4</sup> <https://github.com/lukasmoldon/GHStreaksThesis>

<sup>5</sup> <https://zenodo.org/record/4710603#.YbSOWr3MJD9>

<sup>6</sup> <https://www.youtube.com/watch?v=IR8DpCNQNBu>