How Collective Memory Gets Forgotten: The Origins of Relaxation Speed in Social Video Sharing Platform

Keywords: collective memory, temporal relaxation, power-law, social tagging, co-occurrence network

Extended Abstract

How is collective memory retained or forgotten within human communities? Previous studies have shown that collective attention on online platforms often follows non-Poissonian bursty patterns. For example, daily views of YouTube videos exhibit distinct dynamic classes characterized by exponential decay and power-law decays with different exponents [**1**]. They further showed that these different classes corresponds to the character of the collective memory, i.e. whether it was evoked exogenous shock or emerged endogenously, and whether the propagation is critical or sub-critical.

Niconico is a major Japanese video-sharing platform similar to YouTube, characterized by subcultural content such as video gaming and anime. Since approximately 75% of the videos fall into these categories, the platform is expected to exhibit dynamics strongly driven by endogeneous mechanism, where internal community tend to dominate over external influences. Therefore, Niconico provides a suitable environment for studying the relationship between community characteristics and the observed power-law relaxation. In fact, previous studies have reported that the temporal decay of daily video views in Niconico follows a universal power-law relaxation that is largely independent of the total view count [**2**].

Figure 1 shows the temporal relaxation patterns of Niconico videos across six groups of total views, together with fittings by the following two-phase model [**3**]:

$$f(t) = A\,e^{-\beta t} + C\,t^{-\alpha}.$$

In this functional form, the exponential term dominates the early-time behavior, while the power-law term governs the long-term dynamics. The switching point t_*, defined by the condition $Ae^{-\beta t_*} = Ct_*^{-\alpha}$, marks the transition between these two regimes. Our results indicate that the top-ranked group is dominated by power-law relaxation throughout the entire observation window, whereas all other groups exhibit exponential decay during the initial few days before transitioning into a power-law phase. Remarkably, from the smallest groups to the most-viewed videos, all cases exhibit persistent power-law relaxation.

These findings suggest that forgetting rates of collective memory on Niconico are universally slow and scale-invariant, distinct from exponential decay. We hypothesize that the persistence of these power-law dynamics is driven by endogenous dynamics influenced by communities in domains such as video gaming and anime. To test this hypothesis, we conduct linear regression with the relaxation exponent α as the response variable and social-tagging features as explanatory variables, aiming to identify which tags influence the speed of relaxation. We clarify which tags accelerate the relaxation and which tags slow it down, and discuss how these effects are related to the dynamic process by which users attach tags to videos. By focusing on the co-occurrence network of tags and the interaction energy between tags, we gain deeper insights into how strongly correlated social taggings shape the relaxation process.

It should be noted that the data used in this study consist of all metadata and time-series records associated with more than 20 million videos on Niconico over a four-year period from

2020 to the end of 2023. The data are provided from the data analysis platform owned by Dwango Co., Ltd. in compliance with the privacy policy and terms of use. All personal information is properly handled, and no personal data are used in any part of the research outputs.

References

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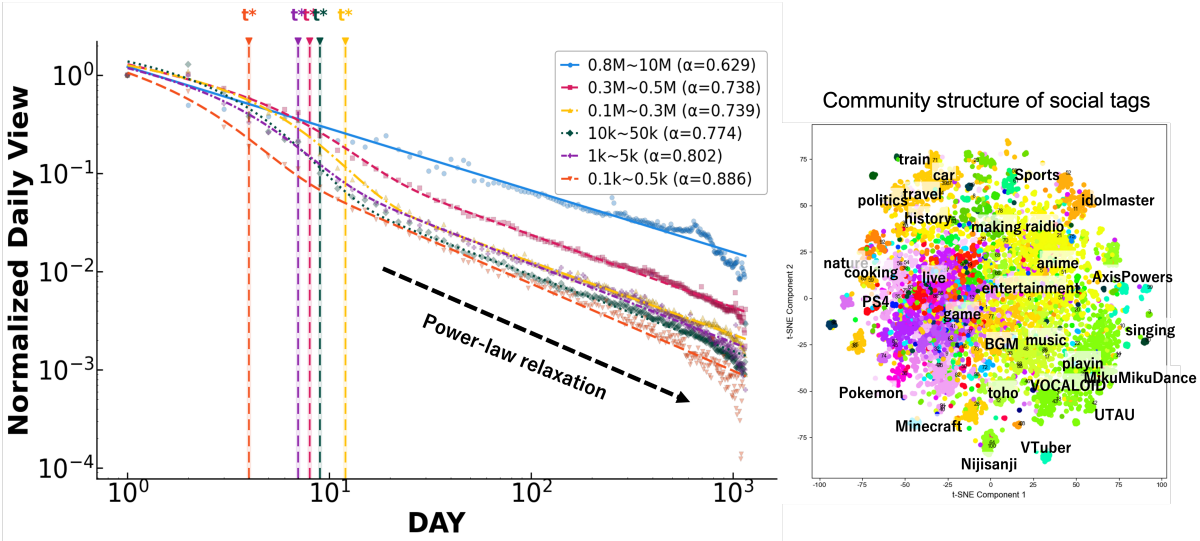

Figure 1: (Left) Temporal relaxation of daily video views in Niconico are classified into six groups by the total view count, and temporal relaxation of each group is fitted by a two-phase model. The early-time regime is dominated by exponential relaxation, while the late-time regime is governed by power-law relaxation. Remarkably, from the smallest groups to the most-viewed videos, all cases exhibit persistent power-law relaxation. (Right) The community structure of tag co-occurrence networks, in which video gaming and anime communities are dominant.