

Endogenous versus exogenous dynamics and scaling laws in YouTube, Open Source Softwares, Cyber-risks and finance

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We study the relaxation response of diverse social systems before and after endogenous and exogenous bursts of activity using the time series coding their various dynamics. One prominent database is made of the daily views for nearly 5 million videos on YouTube that we have collected over 18 month. We find that most activity can be described accurately as a Poisson process. However, we also find hundreds of thousands of examples in which a burst of activity is followed by an ubiquitous power-law relaxation governing the timing of views. We find that these relaxation exponents cluster into three distinct classes and allow for the classification of collective human dynamics. This is consistent with an epidemic model on a social network containing two ingredients: a powerlaw distribution of waiting times between cause and action and an epidemic cascade of actions becoming the cause of future actions. This model is a conceptual extension of the fluctuation-dissipation theorem to social systems [Ruelle, D (2004) *Phys Today* 57:48–53] and [Roehner BM, et al., (2004) *Int J Mod Phys C* 15:809–834], and provides a unique framework for the investigation of timing in complex systems.

This case study is extended to the following examples: Internet download shocks, the Amazon.com ranking of book sales, social shocks, financial volatility shocks, and financial crashes. Simple models are offered to quantitatively relate the endogenous organization to the exogenous response of the system.

If the complex behavior discussed here systems is shared by other complex systems, then our approach, which disentangles the individual response from the collective, may provide a useful framework for the study of their dynamics.

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