Emergence of Consensus as a Modular-to-Nested Transition in Communication Dynamics

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Online social networks can be suitably represented as bipartite, user-meme networks. The features of such networks are constrained by an economy of attention (users' cognitive limits) and a rapidly changing topology. We show, using microblogging data, that competition may be minimized through consensus and that collective attention is characterized by a nested structure of the bipartite network. Our results indicate that topic consensus in social media emerges after a topological transition that minimizes modularity while maximizing the nestedness of the system (panel A in Figure 1), and that online show social networks are comparable to an ecosystem, where generalists and specialists share resources (see Figure 1, panel B). Furthermore, we exploit a set of dynamical equations from Systems Ecology, which integrate competitive/mutualistic interactions among species in time, to prove that only those systems which evolve into nested structures have larger chances of survival (in a user-meme system, "survival" means "continuity of a topic"). Our findings support the idea that nestedness is a dominant pattern in complex networked systems which has received much less attention than modularity. Finally, our results provide empirical evidence that modularity and nestedness can coexist in a single topology at its early stages, but abruptly bifurcate as the system reaches maturity. Such findings have deep implications on a system, affecting its dynamical properties in terms of diversity, stability, diffusion, and so on. This is then a valuable addition to an ongoing debate about modular and/or nested topologies coexistence, which has mainly occurred in the eco- and biological arena [1].

[1] J. Borge-Holthoefer, R. A. Baños, C. Gracia-Lázaro, and Y. Moreno, Scientific Reports **7**, 41673 (2017).

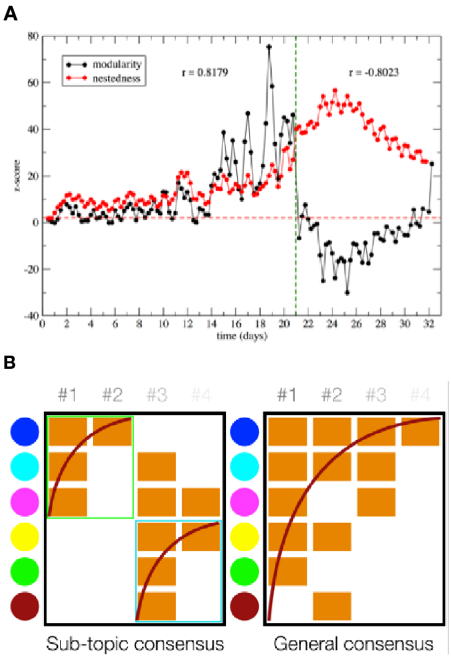

Figure 1: (A) Evolution of nestedness and modularity during the development of a topic in Twitter. Notably, modularity collapses as the topic matures, whereas nestedness keeps increasing towards a maximum. (B) Topic maturation process: from a modular-and-nested setting towards a nested-only structure.