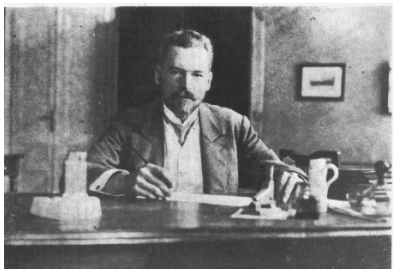

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Phase transitions in the q-voter model with generalized anticonformity

Thursday, December 3, 2020 6:12 PM (1 minute)

Recent empirical studies provide evidence that so-called social hysteresis [1] is present in animal [1, 2, 3] as well as in human societies [4, 5, 6], which would suggest that (at least some) phase transitions observed in real social systems are discontinuous. It occurs that discontinuous phase transitions are not that typical in models of opinion dynamics. Within several versions of the q-voter model [7], belonging to the class of the binary-state dynamics [8, 9], only continuous phase transitions has been observed, including the original q-voter model [10] or the q-voter model with anticonformity [11]. However, the change of transition from continuous to discontinuous (for $q > 5$) has been reported for the q-voter model with independence [11].

In [12] we introduce a q-voter model with generalized anticonformity. Previously it was assumed that the size of the unanimous group of influence needed for both conformity and anticonformity is equal [11]. We abandon this unjustified assumption and introduce a generalized model, in which the size of the influence group needed for conformity q_c and the size of the group needed for anticonformity q_a are independent variables and in general $q_c \neq q_a$.

We consider a system of N voters that form vertexes of an arbitrary network. Each of them is characterized by the dynamical binary variable $S_i(t) = \pm 1$, $i = 1, \ldots, N$ which, in case of social systems, can be interpreted as an opinion on a given subject (yes/no, agree/disagree) at a given time t. In each elementary time step we randomly choose one agent that will reconsider its opinion. With probability p the chosen voter behaves like an anticonformist, whereas with complementary probability $1 - p$ like a conformist. In any case we randomly choose a group of influence from the nearest neighbours of the agent without repetitions. The size of the group depends on the voter's response to social pressure (q_a for anticonformity, q_c for conformity). For $q_a = q_c = q$ the model reduces to the original q-voter model with anticonformity introduced in [11]. If the group of influence is unanimous, the voter is influenced by the group and adapts to it (in case of conformity) or rebels against it (in case of anticonformity).

We analyse the model on a complete graph using linear stability analysis, numerical methods and Landau's theory. We calculate the analytical formulas for the lower spinodal and the tricritical point for which the phase transition changes from continuous to discontinuous. It has occurred that the generalized model displays both continuous and discontinuous phase transitions depending on the sizes of the groups of influence needed for conformity q_c and anticonformity q_a. If the parameter q_c is sufficiently larger than q_a, the type of the phase transition changes to discontinuous.

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