Emergent properties of Social networks as information processors

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Emergent properties of complex systems refer to properties that cannot be simply explained by the knowledge of the constituents of the system. They are not trivial consequences of the interactions of the elements of the system. Typical examples of emergent properties are attributes of a system resulting from the large numbers of its constituents. The statistical mechanics interpretation of thermodynamics is a famous example of that. Another well-known kind of emergent property results from a non-trivial dynamical equilibrium. Self-organized criticality is an example of that.

In this work we point to another possible emergent property, which is not explainable by the relevance of large numbers. It concerns the processing of information by a social networks. That the processing of information by a group of people has fundamental differences with the processing of information by an individual, is not a new observation. Using quantum computing as an inspiration, we offer a new perspective to study of emergent properties in the information processing by social networks. This work has three sources of inspiration:

1- K. Carley[1] has suggested that to understand organizational changes, it could be useful to think of social networks as quantum systems. In fact she has laid what could be construed as possible foundations of a "Socio-cognitive Quantum Mechanical" approach to the study of social networks. Social networks have features reminiscent of Quantum systems: The ensemble is very different from the sum of its parts.

2- Quantum computers have different properties from "classical computers" and Turing machines. They can be more powerful processors than classical computers. Quantum entanglement is at the root of the different processing properties of quantum computers[2]. There is a social network equivalent of entanglement: what is referred to as the density of a network.

3- Mizruki and Stearns in a recent analysis of decisions on deals and transactions in a large bank, related the probability of approvals to attributes of the social networks involved in the decision process. They found a robust effect of attributes of networks like density, which can be construed as proxy for social entanglement and probability of outcome. They establish that the correlation was robust, although difficult to explain. We suggest that their observation could be an unexpected effect of social entanglement. Some aspects of transactive memory may be other ones.

[1] K. Carley, "On the evolution of social and organizational networks",.
[2] C. Bennett, P. Shor, "Quantum Information Theory", *IEEE Transactions on Information Theory*, **44** (1998), 2724-2741.