

Beyond Copying

This paper focuses on the emergence of concepts such as shared conceptions of quality and norms.

Much of the agent based/network literature which focuses on the spread of ideas/behaviour, the emergence of norms etc. essentially involves 'binary choice with externalities' [Schelling 1973]. Heterogeneous agents are connected on a network and are in one of two states of the world (though this can be generalised to k states). Agents switch depending upon their individual threshold (propensity to switch) and the states of the world of their neighbours. The process of 'adoption' of new norms or shared conceptions is essentially one of imitation.

In the context of the adoption of new consumer products, these assumptions may often be a reasonable approximation to reality. This is particularly the case in fashion-related markets. With more complex products such as savings accounts and electronic consumer durables, provided the products all meet minimum quality standards, copying the behaviour of agents on your particular network may very well be a sensible thing to do. Such products are difficult to evaluate, and there may be high costs involved in gathering and processing the relevant information. So it is reasonable to imitate the behaviour of those whose opinions/behaviour you respect in this particular context.

More generally, however, agents will also operate with an element of bounded rational choice. So agents could have heterogeneous preferences on the weights they assign to 'peer influence' [copying] and 'rational choice' i.e. evaluating the attributes of the alternatives in some bounded rational way. The weights will vary not only across individual agents, but in different contexts the same individual will use different weights.

In a recent article, Aral et.al. [PNAS 2009] analyse a global instant messaging network of 27.4 million users, using data on the day-by-day adoption of a mobile service application and users' longitudinal behavioral, demographic, and geographic data. The authors find that more of the contagion can be attributed to homophily than to contagion. An obvious interpretation of this is that any given group of agents will have similar (fixed) tastes and preferences, and adoption patterns within groups are accounted for by these more than by imitation/copying.

An illustration in the context of consumer goods is given by Heineke and Ormerod (2009). They consider, inter alia, consumers with a demand function $U(i,t) = a_i - P + c_i * Z_i(t-1)$ where $Z_i(t-1)$ = proportion of neighbours of agent i buying the product at time $(t-1)$, and an agent buys if $U(i,t) > 0$ otherwise not. The a_i represent the heterogeneous preferences of the product. The market demand curve has two distinct regions. At first, price increases are not matched by demand falls since the presence of a large pool of external demand creates a bandwagon effect that keeps the demand high. At low prices, therefore, demand is completely inelastic. After a certain critical point, however, the demand curve becomes more elastic, as consumers are deterred not only by price, but of the loss of demand from other consumers at the same time. The point is determined by the strength of the bandwagon effect.

In the context of the emergence of shared concepts of quality and/or norms, a more complicated extension of the basic imitation model seems to be required. Obviously, in these contexts we cannot use the 'objective' attributes of the 'offer' such as price and quality, but the rational element could be included in the following way.

Agents have different propensities to attempt to persuade others to adopt a particular norm. Equally, agents will differ in their willingness to consider arguments/information which is put to them by other agents. We assume that an agent adopts the norm of the other if the willingness to be persuaded parameter assigned to the agent is greater than the willingness to persuade of the agent doing the persuading.

The overall decision of an agent depends upon two factors. First, the propensity of the agent to simply imitate or copy others, and the choices made by the agents to which that agent is connected. Second, the relative weights of 'persuadability' and 'persuasiveness'.

Ormerod, Rosewell and Wiltshire (2010, forthcoming) calibrate this model to data on the spread of innovation in four different industries in the Greater Manchester region of the UK. The links between firms are essentially based on a structure of k -cliques with random rewiring to connect them.

They find that imitation is a weaker method of spreading innovation than what might be termed the 'sharing' process. Indeed, with the network structures in these particular industries, the imitation process is incapable of generating a cascade of global proportions.

Ormerod and Wiltshire (2009) adopt a similar theoretical model to account for the distribution of the lethality of terrorist attacks in the database provided in Asal and Rethemeyer (2008). Information is available on the degree distribution of links between the organizations in the database. In general, this is a sparsely connected network.

The variant here is the idea that in order to acquire the ability to carry out attacks other than the most basic, organizations need to acquire not just one but k pieces of information. So there are k passes, as it were, of the model. The model is solved along standard lines, and those agents which acquire the information (by whatever means) are tagged. The model is run again, and the agents which have acquired information in both runs are tagged, and so on. At the end of k iterations, agents which have acquired information in all k are deemed to have acquitted the requisite capability.

A similar sort of process might be worth investigating in the context of the adoption of shared conceptions of quality and norms. Particularly in the context of beliefs, the process may very well not be a simple $[0,1]$ choice. In 16th century Europe, for example, a devout Catholic may rarely have experience a Eureka! moment, as it were, and decided there and then to become a Protestant, but various stages would have been required for the agent to convert. Coleman (1988) and Putnam (1999) appear to argue that social capital is built by the repeated interaction among actors involved in a social dilemma.

Interestingly, in this context also, the 'sharing' process is a more powerful generator of cascades than the 'imitation' process.

Although the above are not explicit examples of the emergence of shared norms, they both have obvious parallels.

The main point is that in models describing the emergence of shared norms, the standard model of imitation on a network through binary choice with externalities needs considerable extension.

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