

Language Change and Social Networks

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Abstract. Social networks play an important role in determining the dynamics and outcome of language change. Early empirical studies only examine small-scale local social networks, and focus on the relationship between the individual speakers' linguistic behaviors and their characteristics in the network. In contrast, computer models can provide an efficient tool to consider large-scale networks with different structures and discuss the long-term effect of individuals' learning and interaction on language change. This paper presents an agent-based computer model which simulates language change as a process of innovation diffusion, to address the threshold problem of language change. In the model, the population is implemented as a network of agents with age differences and different learning abilities, and the population is changing, with new agents born periodically to replace old ones. Four typical types of networks and their effect on the diffusion dynamics are examined. When the functional bias is sufficiently high, innovations always diffuse to the whole population in a linear manner in *regular* and *small-world* networks, but diffuse quickly in a sharp S-curve in *random* and *scale-free* networks. The success rate of diffusion is higher in regular and small-world networks than in random and scale-free networks. In addition, the model shows that as long as the population contains a small number of statistical learners who can learn and use both linguistic variants statistically according to the impact of these variants in the input, there is a very high probability for linguistic innovations with only small functional advantage to overcome the threshold of diffusion.

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1 Introduction

Social network is considered as a determining factor in language change, contact, maintenance and shift, etc. (Labov 2001, de Bot & Stoessel 2002). In sociolinguistics, empirical studies of social network often examine in detail the networks of small communities and focus on the relation between individuals' social network properties and their linguistic performance (Milroy 1980/1987, Eckert 2000). A classic study in this area done by Milroy and colleagues (Milroy 1980/1987) examined three stable inner-city communities of Belfast in Britain, and found that the working class communities have "close-knit" social networks in common. These networks are of high density and multiplex: individuals usually have multiple relationships, being relatives, neighbors, friends, and/or colleagues, and they vary in their degrees of integration into the community, some having very few links with individuals outside their social group, while others having fewer links within the group but more links outside. Studies have quantitatively shown that individuals' linguistic behaviors are highly correlated with their degrees of integration into the network: in situations where linguistic variations are present in the community, the more integrated an individual is into the community, the less variation (s)he has, and the better (s)he conforms to the speech norm of the community.

Most of such empirical studies only focus on synchronic linguistic variations in small communities, and few have touched upon the question on how different social networks affect language change at a larger historical scale. In fact, social network has created a *paradox* in the study of language change: although intuitively one would think that social network should be an important factor in determining language change, very few empirical data have been able to show the effect of social network quantitatively over long periods of time (de Bot & Stoessel 2002). It is hardly possible to get a clear picture of the social structure of a large community at present with respect to individuals' linguistic behaviors, not to mention the social structure in the past.

This gap can be filled by computer simulation which provides a convenient platform to systematically study the effect of social network under controlled conditions (Gong 2007, Parisi & Mirolli 2007). Computer simulation can manipulate various parameters, such as population size, network connectivity, and so on, and it is particularly effective in addressing problems at a large time-scale beyond empirical studies of social networks. These problems include how the dynamics differ in populations with different social structures, how the structure of social network affects the rate of change, and so on.

However, despite of these advantages, existing computer models of language change either do not consider the actual population structure (Niyogi & Berwick 1997, Niyogi 2006), or simply assume the population structure as regular or random networks (Nettle 1999a). For instance, in Nettle's model of language change, the population structure is implemented as a weighted regular network, as shown in Fig. 1, in which each agent is connected to all his neighbors, and the strength of connection is inversely proportional to the distance between two agents.

Recent studies on large-scale complex networks in the real world (Barabási 2002) re-