International Journal of Modern Physics C
Vol. 17, No. 7 (2006) 1067–1076

RECIPROCITY AND THE EMERGENCE OF POWER LAWS IN SOCIAL NETWORKS

MICHAEL SCHNEGG
Institute of Social Anthropology
University of Cologne
D-50923, Cologne, Germany
michael.schnegg@uni-koeln.de

Received 28 February 2006
Revised 1 March 2006

Research in network science has shown that many naturally occurring and technologically constructed networks are *scale free*, that means a power law degree distribution emerges from a growth model in which each new node attaches to the existing network with a probability proportional to its number of links (= degree). Little is known about whether the same principles of local attachment and global properties apply to societies as well. Empirical evidence from six ethnographic case studies shows that complex social networks have significantly lower scaling exponents $\gamma \sim 1$ than have been assumed in the past. Apparently humans do not only look for the most prominent players to play with. Moreover cooperation in humans is characterized through reciprocity, the tendency to give to those from whom one has received in the past. Both variables — reciprocity and the scaling exponent — are negatively correlated ($r = -0.767$, sig $= 0.075$). If we include this effect in simulations of growing networks, degree distributions emerge that are much closer to those empirically observed. While the proportion of nodes with small degrees decreases drastically as we introduce reciprocity, the scaling exponent is more robust and changes only when a relatively large proportion of attachment decisions follow this rule. If social networks are less *scale free* than previously assumed this has far reaching implications for policy makers, public health programs and marketing alike.

Keywords: Reciprocity; scale free networks; anthropology; cross cultural comparison.

1. Introduction

Networks are a general model to describe complex forms of organization. A network $N = (V, E)$ is defined as a set of vertices V and a set E of unordered pairs of distinct elements of V called links of V. Only two networks with V vertices have no structure. One is the network of isolates, where no link is realized. The other is a completely connected graph in which all possible links are present. Research in network science has shown that some structures are much more likely to occur in the technological and biological world than others.[1–3] Most importantly, many known complex networks share one fundamental property: they are *scale free*.[4] Each node in a network has k links; k is also called the degree of a node. Networks are *scale free*