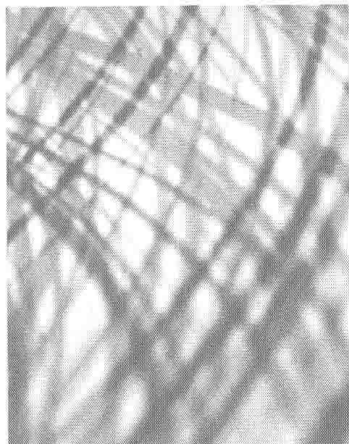


edited by
Robert Stocker
Terry Bossomaier

NETWORKS IN SOCIETY

LINKS AND LANGUAGE





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NETWORKS
IN SOCIETY

LINKS AND LANGUAGE

VALE JOHN CARROLL

It is with deep regret that we acknowledge the passing of our friend and colleague Professor John Carroll in October 2011, and in recognition of his valuable contribution to the research community, we dedicate this publication to his memory.

Preface

The growth in our understanding of networks, especially human social networks, has been quite remarkable over the last decade. But equally remarkable is how the networks themselves have been evolving, driven in part by the many new tools in cyberspace. Along with these new communication tools come increasing numbers of changes to language and lexicography. English spelling in text messages is nothing like the spelling we learn in school, so far at least, while groups differentiate themselves more and more by linguistic twists and turns, new words, slight variations in grammatical usage—the *so not cool* phenomenon.

Although this book can only provide a snapshot, since this is the forefront of social evolution in the 21st century, we present a broad range of ideas from several fields of research endeavour (and we thank the authors for their respective contributions).

We discuss social networks and their integration with communication and language. Although accessible to a wide audience, it contains sufficient technical detail to serve as a starting point for advanced undergraduates and postgraduates and reflects the content of the 5th Biennial Complex Systems Research Summer School held at the Centre for Research in Complex Systems (CRiCS), Charles Sturt University, Bathurst, Australia, in December 2009. The seven chapters of the book cover three broad areas: technical fundamentals, complexity and social networks, and communication and language. Chapter 1 explores the development of some contemporary models, exposing key ideas in the relationship between social networks, patterns of connection and language.

Since the 18th-century mathematician Leonhard Euler formulated and solved one of the first classic problems in graph theory, practical applications of this esoteric mathematical field have

steadily emerged, but social networks have caused rapid expansion. Some understanding of the basic mathematics is an essential starting point. Concepts and results belong here, but proofs and finer points need to be sought from some of the excellent textbooks now publicly available. Alongside the mechanics of graph and network theory, two other topics are covered. Firstly, we need to know how information about networks is collected, from surveys, interviews, email and other techniques, some quite new. Secondly, visualization is enormously important in understanding network structure and the book introduces some of the well-established software for mapping abstract network representations to something we can look at and grasp intuitively. Chapter 2 identifies important metrics associated with graph theory and network theory and discusses useful tools that assist in visualizing network structures. Chapter 3 provides the links between social structure, cognitive performance and language in social groups.

The field of social networks is already too large to cover in a book of this size, and some framework is needed to make a coherent selection. The framework we use derives from complexity and evolution. The key to interest in social networks is their distinctive structures, such as Milgram's six degrees of separation and Watts' small world ideas, now, as they say, "a major television series"! Chapter 4 explores key issues in complex social structure and identifies important concepts that will occupy future research programs in social complexity. But these structures are dynamic, and there are many new ideas to consider in how social networks evolve over time.

Evolution brings us to the third major theme, communication and language. Language has always defined social groupings, from entire language across frontiers to changes in dialect within an ostensibly homogeneous country. Physical co-location is no longer a prerequisite for social structures. Email, text messaging, Twitter electronic communication tools give us near-instantaneous contact across the globe, while FaceBook, LinkedIn and others operate across geographical boundaries. Many readers are likely to "Tweet" their way through the day, new usages that reflect the tight coupling of language, new media and social structures. Do these new technologies reflect ongoing changes in the size, strength of interaction

and geographical distribution of our personal networks? All these issues make the evolution of social networks one of the most fascinating domains of current research. Chapters 5 to 7 discuss practical applications of the ideas explored in earlier chapters with specific emphasis on business modelling, natural resource management in sensitive locations, and the evolution of social interaction resulting from new information and communication technologies.

Our intent is to raise your interest in social networks in general, the importance of language in the emergence and maintenance of networks in particular, the integral patterns of interconnectivity, and the means to measure and model social structure. The extent to which the contributing authors' knowledge and experience forms the basis for your own investigation of the phenomenal world of social structure will be our measure of success for this work.

In the end, it is our hope that you will be stimulated to build on these writings to explore more deeply the ideas, concepts, perceptions and thoughts that personally appeal to you. That these works become the staging point for further investigation would be our best return on investment. May your connections prosper!

Robert Stocker
Terry Bossomaier
Winter 2013

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Chapter 1

Social Networks: Towards General Models

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Aggregation of entities with common characteristics appears to be a universal phenomenon associated with complex systems. Survival, reproductive or safety behaviours are evident in most plant and animal species in which integral “social” behaviours have also emerged. Trees, and vegetation, of similar species tend to “clump” or “cluster” together, birds flock, monkeys groom, cattle and sheep herd, fish school, and so on. In humans, resulting from or concurrently with the evolution of larger brains and an innate capacity for language, social behaviour is observed in the formation of networks of association that transcend these somewhat instinctive elements of our lives.

1.1 Introduction

What is it that enables human social behaviours?

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Humans are systemic. Internally we comprise organic, biological, neural, digestive, respiratory, skeletal, muscular, vascular and other systems. Externally, we interact in social systems (as part of our world environment) that depend on spatial and social proximity, behaviour, capability, knowledge of concepts and ideas, beliefs and values, and personal identity.

Humans are modellers—we are wired to manipulate symbols. We are accomplished builders of symbolic representations of what we perceive through interaction with our personal systems, other human beings, and the environment in which we exist. The mental maps (models) of our experience that we construct in our brains are symbolic representations or abstractions of what is “real” and, in fact, impoverished models of the world that surrounds us [17]: we are “victims of an illusion” [42 p. 4].

Humans are communicators—we are wired for language. It gives us the capacity to communicate our perceptions of our worlds to others as oral and written symbols of what we see, hear, feel, taste and smell—our sensory mechanisms.

Humans prefer order to chaos, but order with a degree of variation to it. Chaos to us represents noise, that is, any pattern with which we interact that we do not understand. As “voracious consumers of patterns”, we are “best at filling in the blanks and making assumptions” [38].

How is this so?

1.2 Social Networks

No person is an island. Individuals form into networks that are established by linking together through various means. Family, work, recreation, clubs, associations, electronic communication and other social “clusterings” occur between people with some common interest. However, people may also be connected for other reasons, such as health conditions, common behaviours and language, or other attributes. They are often linked to key prominent individuals who are recognized as “leaders” (Fig. 1.1).

How big are these networks? From an evolutionary perspective, we emerged from a primate ancestry where grooming was the

Social Networks

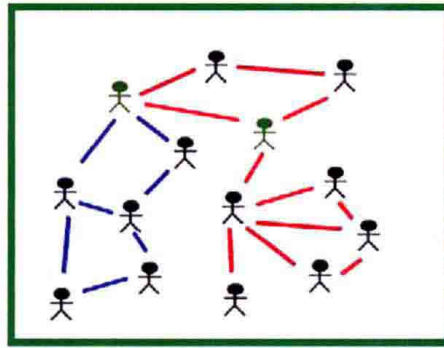


Figure 1.1 Graph of a social structure that shows subgroups (red and blue links) linked by key agents (green nodes).

principal means of communication and social group size comprised around 30 to 40 members. Coincidentally, as our need to accommodate larger group sizes increased, our capacity for language developed, our brain size increased and group sizes grew to around 100 to 160 [20–22]. In general, a human will have intimate interaction with three to six persons—that is, these people will be in quite close contact several times each week. At the next level of connectivity, the average human will have some 10 to 20 close friends with whom contact is strong but less frequent. At the next level, the average human will have up to 150 acquaintances that form more casual associations. Finally, around 1000 “known” other people form the least strongly connected component of an individual’s personal social network [20–23, 50, 51].

Interestingly, there appears to be a “tipping point” or phase change [19, 30, 35, 39] in conversational social group size as the number of members approaches six. At this point the group will typically break into two or more separate groups, suggesting that, for conversational (linguistic) efficiency and effectiveness at least, 5 is the optimal number of members.

Social structure comprises networks of connected individuals who for various reasons will form links of various strengths between each other. Interaction, regardless of network size, types of individuals, or numbers of links to other individuals, can be described

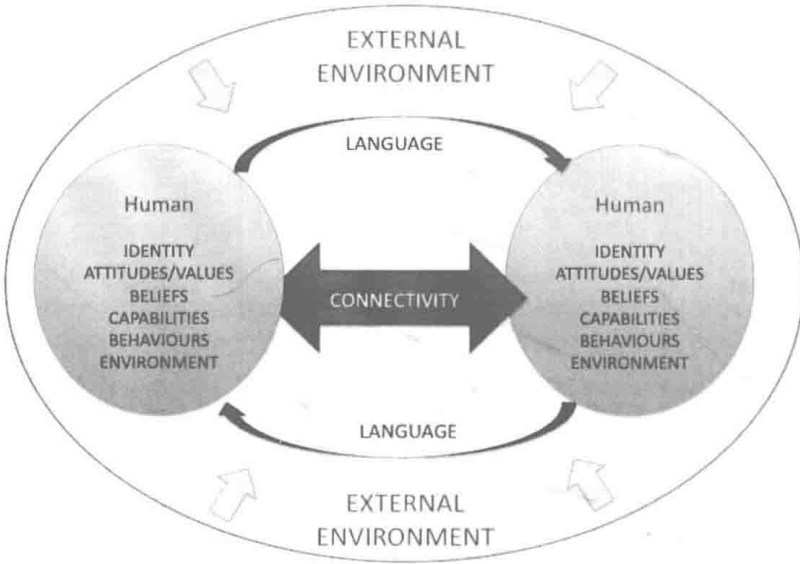


Figure 1.2 An overview model describing the process of social interaction between individual human participants, emphasizing key human characteristics and the importance of language in connectivity patterns between interacting actors in a dyad.

as multiple numbers of single links of varying intensity between numbers of pairs of individuals (a dyad). The connectivity and interaction involves the characteristics of each individual (see Section 1.7), communication between them, the strengths and direction of the ties between them, the levels of influence each has over the other, and the cultural and social constraints that are included in the environmental feedback in which interaction takes place (Fig. 1.2).

So we can consider linked groups of linked individuals and thus increasingly larger social networks. The same patterns of connectivity and interaction occur, but here we can observe patterns of behaviour and characteristics of sub-groups or the whole network structure. Thus, networks themselves can be categorized by their specific structural characteristics, for example as random [24], small world [8, 48, 49], epidemiological [2–3], scale free [7], hierarchical [32, 45–46] and so forth. Such networks are characterized by various metrics, for example, clustering coefficient, centrality, assortativity and the like (see Chapter 2).

How is it then possible to rigorously investigate social structure?