

[Weak Links](#)

The Universal Key to the Stability of Networks and Complex Systems

Bearbeitet von
Peter Csermely

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Preface

Since the publication of the first edition of this book in 2006, network science has become a centerpiece of our modern thinking. This is true not only for our scientific efforts to understand the daunting complexity of biological and technological data, but also for everyday life. Barabasi's excellent book on networks *Linked: The New Science of Networks* (Barabasi, 2002) has been translated into eight languages, while *Tipping Point* (Gladwell, 2000) has long been a bestseller in all lists, and the term 'netocracy' (Bard and Söderquist, 2002) has become a key word in our understanding of how to become influential in a modern, networking society.

Networks have gained a novel importance in the monetary and economic crisis which broke out in 2008, and it has become rather clear that, without a more detailed knowledge of economic networks, we will not be able to predict the outbreak and spread of economic turmoil. Thus, network knowledge is a key asset when planning immediate counter-measures against crisis. However, we also have to reflect on long-term remedies. Without a better knowledge of social network stability, without a proper, network-based development of social capital, we will not be able to prepare a crisis-resistant society.

In order to prepare for the job of long-term crisis management, a great deal of effort has been made over the last 2–3 years to understand the finer structure of networks. Network communities, modules, and their overlapping regions have become a hot issue. Network scientists often speak about 'bridges', 'bottlenecks', and recently, 'brokers'. Besides this, the understanding and modeling of dynamical changes in network structure are of extreme importance (Palla et al., 2007). Network analysis has also enabled us to construct algorithms that can predict network behavior (Clauset et al., 2008). Besides economic and social networks, these novel network tools help us to analyze the heretofore rather unexplored complexity of disease and drug networks (Spiro et al., 2008), in the hope of finding novel cures for many life-threatening diseases.

Exploring the complexity of large networks with many millions of elements and even more links has given us a novel understanding of the weak link concept. We have at least two classes of weak links. The long-range, intermodular bridges are the weak links in the original sense of the Granovetter concept, as described in detail in Chap. 1 of the book (Granovetter, 1973; Kossinets et al., 2008). These long-range links connect distant sites of the network, and constitute a small, but very important segment of weak links. These bridging contacts often give us novel information, and may make someone influential, a modern-day ‘netocrat’ (Bard and Söderquist, 2002; Burt, 1995).

An even more exciting subtype of weak links not only connects distant network regions, but dynamically changes its position from moment to moment. Network elements forming these transient, long-range links often behave as creative elements (Csermely, 2008), playing a key role in the development, survival, and evolvability of complex systems. Creativity is a luxury of any system in business-as-usual situations. Creative elements are not reliable, since – rather annoyingly – they always discover a novel solution. However, this nuisance becomes a life insurance whenever an unexpected situation or crisis crops up. In these extraordinary moments, the survival of the whole community may depend on the existence and mobilization of their creative elements. We find creative elements as active centers in proteins, as stress proteins in cells, as stem cells in our body, very likely as all neurons in the brain, and last but not least, as creative people or groups in our society. I have inserted a new section (Sect. 2.3.2) to describe in detail the help provided by these special, creative network elements in crisis management.

The vast majority of weak links are not from the ‘creative links’ mentioned above. They are just simply transient, low affinity links, and they are weak. However, their weakness constitutes the majority of links in most networks. The diversity, the vast resource of the myriads of weak links, provides for the extremely important buffering capacity of complex systems, which increases their robustness and chances of survival in times of danger and crisis.

The economic crisis started in 2008, and is often described as an over-consumption crisis in long-range, broad terms. The measures to minimize the effects of over-consumption, i.e., to slow down climate change and to save the diminished resources of our planet, often include a search for alternative energy and other alternative resources. We may indeed need alternative resources. But what we need a thousand times more is an alternative lifestyle. This alternative lifestyle will not

focus on our consumer benefits and goodies, but will build a loving and caring social network around us. I hope that this book gives the reader adequate advice for changing her life to be compatible with the needs of our planet and to enjoy a lot more personal and spiritual enrichment at the same time.

Weak links gave me a tremendously joyful experience after the publication of the first edition of this book. The LINK Group received hundreds of emails from all around the world. As an example we made significant progress in understanding creative behavior in the development of cooperation (Wang et al., 2008), working together with a colleague, Shijun Wang, although we never saw each other in person over the last 3 years. I attended hundreds of public lectures on networks and our modern, alternative lifestyle.

Let me close this preface with two emails I received from a boy and a girl in a Budapest high school at the end of 2008:

Peter, following your advice I started to talk to a complete stranger after your lecture in our school. Imagine!!! A miracle happened! Eve, who is a beautiful girl, found me a perfect match, and we have been together from then on. Peter, without your lecture I would now be an unhappy man.

Peter, after your lecture I promised to follow your advice, and gave a bright smile to everyone I came across on my way home. I felt as though I was living in a completely different town! You will not believe this! People smiled back! Two of them even started a very friendly conversation with me. I no longer feel myself alone in this huge city. The streets are full of people who are just waiting for our smiles.

Yes, the streets are indeed full of people who are just waiting for our smiles. Weak links give us hope and strength to survive the crisis, and to discover a novel life for tomorrow. How can we do this? Start reading! And write to us if you need any weak links beyond those in your huge (or not so huge) city.

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Peter Csermely
csermely@eok.sote.hu