

8 Social Nets

This is not only the time to get down to work, as I noted at the end of the last chapter, but also a time to thank you for your patience in coming along with me on this trip to Netland. We have reached an important point. We are just about to rise above ourselves. In the last chapter, we surveyed some of the networks in our body, and in this chapter the same body will be an element of a larger network, the social net. The current chapter will give me a good opportunity to understand my obsession with building social networks. The first sign of this came as rather a shock. It was a great surprise to my 17 year old soul when a sociological survey showed that I was the only person in the class who was in rich contact with two competing groups (a typical weak hub in a bridging position, I would say now). Later I found myself organizing scientific societies, political protests, NGOs, firms and world congresses. I had better spare you from the whole list. It is high time to discover at last what were the properties of the networks I spent several decades building. So, many thanks again for staying with me in this self-organizing task. However, you will have to wait a while yet for the ‘real thing’. I begin by introducing the ancestors of our own nets: the animal communities.

8.1 Animal Communities

Have you ever tried to interview a honey bee? In spite of the low information content of the potentially fatal encounter (the interrogator will be beaten and, as a rather unfair exchange, the bee dies), we know quite a lot about insect social nets. The most fascinating features of insect colonies are the self-sacrificing altruism expressed by colony members, the complex division of labor, and the highly efficient adaptation to environmental changes. As a part of the adaptational plasticity, insect social nets have dense contacts, making the propagation of information an easy matter within the colony. The insect net seems

to be a small world possessing a scale-free degree distribution. The network is hierarchical with the queen at the top, but many decisions are made locally in the various modules led by key figures such as ‘scouts’ or ‘dancers’. Intermodular contacts are made by weak links, which are key regulators of task redistribution in the eventuality of any change in the environment (Fewell, 2003). The very similar ant networks display percolation thresholds and transient synchronization events, and their random to scale-free topological phase transition has already been mentioned in Sect. 3.4 (Bonabeau et al., 1998a; Karsai and Wenzel, 1998; Le Comber et al., 2002; Theraulaz et al., 2002). Animal communities display an almost complete list of the most important network properties. However, some exciting points are still missing. It would be nice to see whether ant or bee colonies display avalanches and additional phase-transitions.¹

Queens of honey bee colonies mate with several males. This results in a high genetic diversity among their workers. Consequently, thresholds for different tasks differ and change as bees grow older. Younger or older bees have a low threshold for tasks inside or outside the nest, respectively, which means that younger bees work mostly inside, while their elder peers go out more often. Different honey bee thresholds for foraging allow a more efficient response to fluctuations in the availability and need for resources. As a result, not all bees immediately switch the search from one type of food or direction to another. Moreover, surplus bees can be redistributed from one task to another (Bonabeau et al., 1998b; Page and Erber, 2002). As another example, brood temperature is an important factor for honey bee pupae development. A difference of 1.5°C in brood temperature may turn the affected bee from a good learner to a mentally handicapped bee (a zom-bee!). Thus, it is no small advantage that the brood nest temperature is three times more stable around the optimal 35°C in genetically diverse colonies than in genetically more uniform ones. The explanation is similar to the differences above. Diversity in temperature response thresholds prevents all the bees from starting to fan or instigate metabolic heating at once, to decrease or increase brood temperature, respectively. Such behavior would cause rather big overshoots and fluctuations in brood temperatures, especially after a change provoked by the environment (Jones et al., 2004; Tautz et al., 2003).

¹Possible experiments may include the examination of a sudden burst of behavior change during a gradual repopulation after removing ants or bees from the nest, or the test of a more hierarchical organization in the case of food shortage.

In summary, bee diversity allows the development of degenerate responses, increasing the number of weak links in the bee net. We should listen to honey bees and learn that difference pays off. So does tolerance of difference. (The other take-home message, i.e., that queen-promiscuity is beneficial for the stability of the society, may be more honey-bee specific!)

Several features of insect community networks can be extended to other animals. The scale-free statistics of group size distribution seems to be a general phenomenon, valid not only for insects, but also for tuna fish, sardinellas and African buffaloes (Bonabeau et al., 1999). Dolphins also form groups with a scale-free distribution. These groups are, however, much more structured. A highly flexible, multilevel super-alliance of bottlenose dolphins helps their stability and survival. The dolphin network is a small world, characterized by a high redundancy of contacts. Changing alliances in the super-alliance and redundant contacts both make the emergence of multiple and interchangeable weak dolphin links very likely (Connor et al., 1999; Lusseau, 2003). Hierarchy levels may vary. An interesting topological phase transition has been demonstrated with macaques, where food scarcity provoked a scale-free to star transition giving rise to a despotic society (Hemelrijk, 2002). Baboons also form complex, multilevel social nets. The human brain has developed to keep an inventory of our contacts (Dunbar, 1998). However, each of our acquaintances is multivalent.² Baboons have at least a part of this rich inventory. They can discriminate between kinship and rank hierarchies (Bergman et al., 2003). Multiplication of the perceived social net by diverse role-attributions raises the number of weak links.³ Baboons have a female-dominated society, since baboon males disperse from their natal groups, while baboon females stay there. Social support among female baboons extends to a large segment of the whole community and helps infant survival. Grooming becomes very intensive and reciprocal. Isolation from this tight grooming net of weak links significantly lessens reproduction success (Noe, 1994; Silk et al., 2003).

²Tante Sissi was not only a neighbor of ours in my childhood, but also an excellent teacher of the German language every Wednesday, and the best living relic of tea ceremonies in the whole town.

³I had to meet Tante Sissi every Wednesday, because her German was excellent, but then she had got used to the habit of brewing each tea three times – the king’s tea, the citizen’s tea, and the proletarian tea as she called them, and for some reason I always got the last version – Wednesday certainly became the only possible day of the week when I could be forced to meet her.

As a take-home message, I conclude that the emergence of weak links grows in parallel with the stability of all the animal societies mentioned. Bee colonies provide excellent examples of the stabilizing power of diversity in response thresholds. These thresholds are genetically determined but can be modulated by age, experience, nutrition and pheromones (Pankiw et al., 1998; Page and Erber, 2002). Bee-bee contacts not only transmit chemical signals but also knowledge through the ‘dancing’ mentioned earlier. Weak bee-bee links, such as an irregularity or divergence of pheromone and dance instructions, may further increase the stabilizing diversity of bee responses. The take-home message here is that – fortunately for us – absolutely perfect dictatorships cannot be efficient in the long run.

The stability conditions of bee colonies strongly suggest the beneficial effects of weak links. Baboons, however, provide direct proof for weak-link-induced stability. Grooming of female baboons has been demonstrated as an especially useful weak link to facilitate community coherence. I will return to this in Sect. 8.6, where I will list several pseudo-grooming elements of our own (post)modern society.

8.2 A Novel Explanation of the Menopause

The menopause, reproductive cessation at an advanced age, occurs in a number of species, such as non-human primates, rodents, whales, dogs, rabbits, elephants, and domestic livestock, and is especially long and pronounced in humans. In spite of this lengthy list, the menopause is unusual. Most animals die when they lose fertility. In the summer of 2004 I was rather perplexed to witness hundreds of bombyx mothers dying right on the spot where they laid their thousands of light-brown eggs. Fortunately our own mothers are luckier. Why did our great grandmothers develop a menopause? Menopause may be (a) a cultural artifact, (b) a senescence-related phenomenon, (c) a protection against the propagation of genetic damage; and lastly and perhaps most importantly, (d) a ‘grandmother effect’ in the form of a combined adaptive response to prolonged infant dependency (Hawkes et al., 1998; Shanley and Kirkwood, 2001; Sherman, 1998; Peccei, 2001). In these explanations, the cultural artifact refers to the fact that we now live long enough to experience the menopause. If menopause is related to senescence, then fertility just decays, like eyesight. If the menopause has developed as a protection against the propagation of genetic damage, then it prevents late pregnancies which may give rise to various genetic malformations, such as the Down syndrome. Lastly,

the grandmother effect means that grandmothers can assist their adult daughters in raising their grandchildren.

Many of the above theories, such as the cultural artifact theory have received quite a bit of criticism (Peccei, 2001). Recently, it is the grandmother effect that has gained the most attention. Packer et al. (1998) showed that the menopause of olive baboons and African lions is not associated with an improved reproductive performance of children or better survival of grandchildren. Lahdenperä et al. (2004) analyzed multi-generational life data sets of Finnish and Canadian families living in the 18th and 19th centuries. They concluded that in both societies long-living mothers increased the reproductive success of their children, allowing them to ‘breed’ (scientific language can be quite interesting sometimes) earlier, more frequently and more successfully. However, when children reached the end of their fertile periods, rates of female mortality started to accelerate. A few centuries ago, Finnish and Canadian great-grandmothers were not very well tolerated. The difference between baboon and lion versus Finnish and Canadian mothers might arise from the extent of the menopause. The shorter menopause may restrict intergenerational help by a parallel own parenthood in the animal species (Shanley and Kirkwood, 2001). Indeed, the post-menopausal periods were roughly twice as long for Finnish and Canadian mothers as for baboon and lion females.

The grandmother effect seems to be rather well established. It certainly works. Grandmas do indeed help their daughters. This is undoubtedly a reason, but are we sure that it is the only one? Have you seen a grandma who had nothing else to do but help her daughter 24 hours a day? I would bet that this level of intensity would not boost ‘breeding’ rates, but would be more likely to have an adverse effect, e.g., the young couple must at least have some privacy to breed more frequently. So I would propose that the menopause is also beneficial in providing more weak links within the animal or human community. Females after the menopause are not the subject of fights or attempts at seduction. Their connection structure shifts significantly to contain far more weak links than before and provides additional stability for the whole community. In agreement with this proposal, the cohesive force in both dolphin and baboon networks is mostly maintained by adult females (Connor et al., 1999; Lusseau, 2003; Silk et al., 2003). *“I have not had the opportunity to see family videos from the 18th and 19th century, but I bet that Finnish and Canadian women of the time were not all as beautiful as the wife of Menelaos, and were not often abducted by Paris to Troy!”* Spite, have you ever seen a family video of Paris and Helen? Regardless of any de-

bate about abduction, younger women certainly have a tighter control and daily schedule than grandmothers (see, e.g., that peculiar breeding duty above). It would be very exciting to see whether the grandmother effect increases with the coherence or wealth of the community, allowing more free time and opportunities in the form of chats, visits to the market, etc., to establish weak links.⁴ It may be that the contradictory appearance of the grandmother effect is due to the fact that researchers did not include the resources of the society in their analysis. If weak links do indeed play an important role in the grandmother effect, then this effect should be strongest in communities where resources are not sparse, but also not too plentiful.



Women survive stress better than men. I hope the above examples have convinced you that we need women. *“Yes, I definitely agree!!!”* Spite, let me finish! We need women for the stabilization of our social groups. And although we need them in prosperity, we need them even more in stress. Men tend to ‘cope’ with stress by displaying greater competitiveness, hostility, social withdrawal, and substance misuse, whereas women do so by seeking out social support. Male behavior is not only self-destructive, but also undermines group stability, while female behavior is both stabilizing and contributes to female longevity (Skrabski et al., 2004; Taylor, 2002). Spite, if we want to live longer, we should start to copy this.

After this comparison of the baboon, the lion, and Finnish and Canadian mothers, I will continue with the most studied networks, social nets. I begin by describing their general features, highlighting those which are specific to ourselves. Then my pet idea comes along (you may have guessed what it is: weak links), and finally, I show how to use social nets for information management, one of the most important reasons for their development besides the division of labor.

8.3 Stability of Human Societies

In the last section, grandmothers undoubtedly emerged as a high point of evolution on Earth. In spite of this, societies contain a lot more actors than just grandmothers. Social communities provide a rich and

⁴I have to make the remark here that the wealth-induced promotion of weak links is not unlimited. Extreme wealth reverses the trend: really rich people tend to build strong links again, as summarized by Granovetter (1983).

very promising field of network studies. This was recognized a long time ago (Lotka, 1926; Moreno, 1934). In fact, with a little simplification, I may say that the network theory was born as an attempt to categorize and understand the bewilderingly enriched halo of human relationships emerging in a systematic way with the birth of our modern societies.

We are not exceptional in this respect. Social networks have almost the same properties as any other networks, including ant and bee communities. You may recall here our own herding behavior in panic. Before describing the special features of social nets, let me first list their general features. I gave quite a few examples of the small-worldness of social nets in Sect. 2.1, so let me restrict myself here to a Hungarian study. I was proud to read that the ten million people of my little country form a truly well-connected small world. In a survey by Utasi (2002), one third of Hungarians reported that they knew a national celebrity personally. *“This result depends heavily on what these guys call a national celebrity. We now have real-life shows 24 hours a day. Sooner or later one of your neighbors will ask for a camera in the bedroom and suddenly become a national celebrity in the field of nighttime acrobatics!”* Spite, ‘these guys’ as you call them are average Hungarians like yourself. They named real celebrities who had achieved something truly important and valuable.

Having saved my national pride from Spite, I started to read Mark Newman (2003c): “Consider two (fictitious) individuals. Individual A is a hermit with a lousy attitude and a bad breath to the point where it interferes with satellite broadcasts. He has only 10 acquaintances. Individual B is erudite, witty, charming, and a professional politician. She has 1 000 acquaintances. Is the average person likely to know A and B? Absolutely not. The average person is 100 times more likely to know B than A, since B knows 100 times as many people.” My illusions were shattered. Mark had proved to me that my beloved Hungary is nothing special. The take-home message is simpler: well-known people are well-known. Let me make a final note on the small-worldness of social networks using another quotation from Mark Newman (2003c): “There are a number of morals to this story. Perhaps the most important of them is that your friends just aren’t normal. No one’s friends are. By the very fact of being someone’s friend, friends select themselves. Friends are by definition friendly people, and your circle of friends will be a biased sample of the population because of it.” Life is demanding. If you want to have a non-biased sample of friends, you should start to look for the hermit with the lousy attitude and the astronomically bad breath. NOW! This is the bad part of it. What is the good part?

You may delete the long row of numbers of charming politicians from your mobile.

Social networks are scale free. Liljeros et al. (2001) showed that the majority of the 2810 Swedes who filled in a questionnaire on the most private aspects of their lives in 1996 had had zero or one sexual partners in the preceding year. However, a few of them had had more than ten. If cumulative numbers were assessed, the most active male had had almost a thousand partners already. However, this ‘achievement’ was almost unique. The same statistics appear again. You always have a chance of picking up a partner with an order of magnitude higher promiscuity (you may call it experience, depending on your own habits – Spite! Please do not grin!), but you have exactly an order of magnitude lesser chance for this. Good news for HIV prevention efforts. It is enough to warn, protect, educate and vaccinate the rather tiny, most active segment in order to make an efficient campaign for the whole. How can this tiny segment of the society be identified in an efficient, lawful and decent manner? The answer is not easy and requires a good measure of wisdom.

Social networks are modular and hierarchical. Modules, especially smaller ones, are bound together by strong links, while intermodular contacts are given by weak links (Girvan and Newman, 2002; White and Houseman, 2003). Modular structure is especially important for the efficient functioning of the social net and will be described further a bit later, where the special properties of these networks will be listed.

Social nets display similar dynamism to other networks. They do have a giant component and subsequent percolation, self-organized criticality, topological phase transitions and synchronization. Here the giant component means that most members of our social networks are connected. For this reason, percolation occurs, which means that news and effects can potentially reach almost all members of the network. Self-organized criticality is revealed by the avalanches I described in Sect. 3.2, and topological phase transitions have been listed in Sect. 3.4 and will be detailed further in Sect. 10.2. For the synchrony of social groups, audiences clapping together (Néda et al., 2000) or stadium visitors performing a Mexican wave (Farkas et al., 2002) are very good examples.

Besides the general network properties, social networks do display some key differences from other nets. A human baby has to learn a great deal. The human brain has quite remarkable plasticity. Rather a large amount of brain capacity has been developed to keep a complete

record of our contacts.⁵ Whom did I speak to, what did I tell her, how did she react, what am I supposed to do when I meet her next time, and so on. This is a LOT of information. Not surprisingly, we have to restrict friendship circles quite drastically to cope with the abundance of characters, situations, expectations and memories. We live in concentric circles of approximately 5, 15, 35, 80 and 150 people (Dunbar, 1998; Hill and Dunbar, 2003). This may correspond to our family and best friends (5 people), close friends (15 people), colleagues and pals (35 people), club and congregation members, fellow fathers and mothers at our kids' school, etc. (80 people), and our 'village' (150 people). Interestingly, people living in a megalopolis like New York also demarcate their 'village' in their neighborhood. Why do they do this? The answer is simple. We simply cannot put more faces into our cache memory. Why am I so sure that the size of our current cache memory is about 150 people? First of all I trust Dunbar (1998). Secondly, if you are a scientist, you agree that we have a good personal example of this. Imagine a conference. If it has 35 participants, it is a rather private discussion, where you will have a chance (and in most cases you dare) to discuss all the details. If it has 80 participants, it is a workshop, where you will still know most of the people by the end of the 2 or 3 days. If it has more than 150 participants you are lost. You cannot even remember all the faces. You feel lonely and tend to cling to the colleagues you knew from before.

The conference behavior mentioned above is a highly typical feature of social networks. You tend to associate with people who are similar to you. Since they also associate with people who are similar to them, you will in most cases find their friends friendly. Their friends will be your friends, too. This process, which is called clustering, is further helped by those occasions when you go out together to have a beer or make up a bowling party. Another rather characteristic feature of social networks is assortativity. It stems from the same habit: similar people like each other. Well-known people, who are usually hubs of the social network, attract other well-known people. Hermits make friends

⁵Let me give a personal example to demonstrate this. If you experience a big stress, or you have received a lot of information and got very tired, one of the first brain functions to switch off is your politeness. Exhaustion makes you inconsiderate. This is not because you like doing this, but rather because taking into account all the preferences, expectations, and game rules of others requires the handling of an astronomically large amount of data. This consumes a LOT of energy which can no longer be supplied by your exhausted brain, and therefore the whole function will be shut off and you will spend an afternoon when you will unintentionally but systematically hurt every single person who comes close to you.

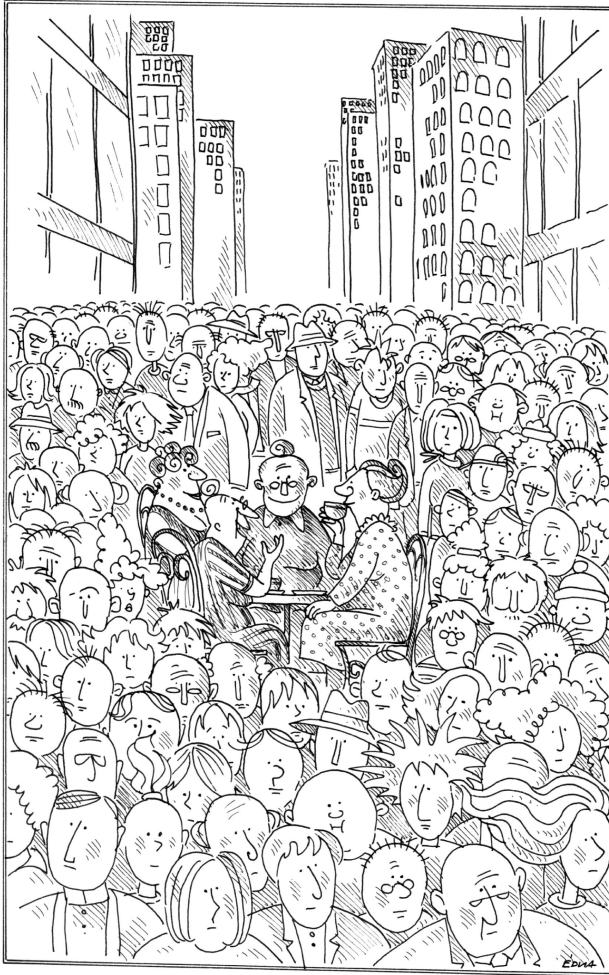


Fig. 8.1. People living in a megalopolis like New York like to demarcate their ‘village’

with hermits. (If they have that astronomically bad breath described by Mark Newman, they might use the Internet. However, if both of them have the same bad breath, then the similarity is complete and assortativity may develop without gas masks.)

As mentioned with regard to baboon society, our recognition is multivalent.⁶ This complex recognition limits our capacity for the small circles mentioned before, bringing a highly developed modularity to the

⁶A good example of this multiplicity is Tante Sissi’s German course, proletarian tea ceremony, and unforgettable role as a neighbor-interpreter, whereby she

hierarchy of human networks. However, the same complex recognition gives us the chance to form long-range contacts, and this provides an extraordinary flexibility and effectiveness to our networks.⁷ We may be proud of ourselves. Our net is richer than that of any other animal society (Newman, 2003b; Newman and Park, 2003). Moreover, our network analysis and networking is a major part of those features which make us human. You may have been unaware of this fact up to now. However, it is high time you recognized your inherent commitment to network research!

The richness of our social dimensions is easily handled if the underlying social network is unchanging (stable). Small villages and other closed communities may master rules and attitudes with century-long practices and traditions. However, the large cities and our rushing, globalized world change our social net from one minute to the next. Expectations can no longer be foreseen and actions cannot be adjusted. We need a new vehicle for stability, and we have found it. Hammurapi, Mohammed, Moses and many other great personalities of human history proclaimed rules. Indeed, besides dogs, humans are the only creatures which follow rules, these being formed as laws in larger or changing societies. Our obedience to the law becomes a much more important principle than the actual benefit or righteousness of the law. Law-abidance is a highly important element of the stability of modern societies (Csányi, 2005). Law-abidance works as a strong link, providing a backbone of behavioral codes and restricting ambiguity.



Strong links are important in fresh democracies. When a sudden change occurs in your society, as happened in Central Eastern Europe in 1989, you think the world has been opened to you. It is very difficult to learn that even an extremely bad law is a thousand times better than the absolutism of the best and most understanding person on Earth. Moreover, it is difficult to accept that, without keeping even the most idiotic rules, democracy does not work. (For you, Spite, I have to add here that, without achieving consent to change these idiotic rules, democracy does not work either.) We have to keep this in mind when trying to export democracy to other regions of the world. A careful balance of strong and weak links is required, and we need highly detailed plans to facilitate the development of both.

uninterruptedly repeated the German text to the Hungarians in German, and the Hungarian text to the Germans in Hungarian for hours on end.

⁷I will return to the explanation of clustering and assortativity in the synthesis of Sect. 12.2.

We have learned that strong links are important because they substitute the lost continuity of modern societies. What other stabilizing forces do we have? You know what comes now, don't you? Allow me to jog your memory: weak . . . ? *Weak what?* Spite!!! Have you just started to read this book? Now go to the kitchen, make a strong coffee, and come back again.

Did you get that strong coffee? Good! Now you will get your weak links too, to get yourself stabilized. Let me remind you of Chap. 1 and the landmark studies by Mark Granovetter (1973). He discovered that useful information often comes from far away,⁸ via long-range links. These long-range links are weak links (Onnela et al., 2005). Extending Granovetter's studies, Lin (1999) generalized the statement, saying that strong links are status-preserving, connecting similar elements, while weak links are status-enriching, connecting different elements.

However, Granovetter took a further great step. Comparing his primary findings on job-finding efficiency, he also stated that "weak ties play a role in effecting social cohesion" (Granovetter, 1973). Indeed, intermodular contacts are also weak. If social modules are bound together, conflicts can be settled peacefully. On the other hand, segmented societies have high conflict levels. Later, I will provide examples to illustrate the consequences of a lack of intermodular contacts.

If intersegmental weak links are important, how can we enrich them? We should learn from the bee and ant communities. We need divergence between the modules and between the individuals forming these modules to develop weak links. Different sensitivity thresholds are important examples of these divergences, since they develop the division of labor (Page and Erber, 2002). For the different sensitivity thresholds, Fewell (2003) gives the following excellent example: "Used dishes pile up in the sink, producing a continuously increasing stimulus. The dishes go unnoticed until the threshold of the most sensitive to them is met, and he or she washes them. This removes the dishes as a stimulus, further reducing the likelihood that the other group members will ever wash them. The result is a dishwashing specialist (much to his/her dismay), and a set of non-dishwashers. Similar interactions across other chores, from cleaning the bathroom to taking out the garbage, generate a division of labor for the household."

⁸The word 'far' demands some explanation here. In social nets distance is not physical distance in space, but distance along the social dimensions mentioned before. We can define distance in social networks via their assortativity and clustering. Due to the assortative and clustered network, our neighborhood is highly similar to us, and the 'further' we go, the more different are the people we reach.

The division of labor generates weak links and becomes a part of cohesion. However, I must warn here that the division of labor is a double-edged sword. On the one hand, the greater heterogeneity we have, the greater is the number of intersegmental relationships, and this gives greater chances that they will be based on weak links. On the other hand, a high drive for efficiency may overspecialize and alienate the members of various groups and act just in reverse, causing segmentation and instability (Degenne and Forse, 1999; Durkheim, 1933; Utasi, 2002).



Diversity stabilizes only if tolerated. The very same diversity destabilizes if it is not tolerated. Continuing my remarks on the double-edged sword characteristic of labor division, let me add here that its cause, diversity itself, is also a double-edged sword. In Hungary, we had a great king, St. Stephen, roughly a thousand years ago. Before he died, he wrote a set of Admonitions to his son, St. Emeric. One of the most important pieces of advice he gave was this: “A country with one language and one custom is weak and perishable. Therefore, I order you, my son, to show goodwill to our visitors, and protect and cherish them, so that they will prefer to stay with you rather than to live elsewhere.” Indeed, St. Stephen allowed Czech, German and Italian priests, as well as many refugees to come to Hungary, and strongly enforced this idea that the local Hungarians should recognize and tolerate them. This thousand year old counsel is valid today: all forms of diversity (Afro-Americans, Chinese, gays, gypsies, handicapped, Islamites, Jews, Kurds, lesbians, religious sects, talented people, Turks, to name but a few) will develop an abundance of weak links and will thereby increase the stability of the society – if they are tolerated by the majority and remain open themselves. But this very same diversity instantly becomes destabilizing if it is not tolerated by the majority. Then the minority becomes segregated and closeted, and will develop strong links. Consequently, the society will be segmented and unstable. From the middle of our own homogeneous group, the labeling of the diversities is rather easy. On the other hand, tolerance might be dangerous, since we have to fight with our own friends to get them to accept aliens. Is all this effort worth making, or would we do better to go back to the Middle Ages, before St. Stephen? I leave the answer to you.

Besides intermodular contacts, division of labor, and diversity, are there other means to develop weak links? Please pay attention! Our next animal lecture will now follow. We shall leave the bees and ants, and try to learn something from baboons. Grooming developed

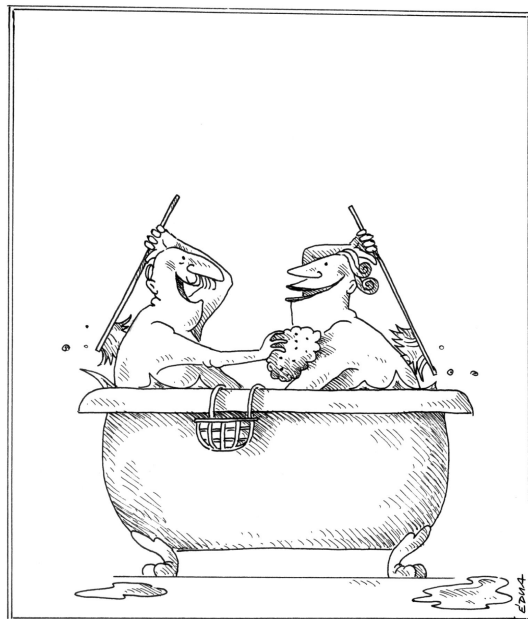


Fig. 8.2. Grooming is a hygienic action but developed as a way of stabilizing society

amongst our monkey ancestors as a highly efficient way of stabilizing the monkey society. In principle, grooming is a hygienic action. However, monkeys spend an enormously large segment of their lives in grooming, in a way that goes far beyond the most extreme requirements of hygiene. We simply need to get groomed. However, to do it day and night in the 21st century would be very tiresome. Instead of grooming, we smile and chat. These are the most traditional pseudo-grooming actions (Dunbar, 1998). Friends, gossipmakers, hairdressers, madams, priests, psychologists, (to name but a few in alphabetical order) may all contribute to the weakly linked, background networks of human society. Part of their job is to be our pseudo-groomers.

Grooming or pseudo-grooming is our evolutionary duty. *“What if I do not have time for it?”* Spite! You always have time for something when you really want it. This is no excuse. However, pseudo-grooming may be an annoying action to some, generally male members of our society. (This is one of the reasons why they die earlier, but I will explain this only in Sect. 10.3.) Very inadequate persons, the VIPs of our society, are usually hubs with the same 1 000 acquaintances, like the erudite, witty,

charming professional politician. VIPs develop a pseudo-circle around them for pseudo-grooming. (We can be quite sophisticated sometimes!) Let me explain this. They are always helped by a number of people, like babysitters, chauffeurs, janitors, and gardeners to name but a few. These helpers are not helping the VIP because the VIP has already forgotten how to take care of his baby, how to drive, how to clean the toilet, cut the grass, etc. As their most important task, these helpers create a net of weak links around the VIP, to do the pseudo-grooming in his place, thereby increasing the stability around him.⁹

From now on, we shall consider the strong links of the social network. White and Houseman (2003) described the societies of the Middle East and Afghanistan (parts of the Balkan region can be added to their description as well). These societies form highly clustered units with extremely strong internal links. Clustering causes high segmentation. In such societies conflicts escalate when the clusters split into opposing factions along highly predictable fault lines (Otterbein, 1968). It is time to remember the baboons and dolphins again. There, aged females maintained numerous weak links in the society and stabilized the groups (Connor et al., 1999; Lusseau, 2003; Silk et al., 2003). In the clustered, highly traditional Afghan and Middle Eastern families, women stay at home. When they are allowed to go out, they must not make numerous contacts, since this is a sign of infidelity which may bring a serious penalty. The society thus loses one of its most important stabilizing forces: women. Segmented societies are unstable (Degenne and Forse, 1999). A lack of women-induced weak links makes them dangerously unstable (White and Houseman, 2003).

At the end of this part, let me bring a well-known example: Romeo and Juliet. Just imagine, if the grandmas of the Capulets and Montagus had got together to have a good chat. Whilst knitting, they would certainly discuss the fate of those poor youngsters who have fallen in love with each other. A few tears, and the story is over! The end will be a happy marriage, and poor William may start to search for another silly segment of the world, where women are not allowed to do their evolutionary duty – get together and have a chat.

I think I have to make two remarks here:

- I am not saying that women's only role in life is to get together to have a chat. In the next section, I will discuss the idea that without them, without female-type behavior, no firms, no human endeavor can be successful. What I mean is that any male chauvinist who

⁹I am grateful to István Kovács for this idea.

despises a single woman for engaging in ‘idle chat’ for hours is endangering his own stability.

- My second remark is even more important. I hope you have noted that women’s stabilizing role is strikingly missing in all the major conflict areas of the world. The fight for women’s rights (chats heavily included) is not an altruistic act of the male-dominated society. It is an outright necessity to save the stability of our planet.



Weak links and general welfare. Let me repeat the idea of Sect. 7.5 concerning the WEAKLINKER and STRONGLINKER personality traits, in a different context this time. As I mentioned there, Bateson et al. (2004) suggested that we may have two phenotypes: the SMALLS adapted to survival and the BIGS adapted to proliferation. I have suggested that SMALLS might correlate with STRONGLINKERS, while BIGS can afford the costs of building more weak links. Bateson et al. (2004) warned that changes in these phenotypes take place by a slow process, requiring many generations. The lack of weak links in Afghanistan, parts of the Middle East, and Albania is probably not only a cultural trait. We need a significant increase in general welfare *for many generations* before we can expect these basic trends to change. I would like to stress that this is not a note against educational programs. We need them as well. This note warns against impatience. The destabilizing, STRONGLINKER behavior may be partly genetic (or at least epigenetic). It cannot change from one second to the next. We must wait. A hundred years perhaps.

You may lean back and say: “Afghanistan and the Middle East are both very far away. You have convinced me. I will write a check and support a women’s rights movement, as well as a long-term project to increase food supply there.” A noble act, indeed. However, you yourself have your own duty here. Granovetter wrote a sequel to his famous 1973 publication in 1983. In this paper he summarized findings according to which, in the job market, less well educated respondents were most likely to use strong links to find a job. However, he also gave an explanation: both upper and lower class individuals are embedded in strong links and suffer a lack of cognitive flexibility. As a result, they develop arrogance towards any other approach than their own (Granovetter, 1983).

Now take a deep breath, drink a glass of crystal clear water, relax, and most importantly: think. I want you to make an inventory. Write down a list of your 15 closest friends. (This is the second circle of Dunbar.) Could you finish your list? Do you have 15 close friends?

Is there anyone on your list, who has an extremely different cultural, educational or financial background to you? Is there anyone on your list, whose background, values and norms are radically different from yours? Is there anyone on your list who would not read this book under any circumstances? *If you do not have such friends, stand up, leave this book on the table and start to collect them.* How do you expect to understand your own country if you lack the cognitive flexibility to do so? Do you really think you are doing your fair share to preserve the stability of your nation? The outside dangers that threaten Western countries may be just a prelude to the real threat of the cognitive isolation and the subsequent instability that slowly arises from within.

Let me emphasize this again. We need both weak and strong links to make our society stable. Actually, we are quite good at expressing both needs in a balanced way. Our conservative parties (if they know what is meant by this name) favor the building of strong links. On the other hand, our liberal parties (if they know what is meant by this name) favor the building of weak links. Neither of them is wrong. We need both at all times. Sometimes we need one of them more. In a wise nation, this is the party which wins the elections.



The two sources of STRONGLINKERS. *“I have to stop you here. Referring to Bateson et al. (2004), you said before that STRONGLINKERS correspond more or less to the SMALL phenotype. Do you mean to imply that conservatives are the poorest, who did not eat enough either in the past or even now? I admit, I am a bit young to have gained extensive social experience, but this sounds very suspicious to me.”* Spite, you have hit upon a very good point again. Let me quote Granovetter (1983), who summarized a large number of studies and showed that strong links are typical in both the top and bottom segments of society. The richest and the poorest are both segregated. Obviously, the traditional core of conservatism is the former, while the SMALL phenotype is mainly found in the latter. However, the occasional merger of traditional conservatism which aims at the top 20% with populism aiming at those in the bottom 20% may have its root in the common preference of these ‘target populations’ for strong links. In fact, this is a winning strategy, since 40% of votes are enough to win an election in most countries.

To end my meditations on strong and weak links, let me put them into perspective. Without strong links, society has no structure, and it falls apart. Strong links, traditions, and order are necessary for social peace and for the effective and reliable functioning of society. Without

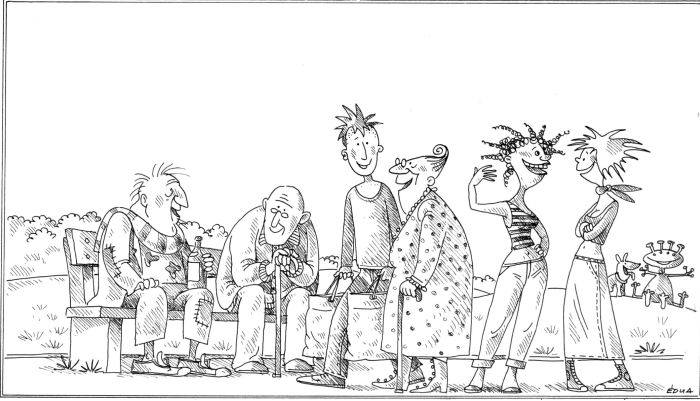


Fig. 8.3. Weak links require and cause cohesion, solidarity and trust in the society

strong links, society has no resistance and will be destroyed by some bigger danger. On the other hand, affection, goodwill and tolerance of diversity all build up informal networks and weak links. Weak links require and cause cohesion, solidarity and trust in society. Weak links stabilize society, emerging as key elements of its fitness and forming a part of its social capital. I hope that my examples of Afghanistan and others will convince the reader that this is no longer a matter of a single society. It has become our problem, too.

It is time to pose the following question: if we do eventually achieve a stabilized society, what good is it? This may sound rather a silly question, but it is worth looking at it from the network point of view. Let us learn another lesson from bees and ants. One of the most important network-related society functions is information management. Bees have to look for pollen, water, and many other ingredients of their daily life. Not to mention the alarm reactions due to periodic attacks by the Big Honey Parasite, the beekeeper. How can we inform each other about the news? How can we get answers to our questions? Strong links provide a fast source of established and focused knowledge. If I have a precisely formulated question and I know that one of my close friends is aware of the answer, I should ask her, since she knows me and I can be sure that she will sacrifice some of her time to answer my question. However, if I have an ill-formulated question or have no idea who might know the answer, it is better to mobilize a weak link. Why will a weak link serve me better in this case? Weak links are long-range contacts and they provide access to non-redundant information. If my knowledge is completely inappropriate even to for-

mulate my question well, then how could I dare to think that my best friend will know the answer? As Mark Newman said (2003c): “By the very fact of being someone’s friend, friends select themselves.” Friends are friends because they have redundant interests. *“Peter, you made such a great issue of my role in stabilizing my own nation a few pages before that I decided to extend my friendships. I now have friends who are completely different from me.”* Spite, I am indeed touched by the influence my thoughts have had on you. But believe me, you have become quite unique. Most of our friends are similar to us. This is the reason for the high levels of clustering and assortativity in social nets.



Opinion is stabilized by weak links. An interesting example of information spreading is opinion formation in networks. If the population is only allowed to make local interactions, it may change its opinion abruptly, manifesting a transition after diffusion-type propagation. However, long-range contacts stabilize original opinion (Kuperman and Zanette, 2001), which may show the stabilizing effect of weak links in this system.

Let me put the same message into another form: several important studies have shown that successful social searches require intermediate to weak links (Granovetter, 1973; Dodds et al., 2003a). Moreover, multiple identities in the form of multiple social dimensions help social searches. First the search goes along the first identity and then it is followed by the second (Watts et al., 2002). However, there is a twist here. Weak links may only give you non-redundant information if this information is easy to access. Tacit knowledge, meaning information which is protected or difficult to formulate, requires more than a weak link. It also needs benevolence – and competence-based trust (Hansen, 1999; Levin and Cross, 2004). Exposure to tacit knowledge needs strong links. Strong links are not individual strong links here, but rather a common attitude across the whole community, ensuring an open, trustful and helpful atmosphere.

We need both weak and strong links to find important information in a social net. How many links do we need? Should we add more and more links? Overconnected networks have low innovation potential, because innovation then spreads only very slowly (Rogers and Shoemaker, 1971). Actually, this is not at all surprising, since it follows from the same dilution effect that we have seen in Sect. 3.2 (Fink, 1991; May, 1973; Siljak 1978; Watts, 2002). If most of the network members have 1 000 contacts like the erudite, witty, charming professional

politician, my innovation will go round and round helplessly, and will reach distant elements of the network paradoxically slowly. Moreover, strong interconnections may mean increased coherence, which biases the whole network to strong links, and makes it rather closed to any change coming from outside. We need not only an optimal amount of weak links, but an optimal amount of links as well.



The secret of the ‘Martians’ – who actually came from Hungary. As an example of success and cohesion in social nets, it is worth mentioning the scientific collaborations of a few legendary Hungarians. They were called Martians due to the peculiar language they used, i.e., Hungarian, which no one else understands. János von Neumann and Leó Szilárd were multi-talented people who introduced seminal thoughts in many areas of science. The weak interdisciplinary links these scientists provided certainly increased the speed of advance in all these areas. Pál Erdős should also be mentioned. He stayed ‘only’ in mathematics, but with an unprecedented multidisciplinaryity, made a significant contribution in numerous mathematical subdisciplines. With a vast number of collaborators, he became a worldwide stabilizing institution of mathematical research for several decades.



Heresy as a network phenomenon. In the medieval Catholic Church the fight against heresy unwittingly utilized the lessons from the network approach. The initial general persecution was soon followed by the development of the Inquisition to target key individuals. The investigations carried out by the Inquisition tried to extract similar information to today’s sociological surveys (albeit with a rather different outcome and methodology). Murder, imprisonment or stigmatization of heretics was actually a way to prevent their further contacts in the society. Several practices of the Inquisition resemble those used in current strategies to prevent the spread of viral (e.g., HIV) infections. Fortunately, 700 years of moral development, which reached their culmination after the inhuman and barbaric acts perpetrated during World War II, have excluded the death penalty, substituted hospitals for prisons, and given special treatment in the place of stigmatization (Liljeros et al., 2001; Ormerod and Roach, 2004).

With the Martians and medieval heretics (actually, these two types of people are sometimes quite close to each other; think of Giordano Bruno or Galileo Galilei), I have now reached the social networks of

society modules. Some features of these module networks will be discussed in the next section.

8.4 Firms and Human Organisations

Organizations, firms, and governmental systems are social networks, and have the same properties. So why should I waste your time with this section? The fact is that these organizational networks have a few special features. I will concentrate on these specialties here. I am fortunate, because Rob Cross and Andrew Parker published an excellent book in 2004, called *The Hidden Power of Social Networks*. This book gives hundreds of good pieces of advice on how to make a business network more efficient. This long line of advice starts with a simple idea: networks are needed for the efficient life of a firm. Quite surprisingly, this trivial observation is not so trivial for many chief executive officers (CEO). Employees make networks even if they do not need to do so. A number of extensive studies have proved that highly sophisticated and astronomically expensive data-base behemoths remain rather under-used, since employees turn to their colleagues with their questions. Moreover, networks are not only important for the firm. They will be important for you, Spite, whenever you start your Real Life (*“Too bad, this man has realized that I am only a fiction. Better to shut my mouth for a while.”*). Distinguished high performers have a large and more diversified personal network. So the take-home message, Spite, if you do not want to end up in the bottom 20%, is to be a diligent student. However, if you want to end up in the top 20% and not somewhere in-between, be a diligent student and learn also how to make an efficient personal network (Cross and Parker, 2004).



The benefits of personal networks. *“What a silly title!”*

Spite might add. (Where are you, Spite?) This is obvious. If you have connections, you can reach resources. You will have a job, solve your problems, and live a happy life. Personal networks mean even more than that. Dunbar (2005) describe the observation that the number of your close friends – the number of people whom you are emotionally attached to and dependent on – correlates with your perspective-taking ability. The more close friends you have, the better you can imagine another’s position, motives, or future acts. This secures a great advantage to plan your reaction, as well as to prevent any foreseen damage. However, there is still another advantage. Now take a deep breath, drink a glass of crystal clear water, relax, and most importantly:

think. *The more perspectives you can imagine, the better you will understand the people around you.* A personal network with long-range contacts involving friends from different social circles not only stabilizes society by making crucial links between segments which would otherwise remain isolated, but also stabilizes the microenvironment around you. Stabilization of our microenvironment is one of the great innovations of evolution, as I mentioned in Sect. 4.3. Most of our technical achievements, like clothes, housing, fire, air-conditioning, world trade (to procure fresh strawberries at Christmas!) all serve to do just this. The more isolated you stay, the bigger evolutionary failure you are from the network point of view. Do you still wonder why such people remain unsuccessful? I will return to this problem in Sect. 12.4, where I try to give a synthesis of the most important thoughts in the book.

Most organizational networks are small worlds with numerous statistical features, such as their size or the standard deviation of their growth, and a scale-free distribution (Axtell, 2001; Stanley et al., 1996). Due to their rather sophisticated task distribution, organizations usually have a modular structure. Now here comes the key feature: the efficient working of an organizational network needs good bridges between modules. These bridges have to be redundant. If someone gets sick, there has to be at least one more person who remains as a bridge. It is even better if the bridges are degenerate, where the links have a backup not by simple parallelisms, but by the general connection scheme of the system (Cross and Parker, 2004). Here it is worth recalling those intermodular boundaries called fringe areas in neuronal networks in Sect. 7.4 (Agnati et al., 2004). Carefully developed fringe areas are of special importance in business organizations. Fringe areas are key points of innovation, too. Firms participating in new forms of industrial district develop an intermediate description of their problems called pidgin formalization (Sabel, 2002). These problem descriptions are sufficiently detailed to refer to the original problem, but sufficiently abstract to provide a large enough contact surface for experts with completely different expertise to assess and help to solve them. As we will see later in this section, pidgin formalization is helped by weak links and played a major role in solving the 1997 Aisin crisis of the Toyota complex (Watts, 2003).

If you want to work efficiently, you need hierarchy. Hierarchical organization is especially characteristic of firms. According to the model of firm growth by Stanley et al. (1996), on average 70 to 90% of company decisions are determined by hierarchical orders. Hierarchy leads to another special feature: leadership collaboration. If leaders of

smaller units are just treated as parts of a larger hierarchy and their horizontal contacts are not promoted effectively, network fragmentation may occur (Cross and Parker, 2004). Remembering the definition of network stability in Sect. 4.3, you will agree that this is a particularly dangerous situation since it may lead to a breakup of the giant component of the firm's network. If the giant component is broken, ideas cannot go around the network and the firm is in fact dead. Leadership collaboration is a necessity for the netsistance (life) of organizational networks.

Firms also display the topological phase transition phenomenon. For instance, as a business group grows, the hierarchy may increase, and the network structure may be reorganized along the random \rightarrow scale-free \rightarrow star configuration axis (Stark and Vedres, 2002). Rather interestingly, I have not yet found studies of self-organized criticality and synchronization phenomena in business networks,¹⁰ which remain subjects of future research.



Firm quakes. In spite of the lack of data, I am quite sure that firm reorganizations satisfy the criteria of self-organized criticality. Most firms have some degree of resistance against gradual change. The cycle thus starts with a continuously growing tension. Things get worse and worse, but remain latent. “If I say anything, my bonus will be cancelled.” “I had better concentrate on my job.” Then all of a sudden, something really bad happens. The firm loses a very lucrative bid. Or the CEO runs over a stray cat on the way home and cannot sleep all night. As he tosses and turns, his self-guilt gradually expands from the ghost of the cat to the whole firm. By the next morning, the reorganization avalanche hits. The outcome is rather unpredictable. However, both the periodicity and the extent of change might actually follow a scale-free pattern.

As I mentioned above, firms, governmental systems and most other organizations are typical formal networks, i.e., hierarchical structures where links are, by definition, strong. In the remaining part of this section, I will list some interesting examples to demonstrate the need for a careful balance between strong and weak links in business networks.

Dodds et al. (2003b) showed that the most stable firms (they are said to be ultrarobust) are those which have an informal, background

¹⁰The Schumpeterian avalanches of innovations mentioned in Sect. 3.2 and other studies on economics are not strictly concerned with business networks, so I do not take them into consideration here.

network in addition to the main-frame of the firm's network, the 'chain of command'. Why is this important? In an organizational network, the elements are individual people. They may get sick. Moreover, their mother may get sick. More commonly, they may get overloaded. (Consequently, they may get sick, but this is another aspect of system biology.) In a good firm the CEO talks to the janitor if they happen to share a ride in the elevator. (To start with, in a good firm the CEO and the janitor use the same elevator!) Moreover, a good firm has a specially designed sanctuary of information exchange, innovation and life-and-death decisions: the cafeteria.

An interesting example of system stability is described by Duncan Watts (2003) in his very informative book *The Six Degrees*. The story is about the Toyota group in Japan. By the end of the 1990s, the production of automobile parts had become highly distributed over the hundreds of Toyota-affiliated firms. Moreover, due to the highly efficient and reliable supply system, the inventory of all automobile parts was reduced to maintain the production for approximately two days. A crucial element in the proper control of the rear brakes, the P-valve, was exclusively manufactured by the Kariya plant of the company Aisin Seiki. No plant meant no P-valves. And no P-valves meant no brakes from the second day on. No brakes, zero cars instead of the 32 500 made daily in all Toyota factories. Early in the morning of Saturday 1 February 1997, the Kariya plant burnt down. Production came to a complete standstill. Such a staggering loss would cause disaster in most automobile companies. But not in Toyota. Within a few days, 62 firms had started to make P-valves. None of these firms had any prior expertise in P-valve production. One of them was actually a manufacturer of sewing machines, with no previous experience whatever in the automobile industry. In two weeks the production of P-valves (and Toyota cars) was back to normal again. How could this happen? Well, weak links had played their part once again. The stress was distributed to hundreds of firms instead of striking one. Moreover, Kariya plant engineers specified the problem in the broadest terms possible using the minimum level of details and concentrating on the function of the P-valves rather than the method they had used to optimize their production in their own plant. This is a very good example of pidgin formalization, mentioned earlier as a fringe area, i.e., a proper contact surface between firms (Agnati et al., 2004; Sabel, 2002). The P-valve substitutes produced after two weeks were not identical, but they were functional, and this degeneracy saved Toyota as well as a

large fraction of Japanese automobile exports in 1997 (Nishiguchi and Beaudet, 2000).

Hong and Page (2004) gave an exact proof that if they hypothetically selected a problem-solving team from a diverse population of intelligent agents, a team of randomly selected people would outperform a team comprised of the best-performing agents. Diversity and weak links pay off. They not only increase group stability, but also raise the innovative potential of the group. In a ‘real-world’ example, MacDuffie (1997) compared the problem-solving of three automobile companies, General Motors, Ford, and Honda in the 1990s. It turned out that weak links played an increasing role in the conditions, organization and general policy for problem-solving in the three companies, in that order. Examples of these weak links were the free interactions cutting through departmental lines, bridging persons, ad hoc, problem-based groups, a low level of centralization, etc. Not surprisingly, the number of customer complaints was highest at GM and lowest at Honda at the time of the survey. The Honda philosophy that “a problem with our product is a problem for the whole company, not for any individual or department” clearly paid off. Needless to say, in the Honda plants, the cafeteria was a central place for discussions!

Other examples of system stability were revealed after the terrorist attack against the World Trade Center on 11 September. Cantor Fitzgerald lost 700 out of its roughly one thousand employees in the disastrous collapse of the twin towers. But business had to go on, and the remaining employees decided to continue. Fortunately, all computer data were saved in several backup copies in remote locations. However, a formidable problem arose: all those who knew the password to access the data had died. So what the remaining employees did was this (Watts, 2003): “They sat around in a group and recalled everything they knew about their colleagues, everything they had done, everywhere they had been, and everything that had ever happened between them. And they managed to guess the passwords.” This outstanding achievement of collective memory shows the power of filtering mechanisms resulting in the emergence of the important message from the noisy information background. This emergence is based on weak links.



The benefits of women CEOs, and ambiguity. As is quite clear already from the above examples, stabilizing weak links cannot be achieved by instructions, reorganizations and CEO memos. The philosophy,

the whole mentality of the firm has to allow and encourage the formation of ever-changing weak contacts. The mixed-type (feminine and masculine) communication and leadership style is very helpful in this. Such a style should mix visions and clear instructions with politeness, empathy, continuous appreciation and nurturing. Women in leadership positions (or men who have been able to learn from their female colleagues) are beneficial to promote weak links. Ambiguity is also helpful to promote weak links. Ambiguity is a form of degeneracy giving similar solutions to the same problem. I will detail the connection between ambiguous meaning and weak-link-induced stability in Sect. 9.1. On the face of it, ambiguity and firms do not seem to go together very well. A firm either has a goal or it does not. Neither benchmarks nor deadlines leave much space for ambiguous information. However, if benchmarks set the goals and not the method or the elementary steps required to achieve these goals, innovative solutions may develop better. Such a general policy requires decentralization and autonomy (Grabher, 1993). All these promote weak links, which are necessary to maintain the innovative potential of the firm.

My last example concerning the effect of weak links brings in another aspect of firms: their ownership. An unstable environment leads to the diversification of ownership (Stark and Vedres, 2002). This change can be regarded as the establishment of an array of stabilizing weaker links in society in times when extra stabilization is needed.

Hey, Spite, where are you? In the other sections, by this time you had already launched a heavy protest against my demagogic and one-sided advocacy of weak links. Well, wherever you are, I shall talk about the strong links from now on. A rather typical example of strong links was the coal, iron and steel complex of the Ruhr area in Germany a few decades ago. In this context, the work of successive generations built up a common language with regard to technical matters, contracting rules and various other aspects of business life. When this industrial sector was hit by the big changes that occurred during the 1970s, these strong links prevented recognition of the change. Instead of reorienting and downsizing, an enormous technological development took place, resulting in a 'sailing-ship effect'.¹¹ Parametric rationality won out over strategic rationality, not only in the coal, iron and steel complex, but in many other business sectors, including the automobile and high-tech industries, which were based on a culture of traditional, strong

¹¹The sailing ship effect refers to an unnecessary overshoot in the technological development, using the example of the sailing ship, where the most important improvements occurred after the introduction of the steamship.

links (Grabher, 1993). The take-home message is that too many strong links are not good for your success in business.

Hansen (1999) examined the development and dynamism of strong links in firms and provided more examples of the adverse effects of a strong-link surplus. Strong links soon bring redundant contacts, since close colleagues of two strongly linked people start to make friends with each other independently of the first two contacts, and a number of redundant contacts will therefore be made. This is a consequence of the clustered and assortative nature of social networks. In life, redundancy helps self-assurance and makes contacts accountable. In life, redundancy is helpful. In firms, a certain amount of redundancy is needed for the backup functions, e.g., for the bridging people I mentioned above. However, if a problem is discussed by five different pairs of colleagues in an almost identical fashion, it is rather a waste of time. Furthermore, if inter-unit links are strong, members spend their time helping other units instead of doing their own tasks (Hansen, 1999). Too large a number of strong links may make the firm inefficient.

Once again let me stress that strong links are mandatory for any organization. When the question is not highly focused, or the information required is complex, a weak link will not help, since it would cost a lot of time which can only be provided by a strong contact. Still, weak links are important for solving diffuse problems and instrumental tasks. On the other hand, strong links are preferred for normative expectations (Hansen, 1999).¹² This ambivalence of link strength requirements may have helped the relativization of link strengths in modern industrial districts, making them more competitive (Sabel, 2002). I will return to the relativization of link strength in modern societies in Sect. 8.6.

8.5 Dark Networks and Terror Nets

Dark networks are antisocial networks organized for terrorism and/or smuggling arms or drugs, and counterfeiting currency. It is essential to learn about their specificities if we hope to fight them effectively. What are their special features? Dark networks are not nested or hierarchical in the usual sense. Almost all these networks can be divided into a highly integrated core and one or more peripheral circles. The core consists of deeply trusted ties, while the periphery has very weak, or

¹²A good example of a diffuse problem is the task: design a car with an alternative energy source! A good example of a normative expectation is: make more cars! To make more cars, we need strong links. However, if we want to make not only more, but better cars, we will need weak links, too (MacDuffe, 1997).

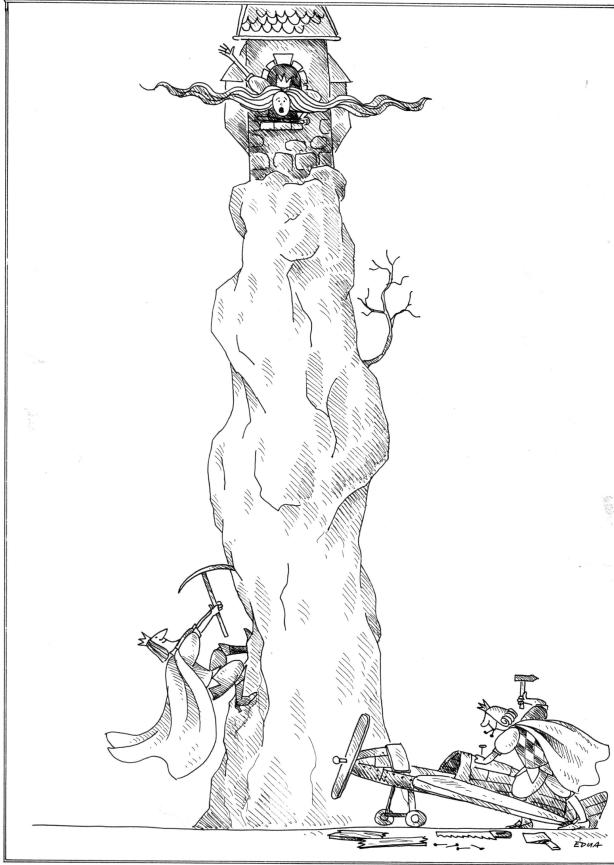


Fig. 8.4. If benchmarks set goals without specifying elementary steps or a method for achieving them, innovative solutions may develop better

even no links to core members. Members of the periphery are always expendable and the core always remains isolated. In dark networks, the deeply trusted core contacts are massively redundant. However, the core contacts become invisible when an attack is imminent or executed (Krebs, 2002).

Dark networks are not small worlds and they do not follow scale-free statistics. The 19 members of the Al Qaeda network directly responsible for the September 11 terrorist attack had an average path length of 4.75, which is very high in such a small group. In these networks long-range links do not exist. If such contacts are ever made, they will be merely transitory shortcuts. These shortcuts are rare events, after which the contact goes dormant and perhaps

never becomes activated again. These networks are extremely flexible. In the event of any threat, they become instantly disorganized. Netsistance is not a question here. If the few people in the core remain untouched, the whole network can be rebuilt again. Redundancy is high to help the reorganization process. This is not a firm. Efficiency and money are not an issue here either (Milward and Raab, 2003; Williams, 1998). These peculiar networks call for intensive studies to understand their extreme dynamism and to find their weak points.



Terrorist attacks are scale-free. A recent report by Clauset and Young (2005) showed that the frequency and severity of terrorist attacks between 1980 and 2002 followed a scale-free pattern. This pattern allows the authors to make a number of thrilling comparisons and predictions. While in 1980 there was an average of 4 days between consecutive terrorist events worldwide, in 1998 the average terror-free interval was already down to 17.3 hours. Probabilistically, an event of at least the total severity of the September 11 attacks can be expected by 2012, if the scale-free pattern is not broken in the meantime. The reason for the scale-free distribution is not exactly known. The notion I quoted in Sect. 2.2 whereby successful completion of many subtasks results in scale-free probability and clustering for the overall success of the complete task (Montroll and Shlesinger, 1982; Shockley, 1957) may explain the surprising trend.

8.6 Pseudo-Grooming

In Sect. 8.1, we learned from the baboons that grooming is good for our health, both physically and mentally. Larger groups cannot maintain their social well-being by this action. Behaving in the traditional way, an average human being would spend almost half of the day grooming, which is clearly impractical. We have thus invented pseudo-grooming instead. The small-talk I mentioned in Sect. 8.2 as a key asset of grandmothers in helping the stabilization of society is a typical example of this.

Gossiping is another important type of pseudo-grooming, providing occasions for a joint experience of empathy-strengthening group cohesion (Dunbar, 1998; Szvetelszky, 2003). A direct proof of the stabilizing role of gossiping has been found by Gabriel Weimann. Studying a kibbutz, he noted that (Granovetter, 1983): “Gossip becomes one of the social forces, suppressing deviants and holding obedience to the com-

mon norm. [...] By the transmission of gossip items, mainly via weak links, as shown in this research, the kibbutz social system can keep solidarity, sanctions and obedience in a heterogeneous, segmented social group.” Indeed, gossip is thought to be developed to control the ‘free-riders’, those who take advantage of cooperative and altruistic human society (Dunbar, 2005).



Gossip and Slander. I should make a clear difference between gossip and slander (Dunbar 1998; Szvetelszky, 2002). As mentioned above, gossip occurs in a spirit of understanding and therefore increases group cohesion. In contrast, slander seeks to isolate and exclude. Gossiping does not require the receiver to reveal his or her attitude towards the content. Slander stigmatizes and seeks to make the target an outcast. In summary, gossip produces weak links, increases group cohesion, and stabilizes the group, whereas slander produces strong links, if any, and may strongly destabilize a group, increasing the risk of group fragmentation. In other words, slander may overcome the netsistance of a group. It is quite remarkable that the above differences in the effects of gossip and slander are independent of moral judgments, i.e., that slander deliberately seeks to hurt and is often an outright lie.

In modern societies, not only weak, but even strong personal links have been deteriorating. When did you last visit your mother? Or your brother? *“What a silly question! I live with them. We just celebrated my 18th birthday yesterday. I would love to be just visiting them both, but not all dreams come true in life.”* Spite, welcome back and congratulations! Now, as you are now an officially declared adult in our country, Hungary, many of my previous criticisms can be withdrawn. I missed you. As an inhabitant of a megalopolis, Budapest, you may find yourself in the middle of a contact desert. An inhabitant of a housing project in one of the suburbs will often have this experience. The growing personal isolation and lack of safety demands a much greater compensation by weak links. In the absence of traditional, ‘human’ links like personal contacts, real grooming is out of the question. Pseudo-grooming like small-talk and gossip cannot be performed directly either. But this presents no problem because modern technology has invented (pseudo)²-grooming. (Pseudo)²-grooming, as its name suggests, is a double substitution. Here not only is the physical act of grooming substituted by a chat, but even the personal presence aspect of simple pseudo-grooming is no longer required. (Pseudo)²-grooming can occur via a wide variety of means, such as the telephone, Internet, etc. These elements of modern

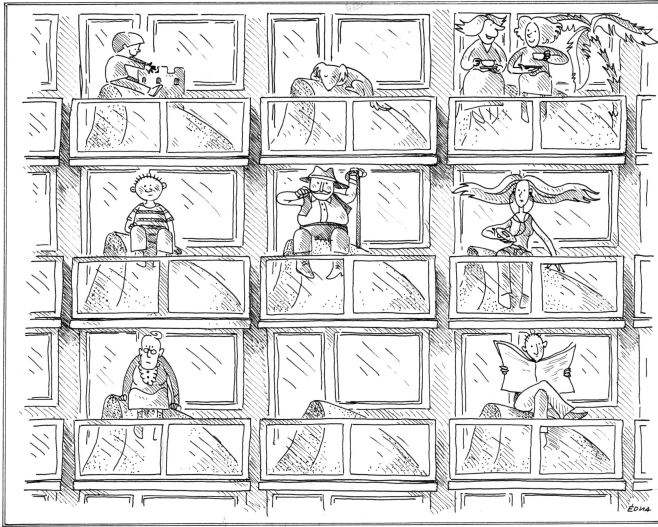


Fig. 8.5. An inhabitant of a megalopolis may find herself or himself in the middle of a contact desert

life have become the main stabilizers of psyches and societies in the 21st century.¹³



Cellular world. We have many examples of the importance of (pseudo)²-grooming in our close neighborhood. Our kid starts to panic if the mobile phone accidentally remains at home. A rather serious depression may develop if the mobile phone gets stolen and the saved numbers are lost. The same depression may strike if our kid does not receive at least as many daily SMS messages as a best friend at school. We are no exceptions either. We carry not just one, but three mobile phones with us. What happens if the first suddenly loses power? What happens if even the second breaks down? Now a serious question again. Do you remember where the button is on your mobile phone which switches it off? Or are you also one of those who receive calls in public lavatories, public meetings, etc., and the list is long. I will never forget the Italian film where a mobile phone started to ring during a funeral. A real synchronization followed. Everyone checked to see whether it

¹³Pseudo-grooming is a double-edged sword. On the one hand, it helps us to survive the isolation of modernity and provides a whole arsenal of techniques for building and maintaining social links. On the other hand, pseudo-grooming reduces the complexity of our personal, face-to-face contacts to the simplicity of an SMS message. Moreover, pseudo-grooming gives an easy escape from the painful intensity of complex personal contacts, and tends to produce emotionally handicapped adults.

was hers or his that was ringing. Even the priest stopped the ceremony for a while to examine his mobile phone for a quick check. But the mobile phone kept ringing. Finally, the mourning relatives discovered (with great joy) that the mobile phone they thought to be lost had remained in grandpa's suit in the closed coffin, and by this accident it was serendipitously recovered. A happy ending, indeed.

Mobiles, SMS messages, and the Internet all serve as weak links, besides the strong links of personal contacts between people (see, e.g., Wellman, 2001), and bring an unprecedented flexibility to adjust link strength. It is now quite usual to break up a relationship with a farewell SMS. A string of 160 characters has become quite enough for this purpose. Andy Warhol's '15 minutes of fame' keeps shrinking. In the next part of the section, I will discuss several examples of modern habits and inventions for quick link strength adjustments.



(Pseudo)³-grooming: radio and TV. Originally, radio and TV were a source of updated, sometimes live information and entertainment. Recently, these functions have increasingly been substituted by the newly acquired link functions of both. Call-ins and SMS votes all give a feeling of involvement and have led to the spread of (pseudo)³-grooming. In this form of pseudo-grooming, not only grooming itself and actual physical presence have been replaced, as in the (pseudo)²-grooming mentioned above, but the participants do not even need to know each other, and even the link between them is in fact a pseudo-link, since it is unilateral and at least partially virtual. Apart from the SMS surcharges, (pseudo)³-grooming is a very inexpensive way to feel that one is part of the grooming community of the elderly female baboons in Sect. 8.1. Emotional involvement is low and the contact can be cut at any time without danger of retaliation. The involvement is self-centered, since the other partner is not even present, and it manifests a typical market behavior: when I need it, I take it; when I no longer need it, I dispose of it. You may actually call (pseudo)³-grooming disposable grooming.



Mall kiss. Sex serves at least three purposes in primate communities. Besides giving a pleasurable means to repopulate the community, it is also a way of giving intimate and intense mutual joy to each other. Finally, sex is a source of stress relief. In its last function, sex actually serves in the same way as grooming (watch a bonobo, chimpanzee or real time show for a check). If you visit a plaza during the summer, you can witness the birth of a new type of schoolbreak sex: the mall kiss. During a perfectly executed

mall kiss, the partners are keen to avoid even the faintest suggestion that they care about each other. Both of them are deliberately scanning the hemisphere behind the partner's shoulder to gather public opinion about their perfectionism, and to discover new subjects for the revised and enlarged editions of the mall kiss. If the partners are real professionals, they will from time to time make a 180 degree turn, allowing each other to scan the space all around. The mall kiss has nothing to do with the first two functions of sex mentioned above. Most of the time, the mall kiss does not even provide stress relief. Besides being an activity to kill time, it shows the signs of (pseudo)³-grooming: low, self-centered involvement, no endurance, and market behavior. You may actually call the mall kiss a form of disposable love.



Disposable love. Disposable love is a much broader phenomenon than the mall kiss mentioned above. Supermarket socialization has made disposability a key element of mate selection. The first step is to take it. I do not really care whether he or she wants it or not. The second step is to examine superficially what I have got. The third step is the decision. If I still like it, I use it. If I am dissatisfied, I dispose of it and go for the next round, hoping to get something better. I do not suffer, I do not try to develop myself for the partner or for the contact, I do not wait and I do not trust. If the relationship is not optimal from the start, if it does not immediately look like a movie romance, I quit, dispose of the love and look for a new one. Low, self-centered involvement, no endurance, and market behavior again. *"You are extremely biased. When I am thinking about my pretty girlfriend, Pity, whom I love with all my heart . . . How dare you!"* I understand your feelings, Spite, and fully believe that you and Pity make a very balanced couple. Moreover, I did not mean to suggest that the behavior I describe is general. Fortunately, it is not. However, this behavior is spreading, which is interesting from the standpoint of social networks. This is the only reason I have included it here, and devoted such a lengthy space to it. Please insert the following standard sentence after what has been written and will be written in these boxes: This is not typical but gives us interesting lessons on social networks. Now, it is time to continue.



Signs for our link hunt. With such a fast merry-go-round of disposable contacts, new methods have to be developed to get the required number of new links. Fashion, smell, forehead bumper stickers about favorite singers, bands, teams, car makes, sports, and about a thousand other things make our teenagers a kind of open inventory for easy contacts as they move around in town.



Net links. In the last two decades entirely new forms of social organization have appeared: net groups, forums, chatboards, web logs (blogs), the list is long. These forms are all highly flexible. They easily establish social networks with each of their characteristics, such as modularity, hierarchy, etc. (Hallinan, 2003; Liben-Nowell, 2005). However, this network changes from day to day, from minute to minute. These groups do not restrict themselves to the virtual world. From time to time, some members want to meet in person. A chat party is then organised. A remark on a blog may be the first step towards a marriage. Everything is possible. Everything is flexible.



A postmodern sync: flash mob. Flash mob is a form of organization using stickers, Internet, or cellular phones to meet and do something unusual for a few minutes. As an example, imagine thirty people coming down on a subway escalator, one after the other, each of them demonstratively reading the same daily newspaper – upside-down. Flash mob collects together a pseudo-group. The participants seldom talk to each other, and very few know each other either before or after. Flash mob very quickly became global (www.flashmob.com), organizing worldwide events. But what is this phenomenon? In fact, it is a new form of synchrony which gives the participants the feeling that they belong somewhere – with the added security that their individuality and freedom will not be damaged. However, it is definitely not forbidden for two flash-mob participants to invite each other for a drink after the show. With joint participation, alienation has already been cast out.



Age relativism. If everything becomes mobile and flexible, the participants should also be mobile and flexible. Youth as a state is mobile and flexible. If you do not want to be petrified, if you do not want to be left out, you have to stay young. We are extremely close to the time when octogenarians will also be engaged in chat parties and flash mobs. Age-related hierarchy is about to be erased.



Gender relativism. Our bets on the gender of a teenager are growing increasingly risky. Same hairstyle, same cloths, same perfume. The situation is no better with older generations. Women should excel in our modern competition for life, while men have to socialize day and night to survive. Gender-based links are becoming less and less well defined.



Information relativism. A century ago, great-grandpas and great-grandmas had the newspaper, or from time to time a letter arrived, and if something really important happened, the village drummer came and announced the news. Information was unique and demanded strong links. Now, information has conquered our kitchen, bedroom and bathroom. The act of accessing information has become relative. Moreover, image flows have erased the differences between dogs and dinosaurs. For a modern kid both are toy figures. The content of information has become relative. Women and men love and die every minute in front of our very eyes. Fake love, fake death. The virtual is set up as real (Pléh, 1998).¹⁴ The validity of information has become relative. We have developed immunity. All our links have been softened.

Although all the above examples extend the number of ways of satisfying our increasing need for new contacts, most of these novel contacts are in fact weak links. Notwithstanding, in almost all these possibilities, there is a chance of making these links stronger. In fact, the illusion may arise that modern network members are masters of link strength adjustment in the sense that they may make the desired link as strong as they want. Let me note that this illusion shows the same low, self-centered involvement, without endurance, and typical of market behavior, as many of the symptoms I mentioned above.

In spite of the extremely flexible range of link strengths, it is rather obvious that the plethora of weak links established by the above inventions cannot be stable without strong links. The desire for strong links and the lack of strong links in most modern, broken families as well as the largely missing strong links of spirituality, induce a number of responses. One such is the appearance of postmodern tribes. These may be disguised as a religious sect, a political movement, or a gang. Alternatively, they may come in the form of an excessive habit. I go bowling every other day with my friends. Not because I like them so much, nor because I love bowling so much, but because my family life is a disaster and I do not want to witness it each night. In these modern tribes, totems and taboos are rather prevalent. A feature of our sect, movement or gang is the totem, and part or whole of the other sect, movement or gang is the taboo. This segregation of modern tribes can seriously undermine the stability of society. However, most of these strong links are in fact only pseudo-strong links. Why are they only

¹⁴The website of a popular chocolate quotes that school children believe that cows are lilac-colored. For them the difference between the real and the chocolate cow has become relative.

pseudo-strong? The reason is as above. Participants often have a low and self-centered involvement here as well. *“Do you really mean to say that a suicide bomber has a low and self-centered involvement?”* Well, Spite, we might actually start to argue over this, since I definitely see here a strongly self-centered behavior, and even the involvement may sometimes be low – I agree, seemingly paradoxically. However, my statement was not primarily about suicide bombers. I was only talking about *some* of the strong links.

Link strength has undergone a rather large-scale relativization in social networks. Link strength relativization in modern industrial districts makes them more competitive (Sabel, 2002). But is link strength relativization good in general? Park and Burgess noted in 1925 that transportation and communication “have multiplied the opportunities of the individual man for contact and for association with his fellows, but they have made these contacts and associations more transitory and less stable.” We all feel the empty space that the erosion of strong links in the past has left behind.



Link relativism. Working conditions underwent a radical change in the 21st century. Many of us (who happen to be reading such a book) work at home or in some other kind of hermitage, and our only connection with the world comes in the form of broadband Internet, a mobile, or a combination of the two. Our food is stuffed into the fridge for weeks. Heating and hot water are taken entirely for granted. In some ultramodern homes, the microchip in the fridge orders the missing items automatically, and they are brought to our ‘incoming fridge’ without further ado. Modern life does not require personal contacts. Requirements and instructions arrive by email, and the result of our work is sent by another email a little later. Neither weak nor strong links are a matter of any relevance today. I am not forced to have a chat with the shopkeeper, because I can afford not go to the shop at all. We may plan both strong and weak links, and we do plan both in our modern life. The enormous liberty allowed by modern technology has significantly contributed to the relativization of link strength in society. Just as a final note, let me add that these thoughts are not restricted to the top (?) 20% of our world. Look around you. In China and India, there is an ongoing air-conditioning revolution. More and more people leave the unbearably hot streets in the summer and run to the enclosed safety of air-conditioned offices or homes. In parallel, they leave the occasional chats and links of the past, and start to live in our modern, air-conditioned isolation.

It is time to collect our luggage. We have just finished our fourth trip into Netland. Opening our luggage (Well, Spite, yours is full of photos of your girlfriend, Pity, I see. Oh! Sorry for my indiscretion!), let me summarize what we have collected here. We have got rich this time. We have found a large number of weak links in ant, bee, baboon, and dolphin communities. Some of these weak links were highly beneficial to stabilize the respective community. Human societies are definitely stabilized by weak links, starting with the role of women, through the intermodular weak contacts first discovered by Mark Granovetter (1973), to some more exotic forms such as the recently developed generations of pseudo-weak links. Diversity of the kind that arises from division of labor facilitates the formation of weak links. However, diversity is helpful only if it is tolerated by the majority. We have learned that both our firms and our kids can only be successful if they make enough weak links, since weak links make our world small and help in the spread of innovations. There were many take-home messages as well. It is our own duty to keep a large number of long-range, weak links in our personal social network, not only because it gives us a chance of being successful and stabilizes our strong links (e.g., our family life), but also because this is one way we can enhance the stability of our country. We also learned that tolerance and support for women's rights movements are not merely altruistic acts, but comprise further important elements to preserve and develop our own stability.

Now take a deep breath, drink a glass of crystal clear water, relax, and most importantly: think. When we started this chapter with bees, ants, and lion grandmothers, would you have thought that they would teach us such an important lesson? Next time, when you go to the zoo, pay them a visit and shake hands with them. (Do not worry, Spite! I only meant a virtual handshake with the lion grandmas.)