Social evaluations and networks: a proposal for integration

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Abstract. In social groups, individuals usually exchange information about their peers' actions, behaviors and attitudes. This exchange of information allows individuals to make more accurate and complete evaluations of other people; on the other hand, knowing facts about potential partners is pivotal to the establishment of new social links. In this work, a bottom-up approach will be applied to model the relationship between social networks and different kinds of social evaluations.

Results coming from Agent-Based social simulations will be reported and discussed in order to shed light on the emergence of complex social phenomena from the interaction among single agents' mental states and behaviours, namely the micro-macro link. More specifically, different types of social evaluations may affect the emergence of innovation and the network configuration of artificial firms working into an industrial cluster.

1 Cognition and the micro-macro link

Agents living in social systems are actually embedded in complex networks of relationships. Social groups can be described as networks with different sizes and configurations in which agents can occupy more or less peripheral positions, depending on the strength and the number of their links. In social groups, individuals usually exchange information about other agents, their actions, behaviours and attitudes, even if they have never met each other before. This exchange of information is essential for two reasons. On one hand, gathering information allows to make more accurate and complete evaluations of other people; on the other hand, knowing facts about potential partners is pivotal to the establishment of new social links and permits to enlarge the social group through the inclusion of far and distant nodes.

In a top-down perspective, social networks are described as complex systems of relationships among several nodes interconnected through diverse links in a variety of ways. This level of description applies to networks already given but does not allow to explain how networks emerge, evolve and change. If we want to understand how networks are created, an alternative approach is needed: following a bottom-up perspective, we claim that social networks are patterns of relationships among the goals of a given set of agents [8]. Heterogeneous agents, endowed with different beliefs, goals and resources are dependent upon each other to accomplish their tasks and achieve their goals. Basically, this means that agent x depends upon agent y, or upon its resources, to achieve its goals. Moving from this simple relationship between two agents it is possible to describe different macro-phenomena, their emergence and evolution.

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In fact, social complex phenomena, such as reputation, norms, and networks, emerge not only from agents' behaviours, but also derive from their cognitive representations and states. Cognition plays a crucial role in combining micro and macro levels: macro-social phenomena may emerge, unintentionally, from micro-elements and their interactions.

Aim of this work is to investigate how image and reputation, two different kinds of social evaluations, may affect the way in which agents are linked, i.e. their networks' configuration. Social evaluations and their transmission, namely gossip, are pervasive in human societies and can actually inform agents' networks of relationships. In order to unfold the connection between social evaluations and networks we need to model agents' minds and to understand why and about whom agents engage in gossip.

In what follows, main theories about evaluations and their transmission will be briefly reviewed with the purpose of highlighting the importance of social evaluations for human societies and of defining the framework of this research. Secondly, a cognitive account of social evaluations will be proposed in order to show how the macro level can emerge from agents' goals and beliefs. Some results coming from simulation experiments with artificial agents will be provided to support the model and to emphasize the importance of cognitive modeling to understand macro phenomena. Finally, future directions of research will be proposed.

1.1 Reputation and gossip: an introduction

The importance of social evaluations has been addressed by a variety of disciplines, with two distinct foci: reputation and gossip.

Reputation plays a fundamental role in social order, adding at the same time cohesiveness to social groups and allowing for distributed social control and sanctioning (plus a number of other functionalities, [6]). People use reputational information to make decisions about possible interactions, to evaluate candidate partners, to understand and predict their behaviours, and so on. The generation, transmission and manipulation of these beliefs contributes to regulate natural societies from the morning of mankind [12]). According to Frith and Frith [15], there are three ways to learn about other people: through direct experience, through observation and through *cultural information*. When the first two modalities are not available, agents turn to cultural information or, in our terms, to social evaluations in order to get some knowledge about potential partners and to predict their behaviours. This kind of information allows people to forecast, at least partially or approximately, what kind of social interaction they can expect and how that relationship could evolve, replacing personal experience in (a) identifying cheaters and isolating them, and in (b) easily finding trustful partners.

Furthermore, in human societies reputation transmission facilitates the formation of groups [19]: gossipers share and transmit relevant social information about group members within the group, at the same time isolating out-group individuals. Besides, reputation contributes to stratification and social control, since it works as a tool for sanctioning deviant behaviours and for promoting, even through learning, those behaviours that are functional with respect to the groups goals and objectives. Reputation is also considered as a means for sustaining and promoting the diffusion of norms and norm conformity [28].

Social evaluations are crucial also in a developmental perspective, as demonstrated by Hamlin, Wynn and Bloom [20]. In their work with preverbal infants (6-, 9-, 10- and 12- month-old), they found that infants' social preferences are influenced by others' behaviors toward unrelated third parties, both in a choice paradigm and in a violation of expectation paradigm: when looking at social interaction events, infants preferred helpers and were independently inclined to avoid hinderers. The authors suggest that this early capacity for evaluations can be a biological adaptation evolved to allow humans to distinguish between cooperators and cheaters and then to engage in cooperative behaviors.

On the other hand, assuming an evolutionary perspective, theories of indirect reciprocity and costly signals show how cooperation in large groups can emerge when agents are endowed with or can build a reputation [22, 18]. As Alexander [1] pointed out, indirect reciprocity involves reputation and status, and results in everyone in the group continually being assessed and reassessed. According to this theory, large scale human cooperation can be explained in terms of conditional helping by individuals who want to uphold a reputation and so be included in future cooperation [23].

Another debated aspect regarding social evaluations is their transmission, i.e. gossip. The content of gossip, i.e. personal information about an absent third party, is quite uncontroversial, whereas the nature of the information, either evaluative or factual, is a matter of debate. Some authors require only the repetition of news about an absent third party to define a conversation as gossip, whereas other scholars consider necessary the presence of evaluative remarks to have a gossip talk. Baumeister, Zhang and Vohs [3] describe gossip as an exchange of useful information people can rely upon to face new situations and to behave properly when direct experience is impossible or too costly to acquire. Wert and Salovey [27] highlight the social character of gossip, and define it as an *evaluative talk* aimed at social comparison. Through gossip people can map the social environment and become conscious of their position whithin it. Rosnow [24] refers to the *secure standards of evidence* of a proposition, i.e. its veracity, to separate gossip from rumors, as also suggested by Noon and Delbridge [21]. The absence of the gossipee is one of the defining features of gossip, but it is also one of the reasons why gossip is condemned as immoral and is considered a malicious and harmful resource cowards use to criticize their peers [26].

Gossip serves many different social functions, both at the individual and at the group level. Gluckman [19] has been one of the pioneers in the study of gossip and scandal and one of the first to stress their positive virtues, among which their ability to maintain the unity, morals and values of social groups. Fine and Rosnow [13] draw attention to three main social functions served by gossip: information, influence and entertainment. Gossip is a valuable source of information about the community, its members, its norms, values and habits, but it is also useful to map the social environment and to make inoffensive comparisons. Regarding influence, this function is potentially prevalent when newcomers join the group or when there are conflicts between members. Foster [14] adds a fourth function: friendship, that refers both to dyadic relationships and to group bonded together by the sharing of norms and values. Other researchers consider gossiping as a means of knowledge: according to Ben-Ze'ev [5], gossip is a pleasurable way to gather information that is otherwise hard to obtain, but it also serves to satisfy the so-called *tribal need*, namely, the need to belong to the group and to be accepted by it.

Finally, one of the most debated issues in the literature about gossip is its being more or less purposeful. Some authors define gossip as idle-talk, giving a preminence to its relaxing and undemanding aspects [5, 26, 11], whereas others contend that gossip has a social purpose and people do not engage in it simply for entertainment, but mainly to achieve their goals [14, 13].

This brief review of main theories about reputation and gossip bear witness to the difficulty of analyzing this kind of complex social phenomena. A possible solution to this problem could be the assumption of a cognitive perspective to understand what happens in the agents' mind, and how cognitive underpinnings affect human behavior. On the other hand, we need to comprehend the emergent character of evaluation spreading and to take into account this complex dynamic: gossiping is a social activity rooted in individuals' beliefs, goals and preferences but it is also an emergent social phenomenon that, in turn, influences people's beliefs, behaviours and relationships.

2 Cognition at the intersection between evaluations and networks

Exchanging social information is a twofolded activity. It is a purposive act leading to specific and intended consequences, but it is also an emergent social phenomenon that has not been previously predicted and purposefully realized. In other words, its consequences can be unintended and functionally maintained, i.e. what emerged is independent of the agents' awareness and decisions, but it constrains their actions and determines their efficacy [7]. Once created and transmitted, social evaluations influence other agents' minds, changing their behaviors and goals. This can happen either intentionally, because the gossipee has the goal of influencing the receiver or even the target agent, or unintentionally, so that gossip effects are unintended but can equally give rise to functional phenomena. In this latter case, gossip has a twofold nature: it emerges from collective behaviours of information spreading but it needs to be represented into individuals' minds in order to work effectively.

Cognition works as a bond between the micro and the macro level, the so-called *micro-macro link* [8]: macro-social phenomena may emerge, unintentionally, from micro-elements and their interactions. In this view, social evaluations and networks derive from apparently autonomous social behaviours whose bases stand in the individual minds and in the relationships people are engaged in. In order to understand how social evaluations may affect social networks, we need to investigate how agents collect information about their peers, how they transform information in beliefs, and which goals drive agents actions, both when they are looking for information and when they pass on that news. Answering these questions is pivotal to the understanding of the relationship between evaluations and networks.

2.1 Modeling the micro-level

When dealing with social evaluations, a preliminary distinction is needed. Following Conte and Paolucci [9], we distinguish between *image* and *reputation*: the former refers to an evaluation regarding another agent's competence, behaviour, attitudes in which the source

is clearly identified, whereas the latter designates an evaluation in which the source is missing. This difference is not inconsequential:

- if image is false, the addressee can punish the evaluator
- if image is false and negative, the target can punish the evaluator

Spreading inaccurate image, also involuntarily, exposes the evaluator to the risk of being reciprocated with false or inaccurate information or, even worse, of being ostracized. On the contrary, reputation is anonymous in itself, it circulates in the social network but its origin is unknown. Therefore, reputation spreading is easier than image transmission, and reputation is also more difficult to modify. Image, even when it is broadly transmitted, remains an evaluation coming from a specific and identified source, whereas reputation becomes an intangible mark floating within the social network. In cognitive terms, an image is a belief about a target coming from an identified source ("According to me, John is a nice guy"), while reputation necessitates a belief about the target, but also the belief that other agents believe that there is a specific evaluation about a given target.

Generally speaking, gossip has a triadic structure in which we can distinguish:

- A *gossiper*: an agent who has the goal to spread information. Informing another agent can be the only purpose of gossip, or it can be instrumental to other goals (influencing the receiver, punishing the gossipee, promoting gossipees image, enhancing groups feelings, ostracise someone, etc), more or less hidden.
- A *topic* or *third party*: an agent whose behaviours, attitudes, choices and emotions are the topic of the communication. The target belongs to the same group of gossiper and receiver and she is judged according to the group's rules and habits. Topic of the gossip talk can be an evaluation about an agent, not necessarily a report on her behaviours.
- A *receiver* (or more than one): one or more agents chosen from the gossiper to be told about the target. Receivers belong to the same social network, sharing the same knowledge and values of gossiper and gossipee. Choosing the receiver is pivotal to achieve gossiper's goals: the receiver can be the actual target of communication or she can serve as a vehicle to reach the intended target.

This triadic structure seems to be common to other forms of discourse, but the fact that the target is always an agent (and not an inanimate object) usually embedded in the same network of gossiper and receiver, is a peculiarity of evaluation transmission.

Relationships among the three roles above are neither symmetrical nor equal. First, there is an asymmetry of power: the gossipee finds herself in a position where she is helpless and vulnerable. The opposite is also true: DeSousa [11] challenges this view and considers gossip as a subversive form of power used by the weak, in this case the gossiper, to protect herself against more conventional powers. Looking at the relationship between the gossiper and the receiver, we find another asymmetry: the former influences the latter, providing the receiver with new knowledge that may change her goals, beliefs and intentions. Generally speaking, gossip is empowering to its participants because gives them access to knowledge

> Like that ill-fabled tree in the Garden of Eden, gossip promises us knowledge of good and evil. Like that same tree, it threatens us with expulsion if we are caught. The more vital the information exchanged through gossip, the more potentially damaging such gossip is both to those who are the topic of the conversation and to those who do the conversing ([2] p. 99).

Circulating social evaluations is a truly social action, namely an action that achieves a social goal. Social goals involve, at some point, another agent or some mental attitudes of that agent (goals, beliefs or emotions) [8]. Informing another agent about a third party is not the only goal gossip allows to achieve; it can imply other goals, such for instance the goal of influencing the other or changing her mind with regard to the gossipee. Distinguishing between the gossiper's goals is not unconsequential and allows to draw some hypotheses, although very preliminary.

There are two main goals the gossiper aims to achieve: influencing other agents or informing them (information can be used also to influence but here we do not care for this second-order motivation). In the former case, evaluation transmission is meant to induce new beliefs or goals, through *cognitive influencing*, that

> consists of providing the addressee with information that is pretended to be relevant for some of her goals, and this is done in order to ensure that the recipient has a new goal ([8] p. 32).

This mechanism is really powerful: an agent can induce another one to perform an action that was neither intended nor planned, simply by making her know that, for instance, the topic has been unfaithful to her. In this way the gossiper acts on the receiver's belief about the gossipee and this could lead the receiver to change her plan. For instance, the receiver can decide to avoid meeting the gossipee because she has a negative evaluation or, also, the receiver can use this information to influence another agent, even the gossipee himself (she can blackmail him in change for money).

While cognitive influencing is targeted (a particular agent is informed in order to achieve a given goal), the goal of informing is more general and can be rephrased as the goal of making information circulate in the network, no matter who the target is. This can be done because information is deemed useful to the group and disseminating it in the widest possible way allows the group to learn in a fast and efficient way, as when talking about the consequences of someone's choice. Knowing what happened to someone who faced a difficult situation can be useful for the listener as a guidance for her behavior or for learning how to avoid committing the same mistake. In this view, the goal of the gossiper is that of making the receiver(s) know how to behave in a certain situation or what consequences can follow, more than simply reporting what happened to another individual. Information spreading can also be pivotal to the strengthening of social bonds among group members. [2]

The final distinction regards the real addressee of the comunication: the receiver or the gossipee. This choice is not trivial and leads to two communication dynamics. In the former case, the gossiper collects, selects, and transmits information about the target with the purpose of reaching the receiver. This path is the most typical and it is "gossip" in the classical sense. When who is told about becomes the actual addressee of gossip talk, the receiver's involvement is only a ploy but the receiver should be a suitable, chatty agent to ensure that she will report to the gossipee, as planned. This "indirect gossip" can be motivated by several reasons. First, the gossiper wants to flatter the gossipee making her aware of her approval or, on the contrary, the gossiper wants to transmit to the gossipee her blame and condemn for her actions. In this latter case, the gossipee may react to what is considered malicious gossip, thus triggering a succession of gossiping with several consequences, both for her and for the gos-

[2] The path going from individual minds to collective phenomena can be followed also in the opposite direction, in which reputation, as a collective and emergent phenomenon, affects agents' cognition, but this issue will not be addressed here.

siper, ranging from ostracism to deep rearrangements of the social network.

2.2 Linking micro elements with macro phenomena

Once described what happens at the lowest level, we can put forward some hypotheses about social evaluations and networks at the macro level. The cognitive model of reputation and gossip can be related to social networks under several respects, but here the focus will be on the difference between networks based on reputation and networks based on image. In fact, the distinction between image and reputation appears to be relevant also in terms of network's structure and enlargement potentiality: image-based networks are based on familiarity and have a low potential for enlargement and innovation. On the other hand, reputation-based networks are wider, flexible and can be innovated more easily.

The difference between image-based and reputation-based networks has been proposed by Conte, Paolucci and Sabater-Mir [10]. They developed a computational system, RepAge, a REPutation and imAGE tool [25], implemented on an agent architecture and tested in an artificial market. In this setting, agents were allowed to exchange image only or image plus reputation. Their results show that social networks based upon image perform more poorly than networks based upon reputation at least when partner selection is a common goal of the network members. This is mainly due to two distinct effects. On the one side, when only image, i.e. evaluation coming from an identified agent, is available, the presence of cheaters triggers a mutual defeat strategy, leading the system to collapse. This happens also with informational error: once agents find out that they received a false information, the informer can not be trusted any more. In the authors' words:

> An image-based social network is expected to be rigid, meaning rather sensitive to errors: if a given threshold of error is overcome, the whole system is probably bound to fall apart, and the network will be fatally affected by distrust.

On the other side, results coming from simulation experiments with Repage show that reputation-based networks are more flexible. Since evaluations are not immediately tested and they can not be attributed to any specific agent, the chain of retaliations is prevented and the network is more error tolerant.

Similar results have been obtained also by Giardini, Di Tosto and Conte [16, 17] with a computational model of industrial clusters. Industrial clusters are usually defined as networks of interactions among heterogeneous and complementary firms embedded into a specific geographic area. In the district, the form of production requires a high degree of cooperation between firms and the lack of formal agreements could lead actors to behave in an opportunistic manner, but the merging between social community and firms [4] helps preventing this result. In industrial districts the interplay between economic dimensions and social relationships is very close, and there is a rich social structure made of informal and personal connections among people working in the cluster. In this context, social evaluations are really important and play a fundamental role in economic exchanges. Actors in the cluster select their partners also relying on evaluations received by other partners and peers, and these evaluations may heavily affect also the economic performance of single firms and of the cluster as a whole. The importance of the social dimension and the possibility of assessing the importance of evaluations in terms of economic performance make the study of industrial clusters especially appropriate to test the cognitive model of reputation and gossip.

In our agent-based model, agents are firms (for a detailed description of the model, see [16, 17]) that can perform two kinds of exchanges: informational exchange and material exchange. Agents have to choose the best available supplier in order to deliver high quality products. When their known suppliers are not available, they can rely on informers, i.e. other agents transmitting evaluations, in order to avoid the costs of direct interaction and to acquire useful information. Two different settings were tested: an image only setting, in which agents transmitted their own evaluations and retaliation against bad informers was allowed, and a reputation setting. In this latter condition, evaluations were not tested immediately and evaluator's identity was undisclosed, so that agents exchanged reputation without the fear of retaliation. Fixed percentages of cheaters, i.e. agents always providing false information, were implemented in both conditions.

Our results show that the quality of production was higher in the cluster with reputational information, compared to the cluster with image, for the same percentages of cheating. In other words, social information gives rise to different network configurations: image-based networks perform better when cheaters are few but quality of production dramatically decreases for higher levels of cheating. Conversely, reputation-based networks are more flexible and resistent when the number of cheaters is high, and the cluster's quality of production is only partially affected. In addition, agents in these networks explore the environment both spreading and using untested evaluations, so that innovation is promoted through the inclusion of new partners and informers.

3 Conclusions and future work

Social evaluations are widespread in human societies and serve many distinct functions: they are a valuable source of information about the community and its members, but they are also essential to map the social environment, to promote membership, and to sanction deviant behaviours in a public way. This list is far from being complete and many other functions can be attributed to this pervasive human activity.

In order to deal with the complexity of social evaluations, we need to understand what happens in the agents' minds, what the causes are of this specific kind of social action, making an attempt to take into account both mental and social aspects of it. Linking the micro and the macro level through cognitive modeling could be proven to be really effective to unfold complex social phenomena and to understand how they emerge from individuals' representations and actions. Gossip and reputation originate in people's minds, spread in the social environment and affect other individuals' minds, in a continuous loop of emergence and immergence.

In this work a preliminary cognitive account of reputation and gossip has been put forward but it needs to be further refined and also to be enriched with testable hypotheses. Once developed a more detailed cognitive model of the actors involved in gossip, two possible directions for future work could be envisioned. The first direction could be to apply Multi-Agent Based (MAS) methodology to investigate through computer-based simulations how gossip generates, how agents use it and with which effects, testing hypotheses about the difference between gossip with a direct addressee, the receiver, and gossip with an indirect addressee. The second direction of research would be more focused on networks' structure and will be devoted to add on the distinction between reputation-based and image-based

networks. A further direction of research could deal with the integration of simulation experiments with experiments with humans in the laboratory, trying to replicate, at least partially, the dynamics of gossip spreading and change, in order to test the cognitive model of reputation and gossip with human participants.

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