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SOCIAL NETWORK ANALYSIS AND POLITICAL PHENOMENA: A CONTRIBUTION TO THE SMALL WORLD THEORY

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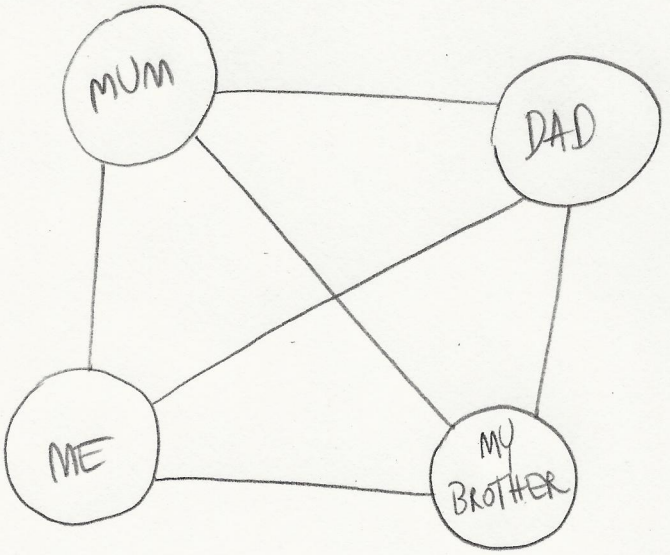
DOTTORATO

... THERE ARE ~~THINGS~~ HAVE TO BE WRITTEN BY HAND
BECAUSE THIS IS DEDICATED TO THE MOST
SPECIAL MODEL I HAVE ~~EVER~~ "MET" IN MY LIFE ...



THIS IS ALSO FOR M. WHO LEFT ME FEW DAYS AGO
ONLY AFTER ~~TAUGHT~~ ME THE BEAUTY AND POWER OF
NATURE. WHATEVER HUMAN BEING CAN DO AND CREATE
IT ALWAYS ~~PEEPS~~ OUR BEST ~~TEACHER~~.

JAN 2014

Francesco Pola

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PRELUDE

This research deals with as fascinating as complicate things. Things that are evanescent and uncatchable in a way. Things that every of us experienced even if never properly caught. This research deals with networks and social networks in particular. The latter are not negligible things but I believe that they represent the more profound social DNA.

Moving from the conviction that the entire amount of social phenomena are intrinsically relational due to the fact they do not arise within social vacuum, this research aims to provide an empirical contribution to the small world theory in terms of political participation considering that an important step for a desirable integration between apparently distinct fields and an occasion for social science to launch a post-disciplinary way of analyzing political phenomena. Despite the small world theory was originated within mathematics in graph theory it was borrowed by a huge amount of academic disciplines like physics, network economy, biology, transport engineering etc. even though with own peculiarities. This was not a case because, despite concerning phenomena are believed to be ontologically different, in depth they are all consisted of

underlying network structures that network approach aims to unveil. At the time of writing literature lacks of a specific and exhaustive network analysis related to political movements or parties because, expect for financial corporations, innovation spreading, illegal networks, scientific partnership, opinion studies and relatives, only a few number of social phenomena have been encapsulated within a specific network frame like small world theoretical framework is. Surprisingly, most of influential scholars on the topic have based their reflection by referring to proper matters of political decision making and surrounding influence in voting decision. Despite a preliminary launch academic trend in studying political influence and network decreased until the last decades. Very little was found in the literature review on the question of whether political participation is determined by underlying social networks or its spreading might be lied on such underlying and invisible structure. This results so surprising if you think that a so massive literature on social network sites and political e-participation has spread since 1990's even though research have usually employed mutually exclusive qualitative or quantitative approaches but not caring about social network structure the web consists of. Unfortunately few research have been addressed to reveal underlying social networks structures in creating and diffusing phenomena themselves like joining a political movement or spreading political information. Talking about small world network structure in terms of political participation does not represent merely a virtuously given research game but leads to a massive number of surprising insights,

questions and implications for what it is concerned not only the rise of new political movements but also their spread and life. It is in fact showed that a small world structure is more likely able to withstand from external attacks resisting more than other network structures and then assuring a corporation to be successful and national economy keeping stable. Basically network is a set of relationships containing objects called nodes and relations called edges. An edge is posed when two nodes come to know and fix a relation regardless of qualitative nature of the relation itself. Sociologically speaking when you analyze networks it does not matter what these relations consist of qualitatively (friendship, co-working, neighborship and so on) but what will be analyzed is the final structure emerging by relations themselves. When you think about social acquaintances it looks like social world of new relations obey to a supernatural law random-based. Even though our life and beliefs can rest dominated by free will our likelihood of being connected with anyone in the world is not so casually done. This is why social relation organization is redundant and follow particular regularities like homophily, namely the tendency to associating with similar individuals in terms of habits, political belief, ethnic origins etc. In fact if anyone in the world know 1000 distinct persons did know mutually who in turn know other distinct 1000 people further not acquaintanced in few steps you can reach anyone in the world. But this is not so because social networks tend to be redundant because two friends of mine have a strong likelihood of being friends themselves and two acquaintances of mine are

probably acquainted too. Small world network structure, despite a huge number of people-nodes apparently far from each other and barely directly connected, shows shortcuts in reaching everyone within such numerous network. This leads to relevant implications in terms of promoting political movement, spreading political belief, information circulation not to mention general cohesiveness of network as will be explained below. Other studies showed how such particular small world property is also of the world wide web and other types of networks I briefly hinted at above. This is the reason why social complexity research compels to investigate social and natural phenomena in the light of a new seemingly unified ontology done by emerging structural properties arising within so apparently different kinds of phenomena. In small world networks there are some relevant nodes detecting the most amount of relations of the entire network: they are individuals who know the most part of people. Lazarsfeld (1968) showed how those ones are opinion leaders able to influence political decisions of their acquaintances posing as brokers and intermediate actors (in network terms defined as *betweeners*) between politicians and citizens. Parallelly they spread fads and viruses too. These special nodes are called *hubs* keeping the most amount of relationships within the network and permitting the life of networks itself. The fact that even the so defined democratic web shows the presence of hubs in what mathematically is called power law distribution (few nodes detecting the most amount of relationships leading to a more likelihood of being reached within the network) forces us to review

the apparently democratic nature of the web. In fact you can produce contents on the web but how many probabilities do you have to reach everyone in the world-web or spreading a new political information if you are not an hub?

However I just limit to illustrate how even a geographically limited local political movement I took in consideration for my research presents a small world structure leading to the need of reconsidering its robustness, spreading and life expectations in the light of underlying network structure.

Referring to methodological protocol I recurred to Facebook network data belonging to all the members of the political movement-case study. Particularly I collected distinct Facebook ego-networks of every single member representing the totality of "friends" every member has on own Facebook platform. This use is justified by the fact that every member claimed already knowing people added in own Facebook networks in line with previous researches: in this sense they can be considered a faithful representation of real networks regardless of their qualitative features. What it is investigated is in fact final rising network structure. After collecting all single ego-networks of every single member distinctly I proceeded to sew together those ones in order to get a complete visualization not only of relationships between the members themselves but also between all people every member knows alone and share with the other ones. Roughly speaking imagine your personal network of people overlapped with one of another person (i.e. a friend, a co-worker). Common acquaintances are not replicated but the not

shared ones are further visible too. In this way you can visualize an exhaustive relational map of people-nodes within the political movement itself and external-not members nodes every member knows in turn and then that can potentially can determine political adherence processes according to cascade models. Obviously the willingness of joining a political movement cannot be deterministically considered only in the light of own contagious reciprocal acquaintances but certainly it can be affirmed that our personal network plays a determinant role in justifying political beliefs and belongings allowing a political movement to become successful or well known or to promote movement and preserving its life too. Interestingly as long as gluing process adds ego-network at the same manner of real entry order of members within the political movement (i.e. a funding member who invites another friend or acquaintance to join movement who in turn invites another one etc.) original hubs tend to enrich their relational power augmenting own degree value (degree is a mathematical value standing for indicating how many connections a node detect within a network) whilst people who are not hubs cannot became hubs despite a strong effort in terms of movement promotion and adding relations throughout movement expansion. This is the well known Matthew Effect Merton (1968) referred to for scientific knowledge and Pareto rich get richer effect. Hubs are determinant in keeping a network (in this case a political network) because it is like they sew together all members within assuring cohesiveness. If a node decide to abandon political network it is no matter because does not affect

general equilibrium; at the contrary if a hub-node cut off is likely to collapse portion of network and consequently the entire political movement. Such phenomena should arise questions for what it is concerned the real value of participation within political movements. The fact that also a political movement presents a small world structure in its underlying network is relevant in terms of scientific knowledge itself: in fact as mentioned above it seems that a common underling network structure is emerging in a massive number of fields from economics to physics not to mention cognitivism, and consequently inviting to a deep ontological reflection too.

This research is divided in five distinct chapters.

The first one briefly illustrates the well debated classic sociological dichotomies ranging from micro-approaches to macro-approaches and discusses ontological and epistemological matters underlying scientific method and theory of knowledge in social sciences.

The second chapter consists of a relatively broad dissertation on the possibility to consider the network approach as a potential third way sitting between micro and macro in the light of a supposed meso dimension network-based.

The third chapter reviews literature on networks specifically referring to the small world theory and its pioneering empirical contributions. In depth it sheds light on the capacity

of small world network to sew and mix together order and disorder within reality and consequently admitting a third meso-dimension.

The fourth chapter illustrates the methodological protocol used for analyzing network data related to the political movement I took in consideration as case-study. Finally the last chapter discusses empirical findings.

As was already evident in the first page this research is dedicated to my family. Our network can resist to whatever targeting attack.

I want to thank you many people here and I try to do that providing them a due honor.

Firstly Prof. Fabio Massimo Lo Verde for supervising me and suggesting me the most fascinating ways to pursue thorough this hard doctoral time. I have ever met networks in my life if Prof. Alberto Trobia did not teach me what networks are, so he is guilty of having made me network-addicted. Marilena Macaluso for supervising me in my first PhD year introducing me to the political topics. Thanks to Maria Carmela La Greca for being survived to the PhD time with me.

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I want to thank you Dr. Toni De Bromhead from Goldsmiths University of London who experienced with me the political campaign my case study refers to.

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Everyone of you is a node added in my personal network. A network always growing but always unforgettable.

14th Jan 2014

Once upon a time there was a cave and some men

Before starting my dissertation here I would like to draw your attention to a myth. The reader probably is wondering why I should recall such a tool for the introduction to my work but as the classics have taught us no good history was told without referring to an explanatory allegory. From ancient times metaphorical histories have been used in popular culture to transfer knowledge. The whole cultural universe of ancient *societies*[1] were invested with oral and mythological stories in order to perpetuate and construct shared values and a symbolic universe of social meanings. This is my plan for the preface of my doctoral thesis since such a myth can fix in the mind an *order in reality* the nature of which will be debated in the following chapters of such a contribution. Modern science itself is based on the supposition that an underlying *order of things* in physical reality can be revealed only through the prior assumption that "Nature"

[1] The term *society* is not properly used in this case because it refers to concepts and realities which arose only in the modern age. A more suitable term can be *community* but I have chosen the first to highlight a more structured and germinal seed already present several centuries earlier as Aristotle stated in his famous ζῷον πολιτικόν. A full tractation of the point is in Tönnies (1887).

constitutes an intelligible order. In fact, what is science but a temptation to seek an order in the seemingly chaotic flow and essence of reality?

It follows the myth I was referring above.

> And now, I said, let me show in a figure how far our nature is enlightened or unenlightened:—Behold! human beings living in a underground den, which has a mouth open towards the light and reaching all along the den; here they have been from their childhood, and have their legs and necks chained so that they cannot move, and can only see before them, being prevented by the chains from turning round their heads. Above and behind them a fire is blazing at a distance, and between the fire and the prisoners there is a raised way; and you will see, if you look, a low wall built along the way, like the screen which marionette players have in front of them, over which they show the puppets.
>
> I see.
>
> And do you see, I said, men passing along the wall carrying all sorts of vessels, and statues and figures of animals made of wood and stone and various materials, which appear over the wall? Some of them are talking, others silent.
>
> You have shown me a strange image, and they are strange prisoners.
>
> Like ourselves, I replied; and they see only their own shadows, or the shadows of one another, which the fire throws on the opposite wall of the cave?
>
> True, he said; how could they see anything but the shadows if they were never allowed to move their heads?
>
> And of the objects which are being carried in like manner they would only see the shadows?
>
> Yes, he said.
>
> And if they were able to converse with one another, would they not suppose that they were naming what was actually before them?

Very true.

And suppose further that the prison had an echo which came from the other side, would they not be sure to fancy when one of the passers-by spoke that the voice which they heard came from the passing shadow?

No question, he replied.

To them, I said, the truth would be literally nothing but the shadows of the images.

That is certain.

And now look again, and see what will naturally follow if the prisoners are released and disabused of their error. At first, when any of them is liberated and compelled suddenly to stand up and turn his neck round and walk and look towards the light, he will suffer sharp pains; the glare will distress him, and he will be unable to see the realities of which in his former state he had seen the shadows; and then conceive some one saying to him, that what he saw before was an illusion, but that now, when he is approaching nearer to being and his eye is turned towards more real existence, he has a clearer vision,—what will be his reply? And you may further imagine that his instructor is pointing to the objects as they pass and requiring him to name them,—will he not be perplexed? Will he not fancy that the shadows which he formerly saw are truer than the objects which are now shown to him?

Far truer.

And if he is compelled to look straight at the light, will he not have a pain in his eyes which will make him turn away to take refuge in the objects of vision which he can see, and which he will conceive to be in reality clearer than the things which are now being shown to him?

True, he said.

And suppose once more, that he is reluctantly dragged up a steep and rugged ascent, and held fast until he is forced into the presence of the sun himself, is he not likely to be pained and irritated? When he approaches the light his eyes will be dazzled, and he will not be able to see anything at all of what are now called realities.

Not all in a moment, he said.

He will require to grow accustomed to the sight of the upper world. And first he will see the shadows best, next the reflections of men and other objects in the water, and then the objects themselves; then he will gaze upon the light of the moon and the stars and the spangled heaven; and he will see the sky and the stars by night better than the sun or the light of the sun by day?

Certainly.

Last of all he will be able to see the sun, and not mere reflections of him in the water, but he will see him in his own proper place, and not in another; and he will contemplate him as he is.

Certainly.

He will then proceed to argue that this is he who gives the season and the years, and is the guardian of all that is in the visible world, and in a certain way the cause of all things which he and his fellows have been accustomed to behold?

Clearly, he said, he would first see the sun and then reason about him.

And when he remembered his old habitation, and the wisdom of the den and his fellow-prisoners, do you not suppose that he would felicitate himself on the change, and pity them?

Certainly, he would.

And if they were in the habit of conferring honours among themselves on those who were quickest to observe the passing shadows and to remark which of them went before, and which followed after, and which were together; and who were therefore best able to draw conclusions as to the future, do you think that he would care for such honours and glories, or envy the possessors of them? Would he not say with Homer,

'Better to be the poor servant of a poor master,'

and to endure anything, rather than think as they do and live after their manner?

Yes, he said, I think that he would rather suffer anything than entertain these false notions and live in this miserable manner.

Imagine once more, I said, such an one coming suddenly out of the sun to be replaced in his old situation; would he not be certain to have his eyes full of darkness?

To be sure, he said.

And if there were a contest, and he had to compete in measuring the shadows with the prisoners who had never moved out of the den, while his sight was still weak, and before his eyes had become steady (and the time which would be needed to acquire this new habit of sight might be very considerable), would he not be ridiculous? Men would say of him that up he went and down he came without his eyes; and that it was better not even to think of ascending; and if any one tried to loose another and lead him up to the light, let them only catch the offender, and they would put him to death.

No question, he said.

This entire allegory, I said, you may now append, dear Glaucon, to the previous argument; the prison-house is the world of sight, the light of the fire is the sun, and you will not misapprehend me if you interpret the journey upwards to be the ascent of the soul into the intellectual world according to my poor belief, which, at your desire, I have expressed—whether rightly or wrongly God knows. But, whether true or false, my opinion is that in the world of knowledge the idea of good appears last of all, and is seen only with an effort; and, when seen, is also inferred to be the universal author of all things beautiful and right, parent of light and of the lord of light in this visible world, and the immediate source of reason and truth in the intellectual; and that this is the power upon which he who would act rationally either in public or private life must have his eye fixed.

I agree, he said, as far as I am able to understand you.

Moreover, I said, you must not wonder that those who attain to this beatific vision are unwilling to descend to human affairs; for their souls are ever hastening into the upper world where they desire to dwell; which desire of theirs is very natural, if our allegory may be trusted.

Yes, very natural.

Figure 1. A pictured image of the allegory of the cave. Prisoners are forced to live in the fake conviction of what they can see is the real thing while only the wisdom man (philosopher) can unchain and discover the reality itself out of the obscurity of the cave.

And is there anything surprising in one who passes from divine contemplations to the evil state of man, misbehaving himself in a ridiculous manner; if, while his eyes are blinking and before he has become accustomed to the surrounding darkness, he is compelled to fight in courts of law, or in other places, about the images or the shadows of images of justice, and is endeavouring to meet the conceptions of those who have never yet seen absolute justice?

Anything but surprising, he replied.

Any one who has common sense will remember that the bewilderments of the eyes are of two kinds, and arise from two causes, either from coming out of the light or from going into the light, which is true of the mind's eye, quite as much as of the bodily eye; and he who remembers this when he sees any one whose vision is perplexed and weak, will not be too ready to laugh; he will first ask whether that soul of man has come out of the brighter life, and is unable to see because unaccustomed to the dark, or having turned from darkness to the day is dazzled by excess of light. And he will count the one happy in his condition and state of being, and he will pity the other; or, if he have a mind to laugh at the soul which comes from below into the light, there will be more reason in this than in the laugh which greets him who returns from above out of the light into the den.

That, he said, is a very just distinction. (Plato, *Republic*, 4th century B.C.)

The allegory of the cave entirely reported above is a classic of Western gnosiology well debated in centuries of theory of knowledge. Despite a fideist design human condition is a continuous research of *truth* through science and experience and in referring to that if a supposed *order of nature* is not assumed the only way you can admit is narrativity with its unexplainable ontological and epistemological grassroots of assumptions. If the reader considers a myth as an off-topic I recommend to keep it in mind in case of emerging controversial issues. This is in fact an invitation to free the discourse at least partially from chains of our personal histories (academic, professional and so on) and for reconsidering every pathway to knowledge critically especially in the light of our human condition of eternal prisoners sometimes unaware of it. I suggest to retain it carefully as a necessary *vademecum* for all knowledge workers can be defined as such and worthy of it.

CHAPTER ONE

From past to present: is a new paradigm needed for (social)[2] sciences?

The scientist who embraces a new paradigm is like the man wearing inverting lens.
Confronting the same constellation of objects as before and
knowing that he does so, he nevertheless found them transformed.

Thomas S. Kuhn

It was a very long time since I attended classes of Sociology as freshman. At that time my approach to sociology was typically text-book oriented and I totally ignored what the essence of it was. I can surely affirm I understood better the *social physics*[3] only after reading and learning major classics of discipline without exception. It is not a case of if the well known way of saying *if I have seen further it is by standing on the shoulders of giants* which was used by Newton in reference to his predecessor Galileo.

[2] I set off within parentheses the adjective *social* because at the moment network approach occupy a common *humus* shared by the whole amount of sciences also the natural ones as I will focus in next sections.

[3] The term was officially coined by Comte in 1838. It is worthy of a more detailed discussion for its power in defining a universal method for all sciences and in particular those social ones. The argumentation of it will be delivered in the next pages in the section reserved to the matter of sociological paradigm.

Just to paraphrase Antiseri (2001) research is a process whose father is previously deposited knowledge and whose mother is necessity. I clearly remember how my Professor started his lecture off with an impressive statement by declaring human beings cannot escape from their relational nature and at those times I found such definition tautological and merely obvious. At the time of writing up I recognized the value of those words recalled in my mind the ineluctable condition of sociality and alterity as element whom society is consist of. An entire discipline lies on a simple concept like that but the controversial point is whether *relation* can be really *measured* or *interpreted* or something more to be discovered. I will release such point in the next sections.

1. Disclosing relations: the dilemmas of classic sociologists

This section will be dedicated to an introductory and preliminary *excursus* on the main dichotomies affecting sociological debate in terms of theoretical and methodological approaches. What I will list here cannot be considered exhaustive at all because a successful academic review on the topic should require a massive amount of contributions that are beyond the scope of the thesis. For this reason I just limit the scope of my work to the more well-debated positions functionally addressed at a more detailed examination of the network framework.

1.1 Out of the scene: a question of compelling *order*

Sociology as a field of study originated in Europe in the 19th century following the tumultuous transformations from the *ancient régime* to the modern State and considering the impact of the French Revolution and the Industrial Revolution on European scholars and academics created the need to investigate the coeval world in a completely new way. This was not so obvious because economics, psychology, anthropology and the other social sciences were already on the way in affirming their academic autonomy as disciplines able to analyze what it is related to Man in a scientific way. But social formations confronting of scholars in the second half of the 19th century no longer consisted of small scale communities (*Gemeinschaft*) characterized by what Durkheim (1893) defined as *mechanical solidarity*. The urgency for a new discipline aimed at investigating the expanding volume and complex dynamics of modern societies was imminent. It took two centuries from the foundation of Modern Science and consequently the scientific method to justify the foundation of a new science called *sociology* distinct from the natural sciences. As I mention below in a footnote the term was officially coined by Comte referring to the noblest of the social sciences as the only one can really *explain*[4] complex dynamics of the modern world as anthropology, economics nor psychology alone are sufficient to pursue on that aim. In

[4] The reader will understand why I use this term.

such guise *sociology* represents the natural development of knowledge in Comte's thought as he named it the *social physics*[5] to underscore its scientific essence and disclaim the proximity to the free speculation of metaphysics. It should be emphasized that Positivism relies on an optimistic and universal trust in knowledge and science whose method represents the only way to an understanding of *reality* itself; observation and experiment allow the mysterious laws of nature to be revealed namely by the presumed existence of an underlying order in physical reality. This was not so novel for astronomy, mathematics, chemistry or physics whose bases the scientific method was rooted in. Such trusting and naïve statement could lead to a consequent consideration posed on the previous assumption that reality is an ontologically fixed entity regulated by an order of universal laws. A Mechanical belief ruled out any possibility of discussing and debating the grassroots nature of reality itself unless in terms of *explainable* cause and effect processes. As stated in Whitehead's own words (1926) there can be no living science unless there is a widespread instinctive conviction in the existence of an underlying *Order of Things*, and, in particular, of an *Order of Nature.* Positivism denies any concurring or mutual influence between the observing analyst and the known object just like the things Plato's hyperuranion consists of in opposition with a dynamic and continuously changing reality summarized by Heraclitus' πάντα ῥεῖ. The

[5] This term is useful for understanding paradigm related matters.

founding fathers of sociology located academic debate on such ontological and epistemological axioms. This was the case of Durkheim in his *Les règles de la méthode sociologique* (1895) universally recognized as a masterpiece of sociological classics surely worthy of being mentioned and articulated here. In discussing the ontological nature of society he states:

> la dureté du bronze n'est ni ans le cuivre ni dans l'étain ni dans le plomb qui ont servi à le former et qui sont des corps mous ou flexible; elle est dans leur mélange. La fluidité de l'eau, ses propriétés alimentaires et autres ne sont pas dans les deux gaz elle est compose, mais dans la substance complexe qu'ils forment par leur association. Appliquons ce principe à la sociologie […] il faut bien admettre que ces faits spécifiques résident dans la société même qui le produit, et non dans ses parties, c'est-à-dire dans ses membres. Ils sont donc, en ce sens, extérieurs aux consciences individuelles considérées comme telles, de même que les caractères distinctif de la vie sont extérieurs aux substances minerals qui composent l'être vivant (*ibidem*).

Despite a finalistic vision Durkheim theorized the existence of *les faits sociaux* he defined

> as des manièrs de faire ou de penser, reconnaissables à cette particularité qu'elles sont susceptibles d'exercer sur les consciences particulières une influence coercitive (*ibidem*).

Hence, society and its "output" exist anyway and regardless any human free will. In his well known maxim Durkheim states *il faut traiter les fait sociaux commes des choises (ibidem)* that means admitting there is not reason to advocate a new analytic method but

the scientific one for the analysis of society too. *Les faits sociaux* representing objects to be known by the newborn sociology work exactly like chemical reactions of atoms generating molecules in which the latter ones are substances raised only after interrelating preliminary existing elements the final output consists of. Just like chemical reactors social actors are compelled to act within coercive frames without any possibility of escaping from them. In this sense the prominence of *structure* on *agency* is can be said evident. This delicate process of observations/causalities from structure to agency (and viceversa if you consider the other approach I will illustrate in the next sections) is the most controversial of all sociology itself. In fact, that which makes the matter really difficult and unsolvable is that society is not formed by a mere sum of agencies such that the ontological result is something more distinct from its single originary elements it consists of. It is not so clear what kind of processes are being enacted *in the middle* of mutually influencing relations of structure and agency. This latter key point is at the core of sociology itself and probably the Gordian knot of the whole contemporary science as I am going to illustrate in the sections dedicated to the network approach as well. It is not my main aim here to offer a complete dissertation on that; anyway I refer to the literature for briefly illustrating these important and fundamental issues (Campelli 1991; Antiseri 1996; Cannavò 1989 e.g.). In respect to the previously listed assumptions a further articulation is needed. Firstly, from one hand it should be highlighted a deterministic vision approaching reality by emphasizing the

role of such superstructural order on human behaviour whose efficacy is avoided in favour of a superiority of institutions on agency. So the only method can be admitted in this case is the scientific one to make successful any temptation of revealing social reality. Sociology borrowed the scientific method from the natural sciences considering social facts in the same way as matters to be analyzed in mechanistic terms just like physical elements. It was not a case of Comte defining sociology as the *social physics* paying an honourable methodological tribute to the highest in the hierarchic scale of sciences. All these previously mentioned conjectures lead to the advent of a well defined structure-oriented paradigm whom the entire *quantitative* approach develop. In the next section I will point out the main questioned critics advanced to the latter one.

1.2. Into the scene: a question of individual construction

Between the end of the 19th century and the first decades of the 20th one the optimistic Positivist trust in science with its recognised unfailable methods diminished their impact on sociological knowledge. That was not a peculiar case as will be clear, anyway it is debated whether a more specific theoretical-methodological reflection on human sciences was needed. The question is related not only to the object of sociology itself but to the entire theory of knowledge too. Very curious discoveries in physics compelled many to renovate paradigm in favour of a more relativistic vision on reality

because Positivism was no longer considered a sufficient or adequate approach undertaking research in sociology. It was the case of Einstein theory of relativity and Heisenberg uncertainty principle I will briefly hint on below. A certain scientific maturity leaded to the advent of a fruitful discussion on scientific method and ontological reality because of a completely demise of certitude in assuming the fixity and immutability of reality. Expectations of a supposed ontologically given reality to be discovered by Man were totally deluded and misled as soon as even physical reality showed its troubling essence. While Cartesian dualism established a determined separation between a conscious being (mind) and its object of knowledge (matter) enacted by observing empirically reality that inspiring all modern science and knowledge this was no longer acceptable after a Heisenberg principle theorization. At the same time as a scientist observes the position of an electron it immediately changes its motion with the differentiation of energy between it and the energy of photon that «lights» the electron. To say à la Popper (1934) the idol of a dogmatic *epistème* revealed it precarious bases. The observed object and the observing subject are strictly linked together and participate in creating reality itself. It is evident how science and knowledge do not exist in a vacuum and they interact to create and change reality even when observing it. Only in our subjective experiences of conviction, in our subjective faith, can we be 'absolutely certain' (*ibidem*) as Dilthey (1989) anticipated few years before recurring to the concept of *erlebnis* (experienced life) as the only tool for

knowledge. So what further possibility for an uprooted and profoundly challenged gnosiology? The matter increases in complexity when it concerns human and social sciences those ones where agents are socially interrelated to one other (in the same matter as natural elements are related) and whose behavioural rationality can be admitted in a certain way. Interactions in creating reality, mind and matter cannot be analyzed according to the lens of the mechanist thesis and the question has to be debated tending to a less deterministic vision of the universal laws on reality. In these terms of social constructionism can be seen as a form of anthropocentric humanism deeply homo-oriented. Multiple and perpetually changeable (social) realities, then, exist depending on the different (personal) perspective you adopt. That is the core of *qualitative* approach in sociology assuming that the only way scientist can pursue is understanding social actor behaviour within *micro* levels of analysis. Failing any attempt of *explaining* an originally presumed immanent reality a fruitfully revolutionary wave lead to the advent of a new paradigm of *interpretation* based research. The sociologist Weber is universally recognized as the founder of such approach that be concisely expressed by the German term *verstehen* namely *comprehending* of the meaning of action from the (social) actor's point of view in its *constructed universe of meaning* (Weber 1978). It can be understood that the latter one should be intended as a shared relation-generated world in line with the grassroots assumptions of constructionism. Weber’s agency-oriented thought alongside its related methodological

individualism is evident in his writings being structure the final step of sociological knowledge you can reach only through a inductive method interpretation based.

> Sociology [...] is a science concerning itself with the interpretive understanding of social action and thereby with a causal explanation of its course and consequences. (Weber 1978).

Referring to the basic concept of social action the sociologist points out

> We shall speak of "action" insofar as the acting individual attaches a subjective meaning to his behaviour-be that overt or covert, omission or acquiescence. Action is "social" insofar as its subjective meaning takes account of the behaviour of others and is thereby oriented in its course (*ibidem*).

Someone could criticize an hopelessly attempt to reach sociological knowledge by recurring to interpretation instead of explanation but a scholar who reads Weber carefully can suddenly note how such latter point should be revised and worthy of attention. Despite that it might seem he denies mechanical processes in building and delivering sociological knowledge therefore a more detailed exploration is due here. In fact Weber does not refute causality itself but, by expanding its meaning within individual behavioural frameworks of agencies he reaches an overall accomplishment of social meaning. In revenging the role of individual experienced facts Weber states

> The fact of experience were known before the generalization, which was formulated afterwards: but without this successful interpretation our need for causal understanding would be evidently be left unsatisfied (*ibidem*).

For positivistic term *correctness* he substitutes it for the word *adequacy* aimed to justifying his methodological individualism. That is why to be defined social facts should be endowed with *subjective adequacy* whose definition is

> The interpretation of a coherent course of conduct is "subjectively adequate" (or "adequate on the level of meaning"), insofar as, according to our habitual modes of thought and feeling, its component parts taken in their mutual relation are recognized to constitute a "typical" complex of meaning (*ibidem*).

Following a first evident critic to merely use of statistics as the only way to "truth" Weber encapsulates his reasonable position within a framed convergence of methods.

> A correct causal interpretation of a concrete course of action is arrived when the overt action and the motives have both been correctly apprehended and at the same time their relation has become meaningfully comprehensible. [...] If adequacy in respect to meaning is lacking, then no matter how high the degree of uniformity and how precisely its probability can be numerically determined, it is still an incomprehensible statistical probability, whether we deal with overt or subjective processes. On the other hand even the most perfect adequacy on the level of meaning has causal significance from a sociological point of view only insofar as there is some kind of proof for the existence of a probability that action in fact normally takes the course which has been held to be meaningful. For this there must be some degree of determinable frequency of approximation to an average or a pure type. Statistical uniformities constitute understandable types of action, and thus constitute sociological generalizations, only when they can be regarded as manifestations of the understandable subjective meaning of a course of social action (*ibidem*).

In his deconstructionist attempt to reveal the fallacy of deterministically given positivistic method Weber accomplished a groundbreaking act recurring to the same recalling of chemistry in supporting thesis as Durkheim did decades before but in a different way.

> For other cognitive purposes it may be useful o necessary to consider the individual, for instance, as a collection of cells, as a complex of bio-chemical reactions, or to conceive his physic life as made up of a variety of different elements, however these may be defined. Undoubtedly such procedures yield valuable knowledge of causal relationships. But the behaviour of these elements, as expressed in such uniformities, is not subjectively understandable. This is true even of psychic elements because the more precisely they are formulated from a point of view of natural sciences, the less they are accessible to subjective understanding. This is never the road to interpretation in terms of subjective meaning. On the contrary, both for sociology in the present sense, ad for history, the object of cognition is the subjective meaning-complex of action (*ibidem*).

Opposite but not really mutual exclusive statements are evident in the following dissertations

> Et comme cette synthèses a lieu en dehors de chacun de nous (puisqu'il y entre une pluralité de consciences), elle a nécessairment pour effect de fixer, d'instituer hors de nous de certaines faòos d'agir e de certains jugements qui ne dèpendent de pas de chaque volonté particulière prise à part. [...]. Il y a une mot qui [...] exprime assez bien cette manière d'être très spécial: c'est celui d'institution. On peut en effect […] appeler *institution* toutes le croyances et tous les modes de conduit institués par la collectivité; la sociologie peut alors être définie: la science des institutions, de leur genèse et de leur fonctionemment. (Durkheim 1893).

At the contrary in reference to social formations like the State, Foundations, corporations Weber insists that

> for the interpretation of action in sociological work these collectivities must be treated as *solely* the resultants and modes of organization of the particular acts of individual persons, since these alone can be treated as agents in a course of subjectively understandable action (Weber 1978)

Resulting of such briefly illustrated dichotomy in sociology it is not a simple case of erudition but yields a further taxonomy of approaches usually defined *quantitative* and *qualitative* respectively. Deeply such classification is not sufficient because attempts of providing a definitive standardization in techniques have been done in various way unsuccessfully. In fact there is not an only criterion to group those ones. Another aspect should be recalled and namely the fact that an entire universe of academic waves and traditions have been completely developed and rooted criticizing the one or the other approach showing their controversial assumptions. I just hint to the most common debated issues here in order to functionally introduce the core of such writing.

1.3. Sociology: an history of struggling statements

There is no history with no groundbreaking events and there is no possibility of telling stories without any accidental facts. Critical thought is the founding element of research itself as Popper states (1934) because is the only plausible way able to reveal errors

permitting to discover better formulated and further explaining theories. In such sense sociological debate may be classified on the basis of ontological, epistemological, methodological issues and, consequently social theories and largely paradigms into *macro* and *micro* approaches. It can be surely affirmed that this is a common history for the whole universe of science not strictly related to social science. In fact both of them refer to a compromise in every case; metaphorically you cannot choose to recur to induction and deduction processes at the same time but you cannot exclude the possibility of a fruitful looping analysis. And this makes sense also in relation to the object of knowledge because you cannot observe hydrogen and oxygen atoms and sea simultaneously. I will illustrate this point below only after a brief dissertation on the main sociological paradigms and theories. Only a succinct even though incomplete list of sociological academic traditions makes us to better comprehend network approach that is the core of such contribution.

1.3.1. Macro approaches: the myth of an universal social theory

For a very long time sociology has been subject to the strong influence of physics considered an indiscussed universe of perfectness and ordering knowledge worthy to be emulated for its rationality. Parallelly the main aim of the discipline in those decades have been investigating social structures formation in order to build a overwhelming

social theory just like mechanical laws in physics. This was a defined goal for early sociologists until the middle decades of the 20th century and in such sense it is not a case as we explained above. The question arises in complexity especially because explaining society is not only a question of disclosing its internal peculiarities and mechanic relations but becomes more complicated because of an inextricably problematic nature of dynamically inner social changes. The development of history itself represents in this way a key challenge for early sociologists who have been working on the theorization of a (macro) social theory able to explain either society in its presumed fixed order of self-accomplishment justifying either its dynamical essence of change. As a result scholars had to deal with inextricable theoretical dilemmas whose base lies on secular philosophical speculations surrounding reality itself; from already quoted Protagoras to Heraclitus just to mention classical philosophies not to say Bergson[6], Russell[7] and Husserl[8]). Roughly it is like trying to catch something *in divenire* namely in its *phase transition*[9] attempting to reveal the forces that create change itself and originary elements too. So how to reconcile and overcome such problematically secular ontological dilemma especially in terms of obscured forces affecting social change? A

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[6] See Bergson H. (2002) *Saggio sui dati immediati della coscienza* [1889] Cortina Raffaello, Milano.

[7] See Russell B. (1945) *A History of Western Philosophy*. Simon & Schuster/Touchstone: New York.
[8] See Husserl E. (2005) *La filosofia come scienza rigorosa* [1910] Laterza, Roma.
[9] I recommend the reader to mind this particular expression because I will use it in a following liminal chapter dedicated to the theoretical approach and empirical results.

preliminary answer to such question was provided by Marx economic theory whose contribution insists on the role of domain and power relations underlying social structures for explaining society. Conflict is the key word for defining social change being class struggle the only responsible agent able to assure the regeneration of new institutions substituting for the previously existing ones. In this way conflict is the grassroots essence of social change itself and its causes are strongly economy based even though not strictly mutually exclusive in respect to superstructures like religion, education and so on, whom entire society produce. Definitely conflict is the common element shared by all social structures whose existence itself can be possible only by virtue of it. Substantially in Marx view there can not be existing society in absence of an inner conflict that means admitting the existence of a perpetual struggle between antagonistic economic forces performed in its theory by proletarians and capitalists. Marxian approach to sociological theory is typically a *macro* prospective on society so that it aims to explain social change and reality in terms of economic power relations strongly embedded in the entire amount of social structures. It is evident how economic forces represent the underlying structure of society being not only consisted of but also whom superstructural components overlap. In such sense, just at the same manner of Durkheim *social facts*, structure lies outside agents enacting its deterministic and ineluctable power on them with any possibility of escaping from its coercion. That is why structure persists regardless agencies just because lies on economic bases

comfortably. A clear linkage to power and domain as fundamental constituents of society and knowledge too will be clear in ensuing academic scholars and authors will be briefly treated below. Alongside early sociologists it was Parsons who provided an holistic theoretical framework in the middle of 20th century. Its well known *theory of action* is based on the concept of *social system* he defined as something

> consists in a plurality of individual actors interacting with each other in a situation which has at least a physical or environmental aspect, actors who are motivated in terms of a tendency to the "optimization of gratification" and whose relation to their situations, including each other, is defined and mediated in terms of a system of culturally structured and shared symbols (Parsons 1951).

Such *voluntarism* Parsons referred to alongside the reference to a shared universe of meaningful symbols lead us to a new valuation of agent within structure. Firstly it was highlighted how such "optimization of gratification" represents a first step for attempting to integrate coherently the role of individuality within structural frame. In this way Parsons by endeavouring to encapsulate apparently individual agents within an all-encompassing framework comes to formulate a coherent schema based on four main system levels strongly interrelated and embedded one each other. In such sense

> Thus conceived, a social system is only one of three aspects of the structuring of a completely concrete system of social action. The other two are the personality systems of the individual actors and the cultural system which is built into their action. Each of the three must be considered to be an independent focus of the organization of the elements of the action system in the sense that no one of them is theoretically reducible to terms of one or a combination of the other two *(ibidem)*.

A fourth system individuated is biological organism. The mechanism of mutual interactions among systems is assured by socialization as indispensable process able to maintain the stability of that trough a continuously interactive action in which the goals of actors are the same goals of system itself in a functionally oriented way. So acting pushed by maximization and motivation agents act keeping the system ordered and stable.

> Since a social system is a system of processes of interaction between actors, it is the structure of the relations between the actors as involved in the interactive process which is essentially the structure of the social system. The system is a network of such relationships. […] Hence it is the participation of an actor in a patterned interactive relationship which is for many purposes the most significant unit of the social system This participation in turn has two principal aspects. On the one hand there is the positional aspect—that of where the actor in question is "located" in the social system relative to other actors. This is what we will call his status, which is his place in the relationship system considered as a structure, that is a patterned system of parts. On the other hand there is the processual aspect, that of what the actor does in his relations with others seen in the context of its functional significance for the social system. It is this which we shall call his role *(ibidem).*

Related to that it should be mentioned another important aspect will be useful in the treatise of following topic. Despite Parsons showed a preliminary interesting in partial micro elements of interaction he did not assume that as fundamental analysis unit. He preferred the combination of concepts like status and role that anyway are not referred to individually taken social agents and neither can be peculiar of interaction itself but it is a structural component of social system (Ritzer 2010). Such brief section illustrates

how difficult is considering a coherent theoretical system able to join micro and macro approaches together excluding any compromise. Despite any ambitious temptation to do that this is only for introducing network framework as a possible third way on sociological dilemmas. I cannot deepen controversial issues delivered by grand theories here because such brief excursion is only functional to introduce network as key-topic of such contribution. But I will pursue on that only after illustrating other important classical issues of social theory micro dimensionally oriented.

1.3.2. Micro approaches: the sociology of everyday life

On the opposite side of sociological approaches lies a completely different academic tradition based on antithetical ontological and epistemological assumptions. These are said *qualitative* approaches and can be referred to the advent of constructionism and a more spread interest in *micro*-relational contexts. This was the case of several academic traditions since the first decades of the 20th century with a more. Being strongly agent centered qualitative approaches share the same interest in comprehend world through the analysis of micro-relational context preferring to reveal social reality not considering a preformed structure affecting individuals but from outfitting rationality social actors in their personal lives and experiences. Such reasonable view on social reality is not a casual one but is rooted on the general assumption of a not escapable evidence of multiple social realities as social agents themselves. Convincing of the idea

that complexity of relations and social behaviour cannot reduce to a mere correlation of mathematical variables, qualitative scholars admitted only the use of peculiar techniques and tools able to make sense to reality in its spontaneous course. Such academic tradition embraces contributions of severally oriented micro theoretical perspectives whose common base consists of the analysis of small size micro realities favouring a more detailed and deep knowledge. In this way sociology chooses to enter everyday life willingly by disclaiming a general and universal possibility of explaining reality unless by recurring to its single agents whom it is consisted of. More deeply explication is not a goal to reach for such perspective because as we have seen in the previous sections you cannot explain something always different as soon as observed and continuously changing. In such sense narrativity along participant observation represent the only way admitted to attempt the picturization of social world being analyst a portion of that and not an external one. Focusing on micro interactional universe qualitative approaches assume a sort of convinced willingness in social agents who act in their personal worlds interpreting reality on their own but on the ground of shared meanings. The key point of matter is comprehending how do they construct such sharing universe of meaning and how do they make sense to their and relatives action. Although the most directly indentified reference to such approaches is Weber another important author should be mentioned especially for what it is concerned network approach I will illustrate in the

next chapter. I refer to Simmel who put in evidence the importance of micro relational universe in giving a sense to social world as pointed out here

> That people look at one another and are jealous of one another; that they exchange letters or dine together; that irrespective of all tangible interests they strike one another as pleasant or unpleasant; that gratitude for altruistic acts makes for inseparable union; that one asks another man after a certain street, and that people dress and adorn themselves for one another the whole gamut of relations that play from one person to another and that may be momentary or permanent, conscious or unconscious, ephemeral or of grave consequence (and from which these illustrations are quite casually chosen), all these incessantly tie men together. Here are the interactions among the atoms of society. They account for all the toughness and elasticity, all the color and consistency of social life, that is so striking and yet so mysterious (Wolff 1950).

Despite with own peculiarities symbolic interactionism and ethnomethodology traditions share a common accent on interesting in everyday social interactions and activity for understanding social universe. In particular social facts are not a supposed transcendental superior order affecting individual actions but the resulting of a continuously negotiation between agents in their personal activities and experiences. As Garfinkel states

> The objective reality of social facts as an ongoing accomplishment of the concerted activities of daily life, with the ordinary, artful ways of that accomplishment being by members known, used and taken for granted is a fundamental phenomenon (Garfinkel 1967).

So *what* and *how* occur in creating society as a whole? This represents a delicate passage for preliminary quest on micro-macro relation. A statement on that is expressed in the following way

> Since the intelligible features of society are locally produced by members themselves for one other, with methods that are reflexively embedded in concrete social situations, the precise nature of that achievement cannot be determined by the analyst through a priori stipulation or deductive reasoning. It can only be *discovered* within "real" society (in its "inexhaustible details"), within "actual" society (in the endlessly contingent methods of its production), and within society "evidently" (in analytical claims that are assessable in terms of members' ongoing accounting practices) (Clayman-Maynar 1995).

Pursuing on this way qualitative approaches investigate *how* such shared meanings emerge within the interactions and how they finally participate in creating and rooting common sense. In disclosing this interrelation universe between individuals relationally given such perspective cannot avoid to investigate everyday life contexts and settings endeavouring to arise realities from private lives in private intimacies too. That is the case of feminist perspective, just to give an example now, whose theoretical framework denies the valuation of scientific method itself because it is based on an historically determined male-oriented patriarchal knowledge so that everything is known until now belongs to and represents only a piece of world and not the entire one. For this reason feminist approaches aims to reconstruct knowledge starting from women private

world[10] and by attempting to deconstruct current universe of (male-centered) meanings. A brief quote can give a reason of that

> More feminist researchers [...] have chafed against dualistic conceptions of reason/unreason, and struggled to change the meanings of science. But they have not generally wanted to present feminist knowledge as "unreason", invalid or not authoritative. [...] Some feminist debate on this issue has retained Cartesian dualism by posing problems of feminist methodology in terms of struggles between "objectivity " and "subjectivity" (Ramazanoğlu-Holland 2002).

This view is strongly related to the concept of power as tool for defining knowledge itself as broadly disserted by many scholars (Foucault 1980, 1988; Haraway 1989) who retain science a social and situated product itself and consequently an insidious tool for perpetuating (gender or class i.e.) power by the legitimated use of an incontrovertible scientific truth whose partiality can be evident. Unveiling such underlying constructed power cannot be a possible thing unless you arise *micro-physics of power* in Foucault's terms (1991) analysing micro relational context in which power itself is revealed and by analysing everyday life in its ongoing processing. Anyway a compromise has to be done because what you miss in generalization of results permits to improve the richness of more detailed data. Anyway other possibilities seem to advance as we will se in the last sections of this chapter.

[10] I will deeply illustrate such point on private-public feminist dichotomy in the next chapters for supporting empirical findings.

1.3.3. Theories of middle range: Merton and the rise of meso-level of reflection

As it was clear above a definitive solution to sociological dichotomies is not available yet and academic debate on is currently ongoing probably because of secular divisions in knowledge itself sometimes too rooted in human perspective for observing and speculating on reality. Anyway a handful of authors put the accent on the possibility of working out such dichotomies in sociology and social sciences too. The sociologist Robert Merton is one of them so that it is of him the well known definition of theories of middle range he indicated as

> theories that lie between the minor but necessary working hypotheses that evolve in abundance during day-to-day research and the all-inclusive systematic efforts to develop a unified theory that will explain all the observed uniformities of social behavior, social organization and social change (Merton 1968).

In his reflection Merton comes to formulate and refer to a set of theories whose usefulness and validity can be easily traced in their multifunctional adaptation in a huge amount of cases. Specifically he pointed out how they were so close to empirical data to permit a direct and immediate corroboration even if able to lies in a partial abstractness at the same time. Following a coherently reasonable dissertation Merton denies the possibility of building a definitive universal theoretical system affirming that

> If the science of physics, with its centuries of enlarged theoretical generalizations, has not managed to develop an all-encompassing theoretical system, then a fortiori the science of sociology, which has only begun to

> accumulate empirically grounded theoretical generalizations of modest scope, would seem well advised to moderate its aspirations for such a system (*ibidem*).

Refuting any positivistic attempt to build a definitively given macro sociological theory able to explain all diminishes in the complexity of reality, Merton suggested a sort of third way as best solution to enter theoretical universe without renouncing to empirically founded system. It is the case of the theory of role-sets that begins with an image of how social status is organized in the social structure (*ibidem*). It cannot be considered a macro theoretical framework neither a situated one but admitting a third level of analysis

> begins with the concept that each social status involves not a single associated role, but an array of roles. This feature of social structure gives rise to the concept of role-set: that complement of social relationships in which persons are involved simply because they occupy a particular social status (*ibidem*).

In providing a preliminary suggestion to the more debated dilemmas in social sciences Merton launches a clear monitus to sociologists stating that

> If this relatively simple idea of role-set has theoretical worth, it should generate distinctive problems for sociological inquiry. The concept of role-set does this. It raises the general but definite problem of identifying the social mechanisms—that is, the social processes having designated consequences for designated parts of the social structure—which articulate the expectations of those in the role-set sufficiently to reduce conflicts for the occupant of a status. It generates the further problem of discovering how these mechanisms come into being so that we can also explain why the mechanisms do not operate effectively or fail to emerge at all in some social systems (*ibidem*).

It is no exaggeration to say that Merton identified the core questioned issue of a plausible solution to paradigmatically done sociological antinomies by the use of a possible middle way to sociological knowledge enacting an union of agency and structure. Criticizing the incapability of general theories of well fitting a massive number of empirical defined phenomena he celebrates the potentiality of the theories of the middle range because

> enables us to transcend the mock problem of a theoretical conflict between the nomothetic and the idiothetic, between the general and the altogether particular, between generalizing sociological theory and historicism (*ibidem*).

Moreover it is also worth noting that Merton claims

> For this middle-range theory is not concerned with the historical generalization that a degree of social order or conflict prevails in society but with the analytical problem of identifying the social mechanisms which produce a greater degree of order or less conflict than would obtain if these mechanisms were not called into play (*ibidem*).

A clear example of theory of middle range can be interestingly delivered by mentioning reference group theory by Merton who underscores how it can be considered a good example of empirical research theoretically oriented permitting an harmonious conjugateness among agency and structure alongside micro and macro link. Focusing on concept like primary groups, group belongingness and relative deprivation Merton comes to the definition of a renewed possibility for sociological theory in order to avoid

a so strict inner division in favor of a fruitful marriage between empirical research and social theory. In dealing with empirical findings belongings to previously delivered researches like *The American Soldier*[11] he commits a coherently theoretical frame group-centered and based. At the heart of reflection lies the concept of group as reference point for social behavior and in doing that you can also proceed on for unveil macro concept like social mobility for instance. In enacting social behavior individuals valuate their personal situation and status comparing that with not exclusively a supposed abstractly existing preordered society but with what they assume as reference point be that closer social context, primary groups, cultural environment etc. depending on the situated action context. The subtle speculation on theoretical validity of such approaches is evident in the following cite

> That men act in a social frame of reference yielded by the groups of which they are a part is a notion undoubtedly ancient and probably sound. There is, however, the further fact that men frequently orient themselves to groups other than their own in shaping their behavior and evaluations, and it is the problems centered about this fact of orientation to non-membership groups that constitute the distinctive concern of reference group theory. Ultimately, of course, the theory must be generalized to the point where it can account for both membership- and non-membership-group orientations, but immediately its major task is to search out the processes through which individuals relate themselves to groups to which they do not belong (Merton 1968).

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[11] It represents a cyclopean set of empirical researches whom authors are S. A. Stouffer, E. A. Suchman, L. C. DeVinney, S. A. Star, and R. M. Williams, Jr. for the first volume called "Adjustment during Army Life,"; and S. A. Stouffer, A. A. Lumsdaine, M. H. Lumsdaine, R. M. for the second, entitled "Combat and Its Aftermath," (both edited by Princeton University Press, in Merton 1968).

The corollary of this is that social behavior cannot be reduced to an unique preordered sociological entity but that individuals personal experience plays an important role for creating structures. Conversely the latter ones provide an inspiring and necessary shared frame to enact social performance in orienting social action. Just to give an example roughly saying people can rationally decide to commit corruption acts for ameliorate profit but this socially considered deviant mean is itself socially released as an output of an excessive emphasis on richness and power that fixing such values as the best desirable goals to be reached[12]. So the necessary linkage micro-macro, structure-agency becomes to arise in sociological debate compelling to reconsider all previously rooted assumptions. It should be mentioned that the linkage to these social mechanisms taking place through interactions yielding the creation and affirmation of structures represents the key topic of analytical sociology that

> is concerned first and foremost with explaining important social facts such as network structures, patterns of residential segregation, typical beliefs, cultural tastes, common ways of acting, and so forth. It explains such facts not merely by relating them to other social facts—an exercise that does not provide an explanation—but by detailing in clear and precise ways the mechanisms through which the social facts under consideration are brought about (Hedström-Bearman 2009).

[12] For a complete tract on deviancy and structure see Merton 1968.

As will be deeply treated in next chapters such approaches represents along Simmel thought one of the inspiring backgrounds for network framework.

2. Methodological triangulation: can we escape from struggle?

Academic debate on sociological dichotomies seems currently ongoing so that clearly appears how hyper-specialization and traditionally given inner divisions overcome any possibility of a dialogically oriented science. It is clear how intrinsically controversial the matters above reported are and how they represent the core of secular philosophical and scientific statements to be untangled yet. Such apparently raised division was so clear in the eyes of Merton himself who noted

> sociology not only became differentiated with other disciples, but it became internally differentiated. This differentiation, however, was not in terms of specialization, as in the sciences, but rather, as in philosophy, in terms of total systems, typically held to be mutually exclusive and largely at odds (Merton 1968).

However this sociological original sin seems to be solely an apparent one just because, as interestingly noticed, Durkheim did ever deny the important role played by individuals in creating the *social being* (Trobia 2001); anyway he was compelled to pursue on its escaping from psychologism in order to sublimate social facts from a merely individual dimension. An analogy can be drawn to Weber statement who parallelly did ever refute explication at all but, by recurring to the mean of *rational*

comprehending, he insisted on the ineluctably necessary conjectural process (consequently undergone to falsification process in Popper's term) aiming to reconstruct social meanings themselves. Referring to such divided methodology Trobia (2005) uses the adjective *diabolic* in its etymological meaning that comes from the old Greek; in fact the word *diabolic* is composed of the preposition *dia-* that means something like "in the middle" and the verbal form *-ballo* whose meaning is "to throw down". In this way the term diabolic is referred to something able to divide and then to generate conflict. However it should be said that some techniques and approaches do not lies comfortably only within one or other framework but can be incorporated *in the middle* of sociological universe though with own peculiarities: this is the case of network analysis as will be showed above. Despite a massive agonistic and troubling debate a handful of scholars admit other possibilities to work out sociological dichotomies. One of the suggestions proposed is the use of *methodological situationism* admitting situation as analysis unit alternative to either individuals and society (Knorr-Cetina, Cicourel 1982, in Trobia 2001). Similarly the sociologist Giddens (1979, 1984) encapsulates matter recurring to the concept of *embedding* introducing the notion of time and space within structure. Particularly he states that social action stems from either personal interpretative frames either shared and socially produced within society itself (*ibidem*). Developing his theoretical view he elaborates the nature of social structures sustaining that

> All organizations or collectivities "consist of" systems of interaction, and then can be analysed in terms of their structural properties: but as systems, their existence depends upon modes of structuration whereby they are reproduced. [...] The production of interaction as "meaningful", I have proposed, can usefully be analyzed as depending upon "mutual knowledge" which is drawn upon by participants as interpretative schemes to make sense of what each other says and does (Giddens 1976).

In arguing the need of rethinking sociology in the light of methodological triangulation (Denzin 1978), Trobia (2005) shows a list of empirical examples insisting on the need to conduct empirical research using mixed methods in order to unify final results[13]. As a result it is so evident how the core of debate lies on *relation* and *relations*, and cannot escape from that. Nevertheless a question can naturally arise: despite a fruitful though subtle preliminary dialogical attempt to converge sociology towards an unique and common aim why such inner division occurred? A question like that did ever be answered but as we will see in the next chapters it seems time is mature for launching a new plausible and advisable dialogue not only within sociologists but also within the entire science too. In the end this is due to the fact that the ambiguous and still unveiled relation between micro and macro dimensions is commonly shared by whole sciences.

[13] For a complete tractation see Trobia A. (2005) *La ricerca sociale quali-quantitativa.* FrancoAngeli: Milano.

CHAPTER TWO

Network as an intriguing representation of reality: is it plausible to think of it as a new paradigm?

Though most of us hope, it is true, for an all embracive future theory
which will unify the various postulates of science,
we do not wait for it before proceeding with the important business of science.

Henry Margenau

Far from the ambitious goal to work out sociological dichotomies, this chapter aims to give an insight to further developments in sociological paradigms by generating evidence on how a desirable dialogue with other disciplines can be fruitful not only for social sciences but also for scientific knowledge itself. Such peculiar a delivery stems from the conviction that a specific science cannot be enriched by itself within a closed self-referential system but, on the contrary, by sharing theoretical frameworks, outfits and empirical findings with the entire separate bodies of knowledge. In the scientific cosmos none can avoid dialogue and neither escape from it unless one prefers to rest in a perpetually comfortable and unchallenged intellectual position.

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When we refer to the notion of paradigm you cannot forget to mention Kuhn's contribution in defining and explaining the subject. As the philosopher, he states in his

famous work *The Structure of Scientific Revolutions* (1962) shifts in scientific revolutions are always silent and invisible: they particularly occur when,

> it is rather as if the professional community had been suddenly transported to another planet where familiar objects are seen in a different light and are joined by unfamiliar ones as well. […] Nevertheless, paradigm changes do cause scientists to see the world of their research-engagement differently (Kuhn 1962).

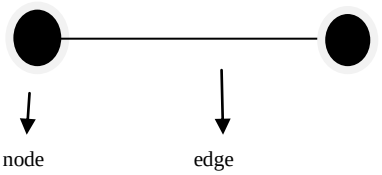
At the time of writing it can be probably affirmed we are exactly at this step as we will have occasion to know following dissertation. Networks in fact represents a profound challenge for the entire world of science because is based on the most deep structures of reality itself. Focusing on *relation*, *relations* and *systems of relations* between elements, the network approach investigates not isolated portions of reality or already defined composed structures, but analyze recurrent patterns of relationships emerging in their own peculiarities and, attempts to reveal emergent properties of systems and their principles of organization. We have already seen that this is not so new in sociological thought being that *relation* are the most essential element of society and consequent social behavior it is consisted of, so that it cannot exist in absence of continuously given relations generating and affirm social structures themselves. It was not unexpected when Durkheim pointed out that the whole is distinct from the sum of the parts spotting the necessity of finding a new discipline other from psychology. As a matter of fact sociology should not be given a legitimate place in academia if social structures were ontologically and epistemologically considered as a mere reproduction at macro levels

of micro agencies-based phenomena. What occurs *in the middle* of social processes from a face-to-face interaction to the creation of a posed social structure rests a very fascinating thing for the entire scientific community. Cautiously speaking the network approach tends to this dimension disclosing patters of relationships. What is particularly interesting is the fact that such controversial issues are also mutually shared by a huge body of disciplines natural sciences included, and this is the reason why it can be admitted we are probably standing at the rise of a new paradigm for knowledge as will be easily comprehended. Just for a brief anticipation we can affirm part of political research always cares about how individuals join a movement or a party or either why some parties are more successful than other ones but unfortunately few researches have interested in analyzing patterns of relationships generating a political movement and favoring its diffusion. At the same time physics can choose to analyze hydrogen and oxygen atoms solely or molecules water themselves but they can choose to analyze how such *in divenire* processes occur, investigating patterns of relationships between such "interactive" atoms.

> While we may be a long way from identifying strict "laws" for the human world, scientists have discovered lawlike regularities there and now recognize that such regularities in no way conflict with the existence of individual free will; we can be free individuals whose actions, in combination, lead to predictable outcomes for the collective. This is much as one finds in physics, where atomic-level chaos gives way to the clockwork precision of thermodynamics or planetary motion (Buchanan 2007).

In this sense network science tends to sew agency and structure together coherently leading some scholars to locate it within a taxonomically determined *meso*-level (Collins 1992) and the evolution of social network is driven by a trade-off between the two (Watts 2003). The essential point is that social agents can act from free will but their decisions are totally embedded within constraining structures made up of organized and regular relational patterns social network analysis aims to reveal in their most profound morphology. Essentially we need to look at relationships between agents and particularly how they arise and what they emerge. To better understand such a point providing few examples can be useful in comprehending it. A network is a set of relationships containing a set of objects (mathematically called nodes and corresponding to agencies in social sciences) and visualizing a map and description of relations between them (Kadushin 2012). Imagine you know one person: mapping this existing relation means putting two distinct *nodes* on a space and linking them through an *edge* representing the relation itself. This is what it is called dyad in sociological terms as illustrated below.

Figure 2. Graphical representation of a dyad.



Although it could appear obvious and tautological such representation grows in complexity as soon as it considers a new node adding such previously pictured out basic exemplum as in the case below.

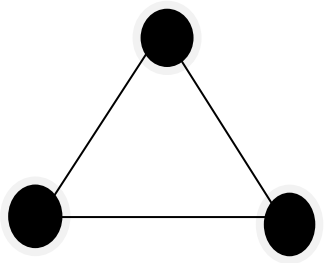


Figure 3. Graphical representation of a triad.

In sociological terms this is a triad namely a relational pattern made up of three people reciprocally knowing each other. Someone can naively think it is just a marginal increase in the number of nodes but what occurs by adding a third element in the social network pattern represented in the graph[14] is completely different from the previously occurred situation. The third element in fact plays an important role making the difference so that what *emerge* within triad is exclusively inscribed within this group arising only as soon as a new node is added. Recalling Simmel (1950) is a due act here. The German sociologist was the first scholar to individuate in triad the minimum sociological unit of analysis for the previously mentioned reasons. A number of social configurations can exist and *emerge* only from the minimum number of three

[14] *Graph* is the mathematical term for indicating such graphical representation of linking node.

interacting agencies. Triad permits the emergence of patterns otherwise unconceivable like authority patterns or the most known *tertius gaudens* in which an individual can gain advantage by his/her own position between two mutually knowing agencies acting as a broker. Such mediating role cannot be conceived but within a triad and never within a dyad. This means there are specific patterns and properties *emerging*[15] if and only adding relations to previously dwelling ones namely they are peculiar to a defined system of relations. This suggests that *at a certain point* relations produce something totally unexpected and completely distinct from a merely marginal sum up of previously interacting elements. It is like *at a certain point* they tend to organize into regular emerging patterns that did not exist hitherto and might not easily be expected before. Imagine the millions of social relations in the world: as we will see despite random oriented expectations it seems social relations *at a certain point* reveal regular patterns of self organization despite expectations. Philosophically, they arise in order from an apparently original disorder and in this sense they represent the perfect linkage from micro to macro levels. Interestingly such a peculiarity is not only of social relations but entails physical world too and recurs in several networked system and this is the reason why the entire world of science compels to review ontological and epistemological assumptions. It is not a case if Urry (2003) refers to a post-disciplinary approach to

[15] *Emergence* is a concept related to the system theory and complexity science has been addressed by researchers in many fields. For a more specific treatise see Goldstein (1999), Holland (1998). Barabási et al. (1999) will be widely treated in the following sections.

indicate the rise of a new knowledge so that conclusively it should be questioned whether a new paradigm can be admitted due to such recurrent emerging regularities in many fields. Referring to that it will be deepened in the following sections and chapters.

2.1. Having in common more than you expect: the imperative of randomness

When we refer to social life in its development of people it is common to think about how absolutely unpredictable events occur by chance, namely disordered and lawless incidences foundations. However, this is not the whole picture as we will demonstrate. As explained earlier there are relational patterns emerging somewhere in a very huge number of fields whether within social sciences or natural ones as there are some not too obvious forces that tend to cause group interactions between people depending on the particular relational structures incident upon them besides other factors. Even though with own peculiarities it seems society and the Internet, the brain and cells, economic transactions and airplanes transfers and so forth can all be represented by graphs. Surprisingly we will have occasion to know most of them show lawlike regularities in their underlying network structure because they always represent connecting elements whose internal flow of things follow a particular structure be it electronic impulses, information or opinions among nodes. Depending on underlying network structures this flow can easily or hardly spread or stop and this is the reason

why virus and fads can be analyzed according the same relational model they go across. As we shall see network structures are not all the same but present characteristics who encourage or deter the spread of things flowing within them even though non-deterministically. The next chapter describes synthesis and evaluation of small world structure that is one of this network pattern representing the core of such contribution. With respect to such common features existing in a massive number of complex systems a clearer dissertation on the topic is required. Even though network theory might appear a modern fashionable concept it is rooted in an antique branch of mathematics called graph theory and propounded by Euler (1975) at the end of the 18th century. In an attempt to solve urban dilemmas he was invited to undertake a controversial problem related to the planning of bridges and path across Pregel River in Könisberg, a city near St. Petersburg. In order to encourage a rational flow of people trough two portions of land he was required to connect the island of Kneiphof with the abovementioned city by planning a rational connection system made up of seven bridges so that people never cross the same one more than once. Practically he was expected to find a route around the city able to permit people crossing bridges never more than once. The picture below simplifies comprehension of such graph dilemmas.

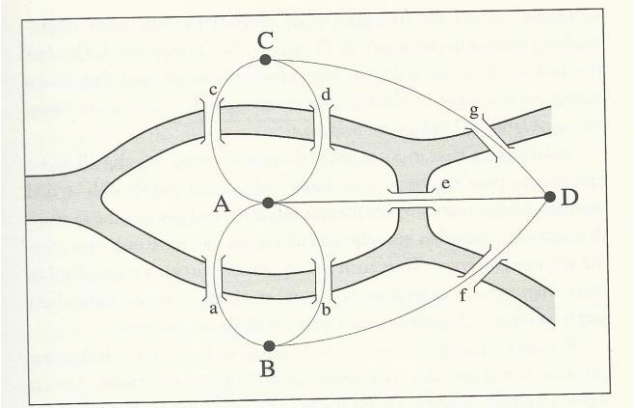


Figure 4. Könisberg Bridges
(Source: Barabási 2003)

As it is showed in the picture Euler was expected to find a path that connected the four lands (defined as *nodes* in network terms and visualized as A, B, C, D) through path crossing bridges and here indicated as a, b, c, d, e, f, g (*edges* in network terms). It is easy to see that a sequential visible route crossing all the bridges only once does not exist. In this way Euler traced a graph launching an exciting mathematics branch that gained currency two centuries later. The reader is probably wondering whether bridges and lands share anything with individuals or cells and in this sense their nature is likely different albeit their underlying network structure probably arise similar patterns. In such sense cells system, transport system, society, groups, fads diffusion, scientific community, trade relations, diplomatic affairs and so forth are always networked. Every system is in itself a network and especially for what concerns social phenomena none can admit they rise in a social vacuum and because such social reality in which they arise does not consist of atomized individuals, relational dimension could be very proficuous. However intricately constructed complex system like society cannot easily be imagined as ordered elements obeying specific rules even though this order-tended view was totally predominant until the first decades of the 20th century. The first serious discussions and analyses of networks emerged during the 1950s with Solomonoff and Rapoport (1951) followed later by two prominent mathematicians Paul Erdős and Alfréd Rényi (1959, 1960, 1961a, 1961b, 1963, 1966) whose theorizations have to be considered a necessary step for current articulations on interconnected universe. Both

Hungarian mathematicians attempted to explain not only the existence of network itself being universe of networked system on its own but particularly they debated a more profound and radical question insisting on originary dilemmas: how do networks form? In sociological terms such question can be translated in how people connect other people? Deeply, are there regularities in how individuals link or meet other individuals? It may appear obvious how the abovementioned question cannot be unquestionably located within a definitive approach but *between* ontological assumptions that range from agency as willingness to connect specific individuals and structure as constraining force determining our possibilities of free will in choosing people being linked to. As will be more clear in following chapters both agency and structure participate in creating networks leading to a less radically done reflection on apparently dichotomous approaches broadly exposed in the first chapter. Being two mathematicians Erdős and Rényi were impressively fascinated by the universe as it appeared in their eyes as a complex system of networked elements like molecules in our body linked by biochemical reactions, nerve cells connected by axons, flying transport crossing airports, food webs between animals, phone communications between people, companies and consumers linked by trade, international relations between states, parliament and citizens linked by parties and so forth. Whatever the nature of the abovementioned systems is that they form a network in every case and in this sense it should be hard to fix universal postulates able to explain all of them in an unique way.

In their view the matter always deal with the complexity of such systems depending upon structure apparently disordered and ruled by the chance. Reducing such complexity to a simpler law means disregarding such evident diversity in favour of a mutual explanation of the entire amount of network phenomena. This was the case of *random graph* theorization Erdős and Rényi formulated stating that nature in its ontologically given sense connect elements randomly regardless they are cells, molecules or people. Providing further details is due here. A random graph is a collection of nodes with edges connecting pairs of them randomly as in the picture below.

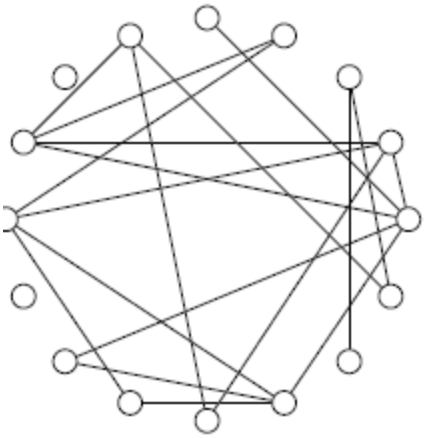


Figure 5. Random graph schematic representation. Nodes are connected randomly so there is not any prefixing order in their linkages. (Source: Newman, Strogatz, Watts 2001)

Intuitively being randomly generated each node within random network presents the same likelihood to be reached from every other vertex in it owing to a tending homogeneity in distribution of degree value, namely in their assigned by chance number

of edges. Such equal disposition lies on a simple mathematical assumption probability-related. Arisen by a “random order” presumedly the most part of nodes detect the same average degree value providing a normal distribution so that few more relationally rich elements cannot emerge even though there will surely be poorer and richer ones depending upon chance. In a random graph almost all nodes will have approximately the same number of links corresponding to the same degree value that let them be similar and this is because it is assumed that any linking between nodes can happen with equal probability. In statistical terms this means that they face a Poisson distribution having a prominent peak that stands for the majority of nodes having the same number of links and whose sides on represent the rarity of deviations from average values in terms of degree distribution. In the random graph degree distribution shown below, most nodes have 10 degrees meaning that the most part of them is connected to other 10 nodes while few other ones link 5 or 15. It is interesting observing that only one node present a value equal to 0 namely it is not connected with anyone in the graph.

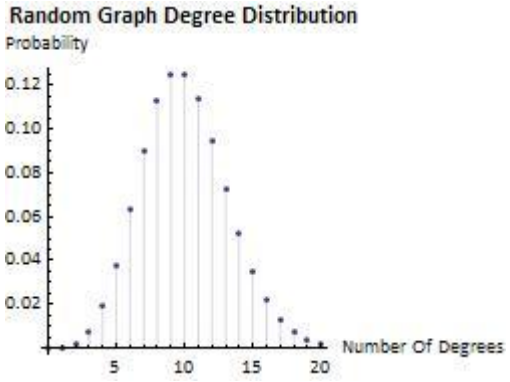


Figure 6. Poisson distribution for random graph. The most nodes have the same average degree value.

In this sense such isolated node does not participate in the creation of so-called giant component final graph consists of obviously meaning that it cannot be reached by anyone. Dealing with graph model simulation Erdős and Rényi started from a preliminary array of isolated nodes did not link one each other and consequently have the same average degree value equal to 0. Proceeding by adding edges randomly they intuitively realized that as long as average degree value was minor that 1 graph presents portions of isolated nodes totally unconnected but as soon as such value become 1 namely every node is connected at least with another one, then the situation irreversibly changed creating an homogenous and unique network of all connected nodes. At the time degree value turned into 1 fraction of all nodes in largest component suddenly jumps as it is evident in the Figure 7 below.

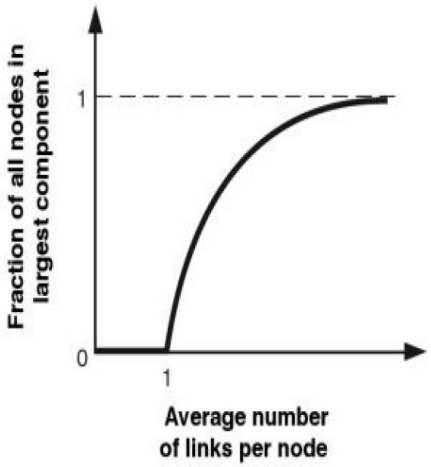


Figure 7. Connectivity process of a random graph. As soon as average degree value reaches 1 all nodes tend to be swallowed up by the other nodes until everything is connected (Source: Watts 2003).

In mathematical terms a giant component emerges in this case permitting not only nodes to be reached with the same likelihood due to the similar average degree value but also to be connected to everyone else in the graph. It is worthy recalling here a concept from physics defined as *phase transition*. At *a certain point* called *critical point* in the language of physics something really surprising occurs and everything changes immediately arising completely new things. This is the case of many distinct phenomena ranging from the status transition of water into ice, explosion of economic crisis to the propagation of fads and news and so forth. Being an unique connected component everything happens within can potentially affect all nodes it is consists of. Unfortunately hitherto it is not so clear what takes place *in the middle of* these transition phenomena in their dynamical and continuous change and occurring just like the passage from micro to macro, from agency to structure. This latter point will be recalled in the last section of this chapter because of its key role in comprehending the network approach. Investigating more social matters in sociological terms society could be nothing that a cyclopean network whose degree value for every individual is always equal to or major than one unless you have been abandoned somewhere in a dispersed corner of the world. In such sense society is a giant component whose apparently randomly organized network rely on though partly ordered patterns obeying specific criteria leading that everyone is connected to everyone in the world. The reason is obviously simple: human being needs sociality being a ζῷον πολιτικόν in Aristotle's

words. But a question should be still answered: how such social networks develop and what eventually given criteria they obey? Are real social networks really and totally randomly formed? Such controversial questions represents the core dilemma and a futuristically serious challenge for the entire scientific knowledge due to an attempt to put an order in a seemingly given chaotic disorder posing between agency and structure at the same time. For several decades such random view was predominant with respect to individuals too as epistemic and heuristic tool so that we use it to think about new acquaintances depending upon casual occurrences. Random graphs following this topological rule are useful theoretical exercises but do not generally neither faithfully represent networks in the real world. Unexpectedly as will be traced such random state is not completely true due to the fact that a partially existing order seems emerging even in complex system of networks where disorder looks like prevalently distributed society included. Such postulate can be comprehended recurring to a simple consideration. In fact you would be much more likely to be friends with someone belonging to your hometown than everyone else in the world randomly picked. So geographical and spatial proximity seem to be a first reasonable probabilistic criterion despite an hyperconnected world makes us aware of certain randomness in our occurring acquaintances. This was broadly demonstrated by several previous works of research on geographical cliques (Feld and Carter 1998), neighbourhood friendship (Festinger, Schacter, Back 1950), like-headquartering interlocking directorates within corporate

boards (Kono et al.1998), international trade with close states (Volker 2000) probably due to lower costs of transportations (Krugman and Obstfeld 2000), co-presence at primary school (Domhoff 1967). But propinquity is not the only specimen of ordering criteria in real social networks as will be understood in the following section.

2.2. Sociality is not totally driven by disorder: looking for order in the chaos

I desire to start this section by mentioning a suggestive reflection stated by Barabási (2003). Argutely he asks

> Would I able to write this book if the molecules in my body decided to react to each other randomly? Would there be nations, states, schools, and churches or any other manifestations of social order if people interacted with each other completely randomly? Would we have an economy if companies selected their consumers randomly, replacing their salespeople with millions of dice? (*ibidem*)

Such profound question relies on deep ontological roots admitting something *ordered* should be given in order to mark predictable regularities in phenomena and in this sense it is really helpful remembering that everything can appear irregular and unsensed until something else is discovered. Hence, referring to apparently totally random universe because reflection on the topic in sociological terms did not reach a certain maturity yet at the time of Erdős and Rényi state-of-research was not ready to take in account the potential existence of portions order in complex system like society. Far from achieving the latter goal by tracing definitive universal and absolute axioms in social behavior this

section explores some of the most known relevant empirical criteria acting as ordering frames for either collective behavior and organization. Commencing with a curious anecdote can result helpful in comprehending the following sections.

It is said that in 1903 during a conference in Geneva the Italian sociologist and economist Vilfredo Pareto was polemically accused and interrupted by his famous colleague Gustav von Schmoller who shouted to him "But are there laws in economics?". The occasion for a personal revenge occurred the day after when Pareto met his antagonist on the way in. The Italian scholar approached him by asking for a good restaurant around. Van Schmoller kindly replied suggesting one good place to eat locating near by and at that time Pareto pridefully exclaiming : "Ah, so there are laws in economics!". So in Pareto's mind economics and consequently social behavior cannot be merely due to sole chance or only to rational choice but that there can be something more profound to be known. His exclamation poses a challenge or at least a further view on deterministic conviction of a totally atomized *homo oeconomicus* et shedding light on a relational level of economic transactions and actions. Pareto's reflection is an elegant proof of how also controversial things can make sense even when they seem not having it albeit they can appear randomly done. Even when casual acquaintances on the way in can appear accidental some intrinsically logical reasoning of occurrence can be traced in a relative way. Simply but not uniquely if you know someone you can suggest everything you want because relations always are vehicle of things within them and act

as conduits. As John Donne said *no man is an island*[16]. Let us continue with listing and deepening the abovementioned criteria.

2.2.1. Homophily: opposites do not attract one another

It can be believed that individuals can group together even though on diverse and different terms, it seems that a sort of "magic" attraction for like-minded people affect human relations. As folk saying goes "birds of a feather flock together". Beyond mythology and popular beliefs homophily[17] is tendency to join with our similar relatives and appears to be the driving force of social relations on different levels permitting the formation of partly ordered networks. The homophily principle appears really robust in empirical evidences (Lazarsfeld and Merton 1954; Laumann 1966; Verbrugge 1977; McPherson and Smith-Lovin 1982, 1987; Marsden 1988; Burt 1991; Mc-Pherson, Smith-Lovin, and Cook 2001). Literature on the topic refers to four distinct dimension involved in homophily process: the same kinds of people come together; people influence one another and in the process become alike; people can end up in the same place; and once they are in the same place, the very place influences them to become alike (Fischer 1982). Even though some individual behavior can appear as free will and micro-determined actions, it is preferred to think in terms of pattern and not people

[16] Donne J. (1999) *Meditation XVII. In Devotions upon emergent occasions*. [1624] Random House: New York.

[17] The term was introduced into social theory by Lazarsfeld and Merton in 1955.

when we refer to network formation and social organization. In order to explore fascinating world of network pattern in terms of homophilic forces it can be mentioned that prominent causes in determining group association are reported also in a famous experiment useful also to comprehend the precious linkage between agency and structure. I refer to Schelling segregation model simulation (1978) related to investigation of racism social dynamics. Discerning segregation processes in his research Schelling pointed out that the tendency to join like-minded people have been identified as major contributing factors for the decline of mix-ethnics society. In fact starting from a perfect mixed randomly society he realized that after a certain time people tended to group in terms of same proprieties specifically ethnical in that case. It Schelling's suggestion people prefer avoiding living in an extreme minority reinforcing segregation depending upon a self-fulfilling prophecy loop. Hence, individuals tend to live with same community people sharing and empowering common habits, beliefs and so forth. What can it be due to? In Burt's thought common norms can bring together individuals with common attributes and reversely common attributes may lead to common norms (1982). Following similar resulting findings there are also some further empirical evidences showing the same by recurring to simulation like Hammond and Axelroad's work on ethnocentrism (2003). Particularly they showed how prejudice generated by attending like-minded people works properly in coordinating activities between agents enforcing pre-existing behaviours in order to reach efficacy and

efficiency in social action. Their results rely on the assumption that agents endow with minimum cognitive ability tending towards already successful patterns and repertoires of action learnt by their relatives experiences and in doing that they enforce status quo. In this sense a supposed micro-behaviour affects group behavior at a more macro level permitting a linkage from agency to structure and viceversa so that homophily appears to be a multi-level dimension emerged either from micro to both macro levels. This homophilic grouping inclination is reported by a huge amount of previous researches analysing friendship choices in classrooms (Hallinan 1982; Hallinan and Williams 1989; Shrum et al. 1988; Kubitschek W. and Hallinan M. 1998), partners' choice (Laumann et al. 1994; Bozon, Héran 1989; Kalmijn 1998; Blau et al 1982, 1984), leisure time common practices (Warde, Tampubolon in Lo Verde 2012; Werner C., Parmelee P. 1979), social locations and e-mail exchange (Kossinets and Watts 2009), work relations (Lincoln&Miller 1979; Ibarra 1995), gender (Blau et al. 1991; Verbrugge 1977; Huckfedlt and Sprague 1995; Ibarra 1997; Popielarz 1999), age (Fischer 1977), and able affecting group habits and beliefs too like in the case of alcohol abuse (Hutchinson and Raspee 2007), deviancy (Kaplan et al. 1987; Cohen 1977; Kandel 1978), life aspirations (Duncan et al. 1968) favouring the rise of similar ties (McPherson, Smith-Lovin, Cook 2001). Conversely structure affects attributes leading people operating within the same arena having similar features and viceversa (Feld and Carter 1998). In this sense it is relevant distinguishing different types of homophily

differently oriented and strongly interconnected albeit they cannot be purified by structural forces: it entails induced homophily that stems from opportunity existing in social structure and then structure-related and choice homophily related to personal preferences and consequently more agency-determined (McPherson and Smith-Lovin 1987). However homophily inclination is traced also at macro-levels, particularly organizational levels as in the case of firms partnerships (Hoover and Vernon 1962) or trade relationships between nations (Krugman and Obstfeld 2000). Nevertheless casual relation direction whether sharing habits affect like-minded individuals or hanging out individuals determines common belief is not clear yet (Erickson 1988) being that an emblematic chicken or the egg causality dilemma posing as a more general class of "structure versus agency" (Emirbayer and Goodwin 1994) questions that have been debated over the years by advocates of "structuralism," on the one hand, and "individualism," on the other (Mayhew 1980) (Kossinets and Watts 2009). Respect to the following most specific topic of such contribution small world theory oriented, it is worthwhile announcing that homophily shrinks social relations within similar individuals and cliques leading to reduced spread of new information so that the latter one within cluster of homophilic networks result redundant. Such point will be better explored in the next chapter. The only thing can be affirmed just now is that homophilic forces partly drive network formation challenging any totally random-oriented hypothesis.

2.2.2. From randomness to power concentration

Network society defined as a society where the key social structures and activities are organized around electronically processed information networks (Castells 2000) accompanies a very controversial academic debate on the democratic empowerment of the Internet. Since its advent in the world several scholars have celebrated the Internet democratization as emancipator tool for citizens able to reproduce a new public sphere (Abramson et al. 1988; Arterton 1987; Williams and Pavlik 1994; Quintelier and Vissers 2008; Margolis and Resnick 2000; Malina 1999; Papacharissi 2002; Poster 1995; Sassi 2000) while other academics put the accent on its intrinsically given fallacy inviting anyway to mitigate celebrating tones (Prior 2007; Norris 2001; Bimber 2000; Boyd and Ellison 2007; Hargittai 2008; Di Maggio et al. 2004; Hill and Hughes 1998)[18]. In both cases an overwhelming analysis of the web network morphology can be useful in comprehending superstructural dynamics existing in it. The key point here is why the Internet is believed being a neutral and powerful tool? Surely such an assumption relies on the idea of a supposed underlying randomness ruling the Internet leading everyone to broadcast freely. Potentially every content can be reached and read from everyone else within intricately networked world of the web and this represents an

[18] Such topic is intrinsically related with widely debated issues on the crisis of democracy (See Putnam 2000; Macaluso 2007) and citizen and consumerism (Sennet 1974, 2006; Habermas 2004; Miller 2007; Lasch 1979; Ettema and Whitney 1994; Hay et al. 1996; Althusser 1970, 1998; Ang 1996; McCarthy 2001; Bourdieu 1977; Scammell 2000; Canclini 2001; Dean 2003; Silverstone 2007) . Tractation cannot be considered exhaustive at all here but represents merely a brief insight on the topic.

important added value, but despite an apparent neutral randomness it seems that even the presumed egalitarian democratic web display power oriented aspects challenging its presumed equality-oriented randomness. If the Internet were completely randomly disposed every page within it should be likely connected with the same probability but this is not the case leading to a peculiar configuration will be deeply illustrated here. In previous sections random graph was illustrated as dominant model in defining universe in the last decades admitting social world is organized according random networks driven by chance. In a parallel sense the homophily principle challenges such randomly done view compelling to review such position in favour of a less deterministic statement. Naïvely it might be expected that the world wide web is dominated by egalitarian forces where all pages are detected with the same likelihood to be reached and consequently read. Guided by the insights of Erdős and Rényi model it can be expected Webpages are connected to each other randomly. In doing so illusion lies on the idea that potentially every content can be really read and in case spread. At the contrary it was shown that the world wide web network architecture is anything but an egalitarian world. A completely random universe should consist of nodes/pages/individuals detecting the same average degree value, namely the same number of relations disorder dominated. Only in the latter case it might be admitted final network – be it the entire population world, the Internet or every type of network imagined – is driven by chance assigning approximately the same degree value to

everyone within it. Despite any expectation there are nodes called *hubs* richer in terms of relation than others proving that even the democratic web display power oriented features. In 1998, Barabási and co-workers (2002) demonstrated that the world wide web obey to specific organization network patterns unveiling that few nodes, namely few Webpages in this case, detect the most amount of links or relations. This means that randomness does not fit properly the Internet topology representing a serious argument against its supposed egalitarianism. Particularly the world wide web degree distribution fits a specific model called *power law* that is very common in other complex systems existing in nature. While random graph model follows a Poisson distribution with a prominent peak given by a bell curve as visualized in the Figure 6, the world wide web presents a power law distribution characterized by a continuously decreasing curve as in the following image (Figure 8).

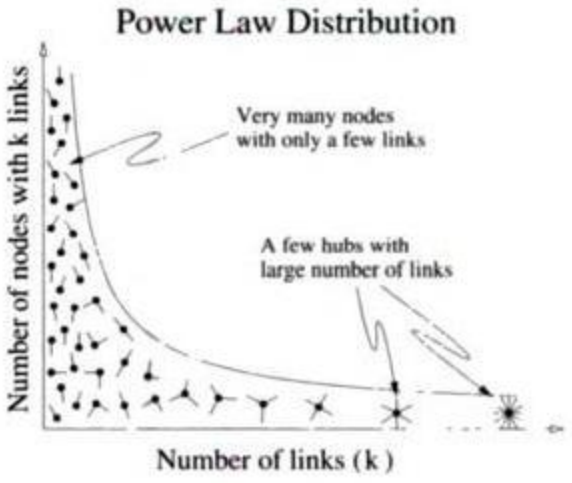


Figure 8. A typical power law distribution. As it is evident the most amount of links is of few powerful nodes while the most of nodes connect few links (Source: Barabási 2003).

If the web were randomly organized the degree distribution has to be described by a bell curve as in the Figure 9. But this was not the case proving how even an apparently chaotic system like the internet is, obey peculiar rules and order.

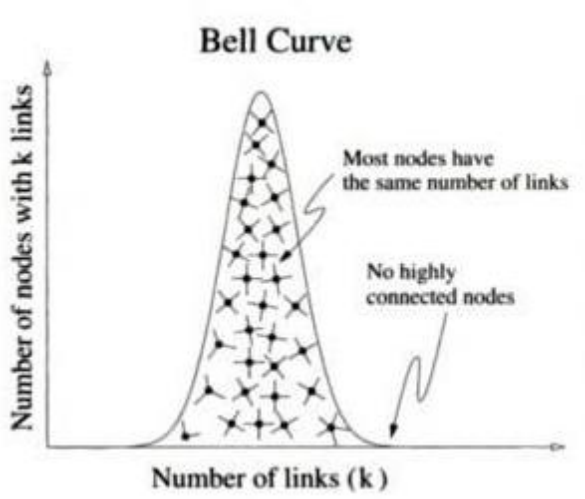


Figure 9. Degree distribution of a random graph in case the world wide web were random-driven. Deviation from average degree value is very rare and large events are forbidden in a bell curve (Source: *ibidem*).

In order to better comprehend an exemplificative picture can be useful to observe the final world wide web graph or network in its power law description (Figure 10).

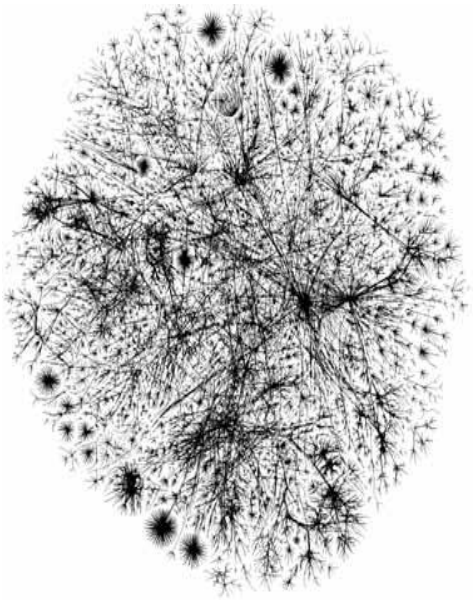


Figure 10. The world wide web structure. It can be noticed the presence of few hubs (darker than others because of their richness in relational terms) connecting the most amount of nodes. In this way hubs average degree value is greater (Source: Opte Project in Trobia, Milia 2011).

Providing further graphical example can support treatrise. The most important difference between a random network and a power law driven by lies on the presence of such important hubs as in the following example. Admitting the willingness of analyzing traffic depending upon networked graphs you have to consider cities as nodes and highways as links. As it is evident and universally recognized hubs-cities exist like Chicago is in the following picture detecting more connections than other cities in US. You cannot affirm the same for Seattle being it less powerful in linkage consequently confirming its dependence from hubs or other connected nodes in terms of achievability (Figure 11).

Figure 11. US transport system visualized as network. Chicago and Los Angeles are clearly hubs-cities while San Diego is merely a one degree value node (Source: Barabási 2003).

In addition networks described by a power law distribution are said *scale-free networks* or *aristocratic networks* (Figure 12) due to a lack of representativeness in nodes, namely an "average" node standing for the others does not exist within them (Faloutsos et al. 1999; Barabási and Bonabeau 2003; Barabási 2003). This called *fractality*

dimension of scale-free networks means that networks like those one are similar at different levels either micro both macro (*self-similarity*): taking portions of the same networks randomly differing in number of nodes you can notice very similar patterns (Trobia and Milia 2011).

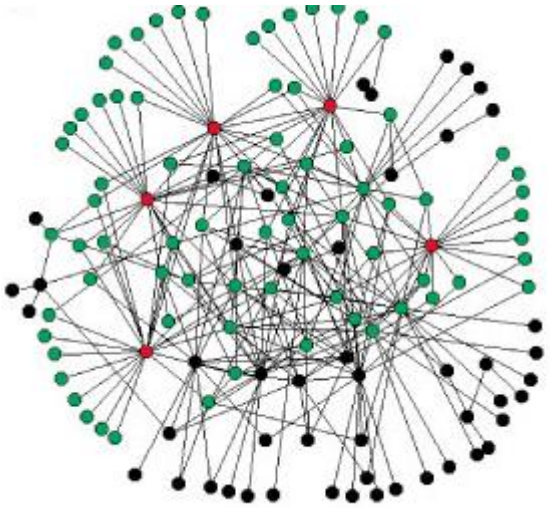


Figure 12. Scale-free network or aristocratic network. The scale-free network is inhomogeneous: the majority of the nodes have one or two links but a few nodes have a large number of links, guaranteeing that the system is fully connected.

As a result this network pattern implies very important peculiarities in terms of overall organization and final assumptions especially in terms of systems. Prominently a deterministic random oriented view on world and relations should be reviewed admitting a partial order in the overall organization of networks world wide web included and in this sense the presence of hubs does not admit absolute randomness because none can admit chance is generous only with few. None can deny Google or the a well known politician is richer than others in terms of links and this represents a

serious challenge for egalitarianism exactly in the same manner of individuals who are richer than others in terms of relations or wealth itself as in the following treated case.

2.2.3. Enforcing structures by disclosing dynamicity in networks: the rich get richer phenomenon

After having learnt that hubs exist challenging randomness, reflection have to be addressed on dynamicity and emergence of such peculiar configuration in networks being common in a very huge amount of natural complex systems. In fact power law distributions are not new in physics neither in social sciences too (Buchanan 2002). It is sufficient recalling how the Italian sociologist and economist Pareto (2010) discovered how even wealth follow a power law distribution with few individuals detecting the most amount of richness in a defined country tending to rest in few hands. Relevantly Pareto's law have been confirmed across continents and cultures posing as universal regularity by defining unequal income distribution as structurally done regardless own skills and abilities (Flemming and Micklewright 1999; Galbraith 1991; Quadrini and Rioss-Rull 1997; Bouchad and Mezard 2000; Jencks 1972). The reason why such inequality occurs rested partly unintelligible as long as it was explained by recurring to a specific simulation model shaped by social relations within a network system. It seems that the matter depends on bestowing relative value to financial resources so that the more rich individuals are the more they risk in investments leading to a greater

likelihood in enrichment following a looping self-fulfilling prophecy (Merton 1968). In parallel due to homophily principle, the rich tends to meet and joins further like-rich individuals creating cliques or clusters of rich people whose massive economic transitions flowing only within the abovementioned cliques. Conversely poor individuals tend to avoid financial risk having less wealth to invest and determining a vicious circle of always chronic paucity (Bouchad and Mezard 2000). Such occurrence named rich-get-richer phenomenon (Pareto 2010) is not new in social sciences and provide respondence to a plausible explanation for the presence of hubs in networks as will be widely illustrated here. The previously mentioned Erdős and Rényi random network model is not sufficient nor is it totally proper in justifying the emergence of hubs in networks especially because of its overwhelming randomness and secondly owing to a lacking assumption of growth. In fact, the random model admits there is always the same number of nodes misleading the possibility of new ones and consequently determining the need of formulating a well fitted model for growing networks really existing in nature and social system itself. Normally none can admit society as statically determined networks. Hence, how does one deal with the problem of expanding networks? A further all-comprehending model is so required or at least needs to be tempted. Following such a suggestion Barabási and Albert (1999) gave birth to a model able to shed light on the problem of growth and hubs domination in real networks (Figure 13).

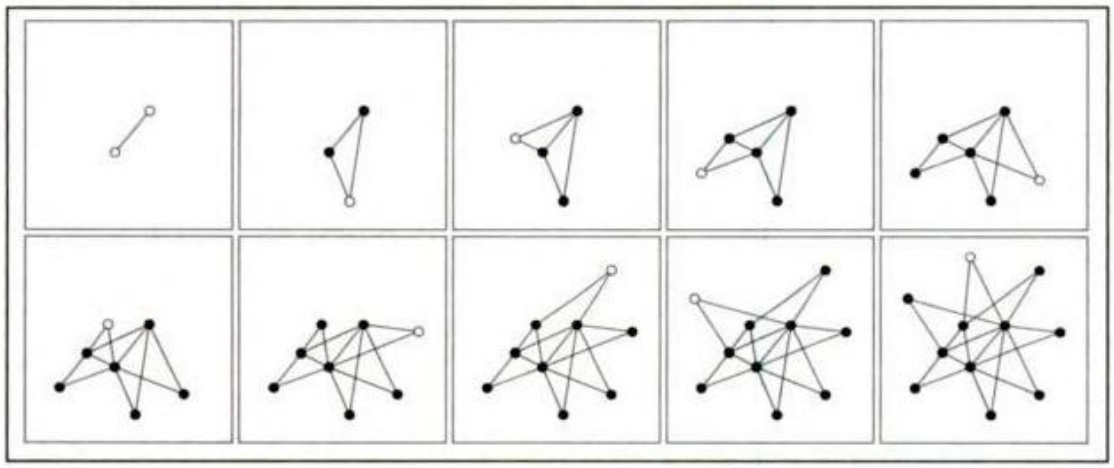


Figure 13. Scale-free network expanding model. Starting from two connected nodes as long as new nodes (white colored) are added early-comers (black colored) take more advantage in getting connections. Proceeding by adding linkages to two distinct nodes each time a new node has come the more they are linked to, the more late-comers likely will be connected with senior nodes (Source: Barabási 2003).

Following simulative attempts of reproducing the born of scale-free networks existing in real networks both abovementioned scholars created a particular stochastic model of few early comers nodes where every new added node can choose to be linked to previously early-comers. As a result later-comers take less advantage in getting connections because they did not accumulate links throughout processing. Probabilistically senior nodes enjoy a more profitable position due to cumulative accumulation of connections during time. Interestingly respect to a further assumed augmentation in number of nodes to be linked to, ranging from two to an arbitrary value, it seems that final result does not change leading to the same findings (Barabási

et al. 1999). After *a certain time* as long as new nodes are added, network reaches hub-dominated structure keeping the same one for all the time. This is what is called *preferential attachment* model and perfectly overlap the previous mentioned rich-get-richer phenomenon showing how apparently distinct types of networks obey to the same regularity. Alongside Pareto's law literature offers a massive array of previously discovered similar empirical evidences especially in social sciences. Dissertating knowledge and science production Merton (1968b) recurs to a evangelical expression *for unto every one that hath shall be given, and he shall have abundance; but from him that hath not shall be taken away even that which he hath* putting in evidence how scientists already well known tend to get more citations than others massively augmenting their fame at the expense of late-comers and regardless objective merit. Similar findings leading to a success breeding success model confirm the above named *Matthew effect* relating to academic quotation system (Price 1976; Lotka 1926; Bradford 1985), word use and language (Zipf 1949), urbanization of cities (Xavier 1999), sexual relations (Liljeros et al. 2001), group behavior decision making (Ash 1951) and consequent groupthink (Janis 1982) further validating preferential attachment model in different types of networks. Following an explicative picture of a preferential attachment network (Figure 14).

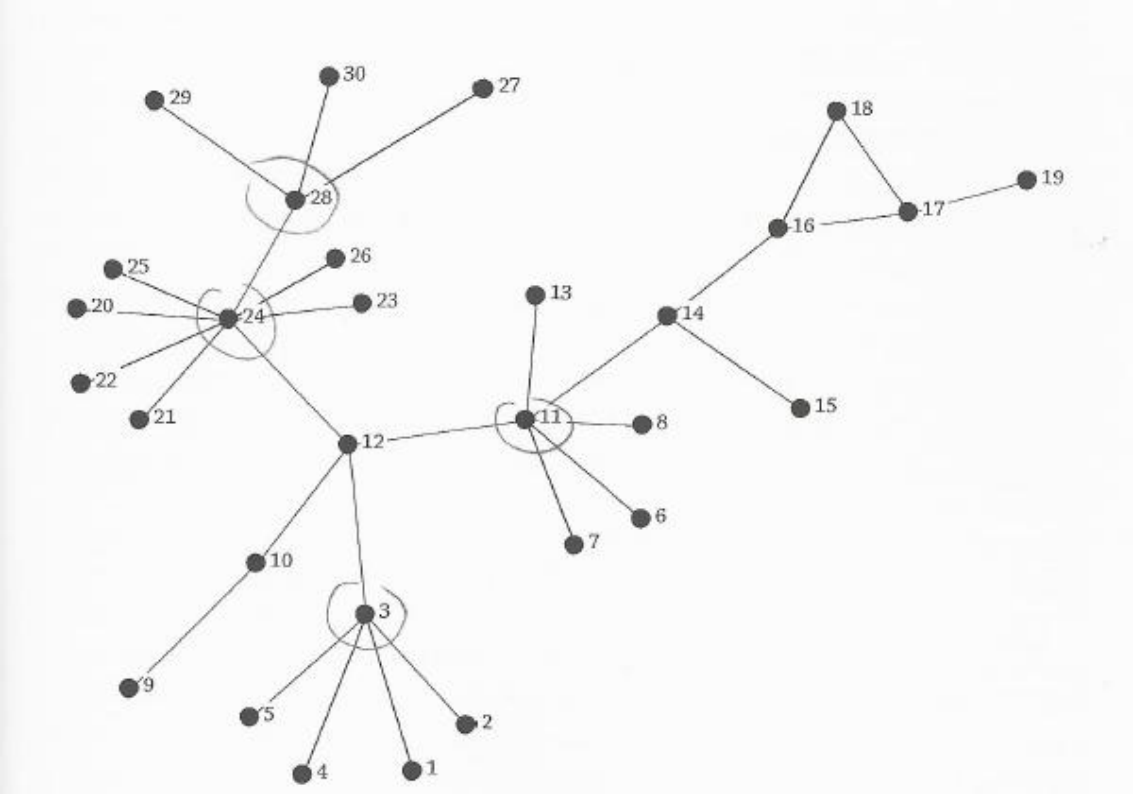


Figure 14. A preferential attachment network. Nodes are progressively ordered. Few early-comers take a clear advantage at the expense of the most numerous late-comers whose degree value is consequently lower (Source: Kadushin 2012).

Beyond social and natural phenomena related to economic inequality, poverty and hubs-domination in power law distribution existing in natural sciences too the matter of why such hubs emerge remains unsolved and a wider reflection is needed.

2.3. Order and disorder can coexist dialectically: towards panism?

As pointed out in the introduction to this chapter network approach represents a new perspective on world needing to be broadly explored. The study of networks is in fact part of the general area of science known as *complexity theory* (Hayek 1978; Hayles

1991; Solomon and Shir 2003; Gogolin et al. 1999; Snooks 2008; Bechtel and Richardson 1993; Sawyer 1999) investigating collections of interacting parts (Buchanan 2002) – be it atoms, cells, individuals, traders on a stock market floor, nations etc. in their relational self-organization pattern (Kessler and Werner 2003). Being always interacting parts of a whole system they can be represented by recurring to a networked graph and in this sense revealing underlying organization they enable a profound reflection on hidden laws of form ontologically done (Barabási 2011). The presence of hubs is one of this regular peculiarities existing not only in the world wide web but also in other complex systems here briefly explored. It is needed to anticipate that hubs are responsive in generating a particular type of networks called *small world*. In the light of recent spreading in complex science literature it can be worthy of being mentioned the fact that several real networks share such power law distribution and hubs-dominated organization posing a serious challenge to ontological questions. By way of illustration using simulative model world's rivers networks show a fractal model where power-law distribution of water flows emerge clearly inviting to quest originary hydrographic genesis (Iturbe and Rinaldo 1997). Analogously this is the same case of interactions network between the various proteins in the yeast *Saccharomyces cerevisiae* (Jeong et al. 2001), networks of neurons in several species of animals and insects (Latora and Marchiori 2001; Lago-Fernández et al. 2000), neural networks in human brain (Yong et al. 2007; Smith Basseth and Bullmore 2006; Bassett et al. 2006), scientific co-

authorship (Redner 1998; Newman 2001), human language structure (Solé and Ferrer y Cancho 2001), metabolic networks (Jeong et al. 2000) all showing power law distribution architecture (Amaral et al. 2000) regardless they are social or properly natural networks. The fact that they all share the same topology being ubiquitous compels to review complex systems in the light of a unique and probably unified network ontology and this is the reason why network analysis represents a plausible new perspective on world posing as plausible paradigm. Whilst previous paradigm have focused on micro analysis of an assumed complex and always variegate reality or on macro predictable and ordered reality reduced to a comparable subject, network analysis seems to looking for another dimension tending to sew such apparently divided perspectives. Especially for what concerns sociological academic debate on where posing network approaches the matter results controversial due to traditional distinct approaches it was introduced to sociology since the 1930's. Thorough decades research on social network analysis addressed distinctly either structure both agency orientation. Predominance of a macro structure on agency representing a legacy from Harvard School is clear in some works (Wellman and Berkowitz 1988) while recent developments admit a *meso*-level of analysis (Collins 1992) in line with the previously mentioned analytical sociology (Goldthorpe 2006; Hedström 2006; Barbera 2004) and alongside other authors' statements addressed to a circular and reciprocal influence between structure and agency within social network (Knoke and Kuklinski 1982;

Marsden and Lin 1982; Wasserman and Faust 1994). At the contrary a hardly opposition from other scholars states for an impossible epistemological compatibility among them (Porpora 2002; Salvini 2005). Nevertheless more recent contributions seem to shed light on a fruitful possibility of mixing approaches (Crossley 2010; Trobia and Milia 2011) focusing on meso-scopic dimensions (Onnela et al. 2012). However the more interesting aspect in network approaches is the common ground shared with physics in analysing reality. The core of such common root relies on the concepts of emergence previously mentioned and the key-point of phase transition from a status to another one or from micro to macro dimensions. Returning on the treated power law and hubs-dominated topology another aspect to deepen is due here. It is worthy of being mentioned that beyond the fact that the latter architecture exists in a wide array of complex systems already listed, power law emerges also at *a certain point* of physical processes when a status transition occurs and thorough it. Practically power laws operate during a phase transition. It is the case of freezing processing where disorganized liquid water *at a certain point* is substituted by the perfect order of crystalline ice (Barabási 2003). Similarly the randomly oriented spins in a ferromagnetic metal are disorderly disposed unless an external high temperature leads to a sudden change in their orientation (Figure 15). In the vicinity of the critical point both process quantities show the same power law distribution corresponding to a disorder-order transition. Particularly in the latter case proceeding with the phase transition

induced by external high temperature some clusters of atoms change spins direction influencing the resting ones until they are all ordered in the same way. This seems occurring because of a fascinating internal "communication" between atoms (consequently designing a graph) that at *a certain point* and *in the middle of* process start to looking for a stable order within system.

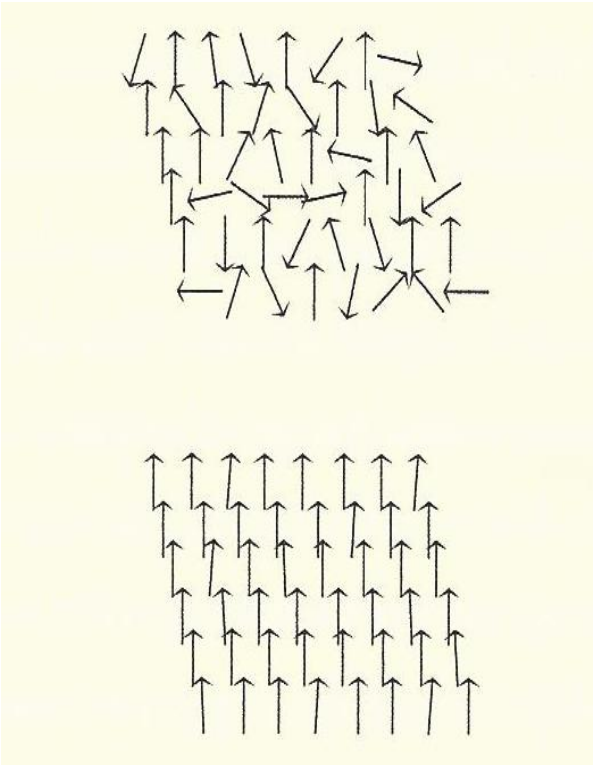


Figure 15. Disordered spins directions and their transition to an ordered disposition under external high temperature stimulus (Source: Buchanan 2007).

Such latter aspect directly crosses a more wide matter related to the rise of a new social physics (Urry 2004; Galam et al. 1982; Ball 2002; Stewart 1947, 1950; Glymour 1983) as previously theorized by Comte at the origins of sociology in the 19th century and

addressed to observe reality in the light of a renewed common ontology. As argued by Michard and Bouchaud (2005) individuals respond to external forces sharing common social norms but at the same they are influenced in changing opinions and eventually norms by interacting one each other exactly at the same manner of *embedding* Giddens' notion (see chapter 1). Such statements coherently meet reflection on the matter of order in social systems already addressed by several authors (Lewin 1992; Waldrop 1992; Bailey 1990; Marion 1999) admitting the need of partial disorder (*entropy*) within systems (Bailey 1994). Concluding it appears hopeful insisting on network as new added perspective on (social) reality because of its presumably possibility of staying *between* agency and structure, micro and macro, order and disorder locating *in the middle* of them and capable of favouring dialogue between apparently distinct disciplines. Anyway there are still more puzzle-solving than solved and answered questions. Referring to succeeding chapter treatise will be addressed to show how order and disorder are combined together in social systems recurring to a deeper investigation of small world theory and its conveniently evolutionistic implications alongside empirical outputs for social phenomena.

CHAPTER THREE

Apparently distant and apparently close but just living in a small world

I read somewhere that everybody on this planet is separated by only six other people.
Six degrees of separation. Between us and everybody else on this planet.
The president of the United States. A gondolier in Venice. fill in the names.[...]
It's not just big names. It's anyone. A native in a rain forest. A Tierra del Fuegan. An Eskimo.
I am bound to everyone on this planet by a trail of six people. It's a profound thought.

John Guare

In the new global economy, connection has become a central issue for a wide array of disciplines ranging from sociology to informatics, from political science to economics not to mention communication studies. In a networked society none can think to escape from a reflection on connections and mutual influences across countries, communities, global movements etc. This chapter aims to review literature on the theoretical framework I employ to encapsulate the following research findings. I refer to small world theory and its current empirical implications. The second part will be dedicated to the more specific epidemiological and diffusion models able to shed light on the contagiousness of social phenomena by prominently taking into account online environments. Discussion will directly cross political communication flows within social network of different sizes.

3.1. A brief history of small world phenomenon

Imagining the world as a small universe is not such an uncommon belief. The proof lies in the presence of similar ways of saying that exist in many languages and cultures arguing for the existence of an always really close world beyond any possibility of pure coincidence. The basic fact is that everyone is connected to almost any other individual within such a world and so represents a potential and plausible capability of being reached by anyone else just because everyone in the world is part of a unique connected whole. For a long time such a fascinating belief has posed theoretical questions for several scholars looking for a scientific foundation for an overwhelming popular conviction. Experiencing how a world can be really small is not only a matter of chance or coincidence but relies on more profound structural reasons based on network configuration. Despite the average number of each individual acquaintances, namely people directly connected, what really matters in the small world phenomenon is how such acquaintances are in turn connected and how their respective acquaintances are connected and so forth following a long chain until everyone is comprehended within a potential global relational map. It can be easy to understand how such a picture of people connected to other people is really difficult to find in empirical data but several previous researchers attempted to reach this goal employing ingenious means. Formulated in the mid 1950's by political scientist Ithiel de Sola Pool and

mathematician Manfred Kochen (1978) the small world phenomenon addressed whether and how acquaintance-chains can affect political behavior and electoral success. They focused particularly on some process dimensions related to the diffusion of political concerns from the grassroots to the political leaders, innovation spreading for technological advance and strategic use of networking like social climbing.
In doing that they started to investigate three main questions.

- How great is the probability that two persons chosen at random from the population will know each other?
- How great is the chance that they will have a friend in common?
- How great is the chance that the shortest chain between them requires two intermediaries; i.e., a friend of a friend?

These questions can appear to be easy to answer unless some peculiar social aspects complicate matters. In fact if social networks were completely random it would not be difficult to calculate such values. After estimating the average value of every individual acquaintances (*degree*) and knowing how many people inhabit the world or a given area a plausible answer can be provided. If each individual on average knows 100 people and everyone of them knows 100 further people who in turn know other distinct 100 people in only three steps (a friend of a friend of a friend) you can potentially reach 1.000.000

people. The latter description corresponds to a society living within a social structure vacuum and clearly this is not the case. As explained in the first chapter like-minded people tend to join together according to homophilic forces that determine a strong social vicinity between likeminded individuals and a further long social distance between people depending on different social structural dimensions (profession, hobbies, lifestyle, class etc.). Beyond that other important factors seem to drive social network formation. Just to recall the above mentioned example every one of us share a certain number of common acquaintances with our relatives and friends. This means that a close friend of mine cannot easily expand my potential new acquaintances because if I have two friends they probably already know or have a great likelihood of becoming acquainted in time. This is what Rapoport (1957) defined as *triadic closure* representing a helpful concept for comprehending social network formation but at the same time leading to a more complicated situation for supporting the small world phenomenon; that is, social networks evolve in such a way that triads tend to close up on themselves reducing a broad expansion of further acquaintances and affecting a real possibility of reaching everyone in the world through a chain of a few steps. Consequently transitivity in forming new relations implicates redundancy in linkages that in turn generates the tendency to cluster together because of a mutuality of ties within like-minded people. Such social network peculiarities that are not random make the difference in a determinant way. Whilst people within clusters are plausibly

connected one to another restricting distances depending upon the same social dimension – be it profession, proximity, lifestyle, friendship circles etc. – it seems that out of that connection morphology changes configuration and dynamics to create huge social distances within distinct kinds of clusters. All such preliminary considerations compel one to review any possibility of formulating a mathematical social network model in the light of social structural dimensions. In this way sociality appears to be structured in peculiar ways and in this sense suggests a partial order within randomness (see chapter 2). As a result social structuredness challenges randomness and consequently forces us to reject a strongly determinist position as will be clarified later. In this sense explaining the small world dilemma should necessarily deal with and unfold a dimension made up of overarching structures affecting individuals in linkages, opportunity and psychological motivation or agency to network in specific ways, not to mention the lack in knowing one's own friends' acquaintances. In its complicated formulation the small world phenomenon seems to raise more questions than answers due to the need to take into account the dialectical agency-structure dilemma discussed above. Taking apart the latter issues Pool and Kochen primarely focused on structural dimensions of human acquaintances network formation and configuration for explaining the small world phenomenon even if aware of social structure-related complications.

In order to construct a mathematical model able to reveal the small world belief in empirical terms Pool and Kochen selected a certain number of individuals from

different social classes who were asked to list people acquaintances and indicate their common contexts. For what it is concerned to social structuredness level they attempts to estimate value according probabilistic assumptions. In their timely study Pool and Kochen concluded that the most of respondents needed averagely two other intermediaries to reach everyone else within network. This is what is called *average path length* in network vocabulary, as will be explained in more depth later. Unfortunately these preliminary results may have not broad generalizability due to partial consistency of empirical dataset: nevertheless they merited to provide scientific relevancy by launching small world dilemma within academic discourse. In addition they compelled to avoid considering any social motivation revealing how such connection occurred neither whether plausible pre-existing connections expired for a certain reason (death, conflict i.e.), namely they did not pay attention to micro dimensions of network formation not to mention arduous matter of dynamic growth. These seem to be persisting problems just because they unavoidably arise within controversial sociological dichotomies ranging from structure to agency and viceversa. In this sense the latter concern was at least taken into account by following attempts to provide preliminary answers to the small world dilemma. Further attempts were made in order to properly formulate small world theory based upon experimental approaches.

In 1967 social psychologist Stanley Milgram employed a singular expedient aimed to estimate how many acquaintances averagely would it take to connect two randomly

selected individuals. His method was conceived to empirically trace chains between selected people and consisted of using a letter-referral technique. After randomly selecting a handful of starting individuals from Wichita in Kansas and then from Nebraska they were required to send a message to further target persons in Boston (Milgram 1967) and Cambridge in Massachusetts (Travers and Milgram 1969). Few information help them: name, profession, residence and age of target are claimed whilst the only limit was contacting people already known. In order to trace processes starting persons should indicate whom they send to even if in case of personal basis acquaintance or depending upon who they suppose being a good intermediary to reach final target persons. This leads to individuate how people orient their choices in reaching other unknown people posing potential interesting insights for comprehending social network formation in terms of micro-based information. Surprisingly and out of any expectation a considerable amount of people succeeded in consigning message to the final target person despite a certain number of mediator channels. In order to verify how and whether either social and geographical distances imply reachability they planned to start from three distinct groups based upon social specificities. Being target person a financial broker from Boston they selected starting people according distinct criteria: a first group made up of Nebraskan randomly chosen people followed by a second one consisting of Nebraska stockholders and finally a third group of Boston inhabitants randomly picked. Intuitively the last one succeeded more than others

showing a success rate of 35% and confirming how geographical proximity positively affect reachability while a significant 31% was obtained by Nebraskan stockholder group supporting homophilic influence in social network formation. In both cases the number of intermediaries did not exceed six individuals locating between an average value equal to 4.4 in the first case and 5.4 in the second one. Unexpectedly Nebraska random group reached target person recurring to averagely 5.7 intermediaries showing a successful performance in the 24% of case. They concluded that less than 6 people are between any pairs of US citizens. Beyond surprising result what it is worthy of being recalled here is the fact that sociality plays a determinant role in how social network formation occurs and develop. Proximity and homophily seem to drive in a such dynamic way small world issue: in detail they affirm that social communication is sometimes restricted less by spatial distance than by social distance. What they noticed was a significant gender based homophilic choices alongside a tendency to select people of the same ethnic group: practically participants were three times as likely to send the folder on to someone of the same sex as to someone of the opposite sex just like tendency to contact like-ethic people. For this reason both authors supported hypothesis of structural relationships racial barriers-related within US social stratification. Various criticisms have been made of the methods in this study. Firstly such data are locally situated and not having significant generalizability (Erickson 1979). Secondly it is not totally clear why some chains are interrupted while other ones are successful (White

1970; Kleinfield 2002). Thirdly starting people selection cannot imply tracing real network and anyway do not permit to individuate the most short path (Killworth et al. 2006). Both authors take consciousness of some micro-dimensional-addressed limitations in their study to state that when we speak of five intermediaries we are talking about an enormous psychological distance between the starting and the target persons, a distance which seems small only because we customarily regard "five" as a small manageable quantity (*ibidem*). Undeterred by precariousness in letter-reference method and following diffusion of well-known six degrees of separation formula, several studies attempted to unveil secrets of small world belief especially focusing on dialectical relationship between social distance and several types of social stratification related variables. Some of them report significant correlations between network closeness (as inverse of social distance) and professional opportunities (Erickson and Kringas 1975); between same-sex individuals and social distance (Lin et al. 1977); same-ethnical individuals and social proximity (Korte and Milgram 1970; Lin et al. 1977; Weimann 1983). Similarly small world method was used to investigate social distances within organizational context measuring how socially distant are individuals depending on different level of bureaucratization (Lundberg 1975), connectedness among students, administrators, heads, dean etc. within universities (Shotland 1976) and schools (Stevenson et al. 1977). Except for a preliminary attempt to avail telephone (Guiot 1976) more recent researchers approach small world issue recurring to a shift in

using medium. In stead of letters they make use of emails aimed to emerge a wider exploration of small world phenomenon anyway maintaining method. Despite its great potential email use it is important to realize that email use has its limitation too; just to give an example digital divide biases email method in generalizability due to a lack of Internet access in some people (Lenhart et al. 2003). On the other side its strengthen lies on the possibility of recurring to a cross-countries expandable sample. In this way small world experiment was replicated in 2003 with more than 61 thousands of email users in 13 distinct countries (Dodds et al. 2003). Albeit success rate in reaching target persons was low (only 1,6 chains result successful) and average number of intermediaries was 4,05, the most striking result to emerge from the data is that individuals do not appear willing to pass messages in absence of incentives. The latter aspect unavoidably urges micro-oriented rational choice reflections in social network formation further confirming an at least double nature of small world dilemma ranging from structure to agency and viceversa. It is not case if they state that network structure alone is not everything (*ibidem*). Such micro-dimensional point was further investigated by a more recent experiment showing how in absence of local information on surrounding structure (namely our immediate and direct relatives) discovery of the shortest path in reducing intermediaries within a certain network can be really difficult to obtain. In this sense social identities permit to guide individuals within structure leading networks being the trade off between agency and structure (Kleinberg 2000a;

2000b). Nevertheless experiment sheds light on very relevant information relating social network configuration. Particularly same-sex homophilic tendency in developing social chains is further supported alongside geographical proximity. Mention should also be made of qualitative information in relation to structural network morphology. Respondents were in fact asked to specify how they have known people whom they send letter to by explicitly indicating their kind of relationships (friendship, sibling, acquaintances, co-worker, partner etc.) and why they retained them a suitable choice for reaching final target people. Interestingly the more relation between starting person and following channel is low in strength and intimacy the more reachability increases. This means that weak ties in personal networks favour search ability in line with the well known Granovetter's work on ties and employment chance (1973). Albeit relevancy of the latter ones will be better illustrated in next sections it is useful to anticipate that such weak ties are even responsive of solid connectedness and small world phenomenon also in absence of hubs (Dodds et al. 2003). This also accords with our earlier observations, which showed that clustering alongside triadic closure attain redundancy information dimension; mutual communality of ties reduces access to new information affecting professional opportunities and shrinking bridging social capital (Putnam 2000; Burt 2000; Lin 2001; Woolcock 1998; Adler and Kwon 2002). Pertinently the reason why such weak ties are relevant in potential reachability stems from their social connectivity potentiality in so far as they permit to connect not only individuals themselves but

distinct “small worlds” around them or properly said clusters homophily-driven (Figure 16).

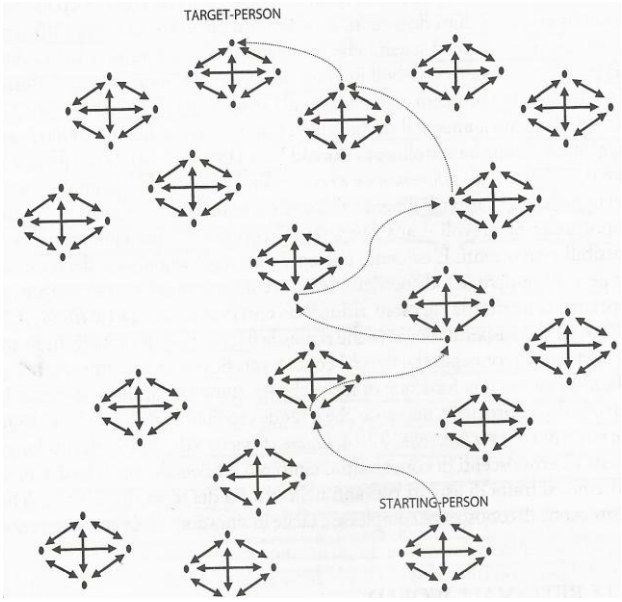


Figure 16. Travers-Milgram experiment on small world. Every cluster is a small world itself while weak ties permit information to flow beyond them (Source: Ramella 2013).

Standing apart from a strictly micro-dimension of small world phenomena a mathematical formalization of the model was made by Watts and Strogatz (1998) in order to comprehend how network formation provokes a small world effect. In doing that they compelled to deal with posing questions on dynamicity and growth in network formation and change. Recurring to simulative models they started from a fixed number nodes network based on strictly ordered meaning that each nodes is connected to the closest ones (Figure 17). This seems to be the case of the *regular lattice* in the disposition of ice atoms following phase transition from chaotic water liquid status to

solidity as discussed in the previous chapter. In social terms such situation corresponds to individuals connected only with their closer relatives. As visualized in the picture C is directly connected to C1, C2, C3 and C4. In case you want to reach other people within network you need many other individuals you are not directly connected namely you have to recur to several intermediaries to achieve goal. If you consider several millions of people in the world one life is not enough to do that because you should repeat steps until the goal-individual is reached. This means that social distance within an ordered network is so long because you need several millions of intermediaries to reach everyone is not directly connected with you or your closer relatives. Randomness does not exist within the first case due to a supreme order domination where your acquaintances know each other whose in turn know each other with their respective relatives and so forth. P value is a randomness indicator that is equal to zero in a totally ordered system and 1 in a completely disordered one. A system like that requires a huge amount of forces to work.

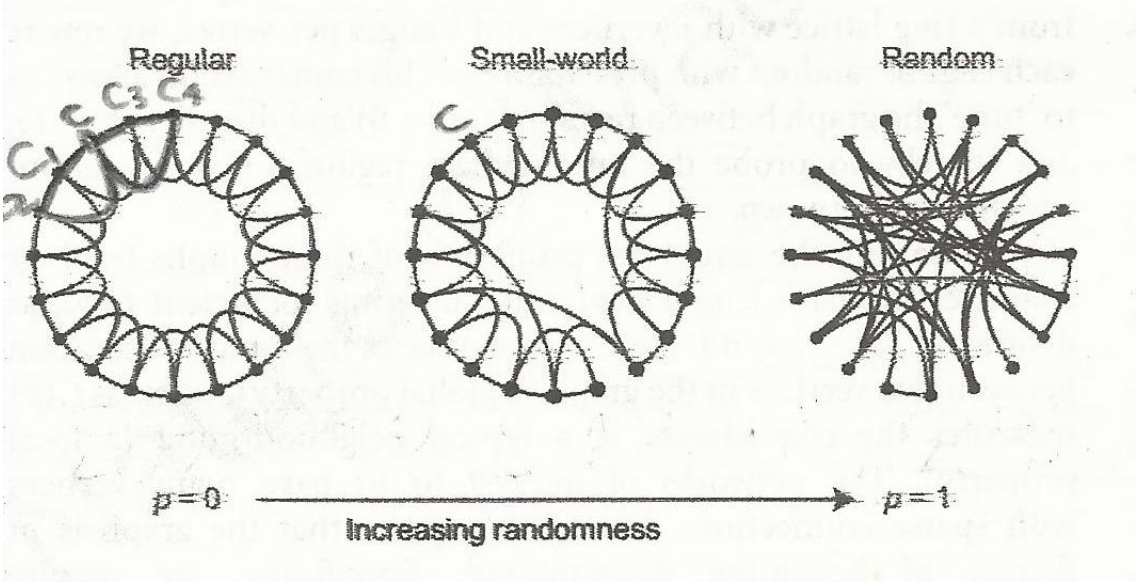


Figure 17. Wattz and Strogatz small world model (Source: Watts and Strogatz 1998).

Their simulative model permits them to contemplate the portion of randomness in rewiring the same nodes. On the opposite side lies disorder dominated final state. None peculiar rule drives nodes connection and randomness reigns. Everyone can be connected to anyone randomly. In a such situation chance is the only guide to reach individuals like in the first case and you have to surrender fortune unavoidably if you look for an individual within such totally chaotic network. Even in this case your efforts in reaching everyone would be very high. Contrary to the first case social distance is reduced and closer relatives are necessary connected one each other. Both extreme cases imply presence of impressive exertion. If you want to transmit things (information i.e.) within such extreme networks one life is not enough. Order and disorder alone appear poorly efficient due to a massive effort in flowing things within them. Obviously both

situations stand for extreme cases and this might mean that a medium situation can represent a good compromise. This is what Wattz and Strogatz noticed within their model ranging from a complete order to a further overwhelming disorder. *At a certain point* of simulation, just as soon as portions of randomness invade rewiring connections logic, something surprising occurs. In the phase transition from order to disorder a phenomenon worthy of mention emerges. They affirm that few random edges are enough to drastically shrink distances between nodes even in absence of hubs leading to the rise of what they called small world networks. In such medium phase order and disorder coexist raising a more efficient system due to reduced distances and local order within the closest relatives. In social terms few weak ties are sufficient to reach a huge number of remote people so assuring connectivity at minimum exertion. This means that even an apparently minimum local change can effect important variations, making a difference at a structural or global level making difference. Very simple rules, at the level of individual actions, can generate bewildering complexity when many such individuals interact over time (Watts 2003). In this sense small world networks dialectically contain a contingent unfolding dimension ranging from agency to structure and viceversa, from individual to structural level, from micro to macro, from order to disorder. Further mathematical explications can be useful in comprehending dynamicity in small world network emergence and growth. In pursuing the explication of the small world phenomenon Watts (1999) formalized a mathematical model able to validate

small world effect within a social framework. Firstly further preliminary mathematical concepts are due in order to completely understand even though they already raised. *Clustering coefficient* and *path length* represent key-concepts for comprehending small world structural properties of a given network. Both of them can be referred to local portions of nodes showing degree embeddedness of nodes or averagely done as overall structural property of network. The former is defined as a measure of the local graph structure. Specifically if a node X has K_x immediate neighbors, then this neighborhood defines a subgraph in which at most $K_x(K_x-1)/2$ edges can exist (if the neighborhood is fully connected). C_x is the fraction averaged over all vertices in the graph. Equivalently C can be regarded as the probability that two vertices will be connected, given that each is also connected to a "mutual friend" (Watts 1999). Clustering coefficient ranges from 0 to 1 depending upon higher of lower value of embeddedness of nodes. Recalling triadic closure concept is due to understand how such value tends to 1 as soon as every potential connection occurred to triadic closure property. The more clustering coefficient tends to 1 the more nodes are directly connected in reciprocal way. Conversely if none of the possible connections between the neighbours of a certain node are realized clustering value is equal to 0. High clustering values stand for strong embeddedness degree of nodes. It is easy to comprehend how high clustered networks represent close relational world unless some weak ties connect them to other clusters. The tendency to close up of high clustered network restricts reachability possibility

within triadic lines as in the case of regular network. For this reason another mathematical property is needed to display how extended a network can be regardless its number of nodes and clustering coefficient. Structurally a huge amount of nodes does not necessary guarantee alone a small world effect because you need to know how distant are them within it. Path length aims to measure such distance within individuals within a certain considered network. Particularly it is defined as the average number of edges that must be traversed in the shortest path between any two pairs of nodes in the graph (*ibidem*). This value corresponds to an average number of intermediaries you have to recur to reach everyone in the world like in Milgram and Travers experiment. Geodesic is the proper term to indicate the lower social distance value in terms of people-channel. Either clustering coefficient both path length are necessary to define small world networks due to their peculiarities. In the regular graph above both values are very high so that every node is so clustered within its immediate adjacent nodes strongly embedded one each others. At the same manner path length is high too due to the fact that you have to go across several thousands of intermediaries to reach every other node within the same network. On the opposite side random graph presents analogies in terms of extreme values even if in an antithetic sense. Clustering value is low because of a scarcity in embeddedness degree of closest nodes and path length is further low because as it is previously clarified if everyone of us know people who do not know each others who in turn are not acquaintances it can be easy to reach everyone

in the world in few steps corresponding to paths. Contrary to the previous ones small world networks display interesting properties because of a high clustering coefficient alongside small path length values. What they noticed is that processing on passage from regular network to random one both values assumes interesting apparently controversial features able to conjugate high clustering and short length together (Figure 18).

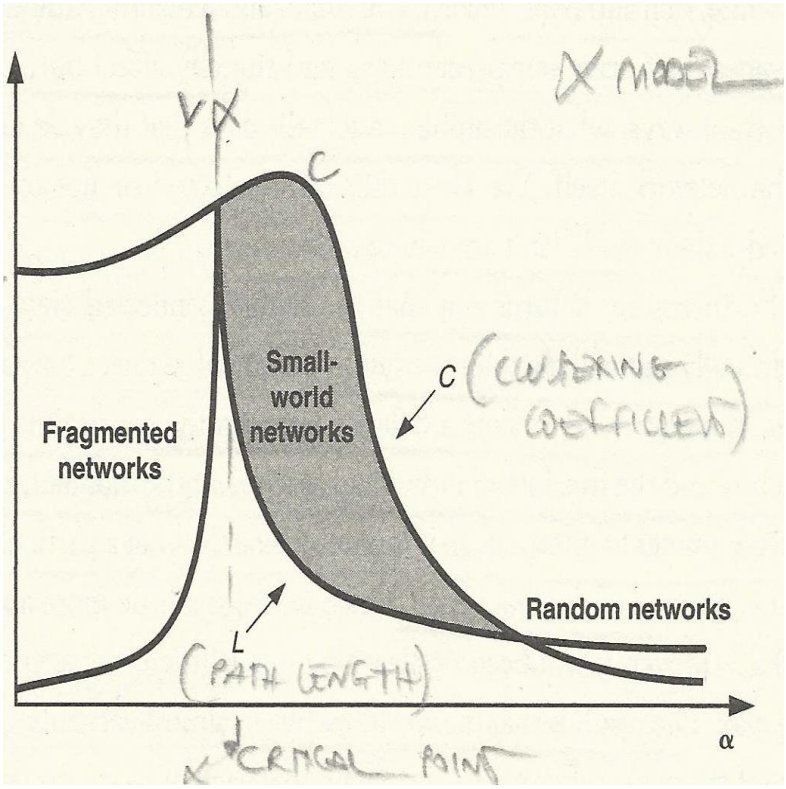


Figure 18. Small world network raise according a dynamical phase transition in what is named alpha model (Source: Watts 2003).

Alpha model visualized in the picture is useful for a better comprehending. Taking apart deep mathematical peculiarities it is sufficient understanding that Alpha value on X axis

represents ratio of likelihood of two nodes connect to number of mutual friends shared by them. Processing on the passage from starting situation where several relatively high clustering networks (fragmented networks) coexist *at a certain point* called critical point as in phase transition, close to the maximum value of C they noticed that L value immediately drops leading to the raise of small world networks shaded in the picture for a certain time until randomness starts to reign. As will be evident in the next section such mixture of low path length and high clustering values seems to be relevant in social and systemic terms.

3.2. Small world convenience

Beyond any plausible coincidence small world networks seem to exist in a certain array of real networks posing several questions at different levels be it ontological, causal or substantial. As Watts and Strogatz already reported from previous research they are peculiar of distinct empirical cases referring to Hollywood film actors collaboration network, the power grid of the Western United States and the neural network of the worm *Caenorhabditis elegans*. In all mentioned cases graph presents a small world configuration consisting of relatively high clustering and short length in relation to the same number of nodes and edges random graph. In small world network both values

challenge randomness showing unexpected mathematical results so that comparing clustering value and path length in a small world network and in a random one being the same in number of nodes and connections clustering value appears higher in the former and lower in the latter one in the same manner of path length. Literature reports a massive range of empirical examples where small world morphology clearly emerges. Alongside the already mentioned complex networks (see chapter 2) other types of network exhibit small world properties (Newman 2003; Barabási and Albert 1999). Ecosystems are small worlds with food web networks that appear concentrating on few hubs-species assuring robustness to the whole one (Solé and Montoya 2000; Pimm et al. 1991; Yodzis 1981). It is the same for other kinds of biological networks (Wolf et al. 2002; Barabási and Oltvai 2004) including brain networks (Smith-Bassett and Bullmore 2006; Humphries et al. 2006). Small world networks with their assuring connectivity at reduced transactions cost not only appear display a comfortable underlying structure for permitting a more efficient flowing of things within but also result strongly robust and resistance in case of a random attack to their consisting parts (Barabási 2003; Hao et al. 2007; Crucitti et al. 2002). In deep hubs small world networks consisted of assure high level of connectivity due to the fact that they detect the most number of relationships. For this reason they assure robustness to a random attack but, at the same time, represent a vulnerable Achilles' heel in the same way because in case of precise hubs failure the whole network falls apart immediately collapsing. This means that a small

world network system risks to be destroyed if their hubs are attacked but not in other "random" cases. Parallelly a random graph without hubs shows relevant vulnerability in front of a further random attack. Interestingly it should be noticed that even criminal networks are figured out in the light of a real applicability of network resistance/vulnerability property and permitting a criminal network surviving or collapsing in case of a hubs-targeted intervention by law (Yang and Sageman 2009; 2007; Yang and Tang 2010; Sageman 2004). Nevertheless concerning research findings are not easily available due to security motifs (Tang and Yang 2012; 2009). Beyond the most disparate applications small world peculiarities unavoidably raises evolutionistic quests in all distinct fields small world network have been discovered until nowadays. Challenging randomness small world networks in their mathematical conceptualization and hubs presence too provoke not only the need to investigate ontological quests on their existence but also presses for stimulating functional meanings discovery. The same fact that they belong to distinct types of system networks represents itself a singular coincidence worthy of being further deepened even if this is not the right place to go into deeper detail. Nevertheless this does not prevent from appearing relevant in respect to sociological phenomena by investigating whether small world morphology emerge in social structures or social systems in generally or even whether they characterized a certain number of social formation be it parties, markets, organizations, corporations and so forth even if a due caution should be welcome in any case. Referring to social

system peculiarities literature counts a modest number of investigations in terms of small world network underlying specific social structure previously analyzed. In addition beyond the ontological question itself another relevant issue lies on the need to comprehend whether and how such peculiar network morphology affect final output consisting of emergent results raising within only and if only networks "works" in its union of interactive parts. Practically if a small world network is of specific social formations what does it imply in emergent terms? Despite questions appear really hard to be answered a list of previously available research attempted to solve such dilemma. The same fact that small world networks showed robustness in pure graph theory seems determine further high tolerance degree and resistance within those social systems whose underlying network structure presents a small world morphology. Beyond the ontological coincidence shared with biological network systems another aspect is worthy of being highlighted that is what a small world system can generate relating to emergent outputs. In this sense previous research within innovation studies found that small world networks can have an effect in improving from one hand creativity emergence[1] and from other hand innovation diffusion (Uzzi and Spiro 2005). In deep Broadway network artists show being small world networked consisting of high clustered networks at local level and well-connected between them globally. Such peculiar morphology permits to conjugate together relevantly necessary advantages.

[1] It can be useful to quote further research on creativity distribution recalling Florida R. (2003) *The rise of the creative class.* Basic Books: New York.

Whilst trust and reputation of artists appear circulate easily within local high dense clusters posing a due level of bonded homogeneity at the same time they appear being better diffused beyond local boundaries of clusters due to short lengths at global level. Reduced distances by weak ties bridges generate in turn an easier introduction of innovation from other clusters anyway they are connected too at a global level. Such virtuous circle appears having a determinant effect on final outputs in terms of success and performance of artists. As a result they show that small world fruitful mix of local cohesion and global connectivity affect creativity in the following way. Correlation is done depending upon clustering coefficient path length that appear negatively associated with creativity and success in case of high values in both measures. This is due to the fact that low clustering values represent a situation where trust and reputation of artists are not fortified due to minority in mutual relation sharing and transmission from outside clusters is impeded owing to fragile connectivity at a global level. On the contrary excessive clustering values do not favor creativity in the sense that mutual and redundant ties are not good conduits for new ideas whereas high path length do not assure a well connectivity at a global level nor innovation introduction that risks to be dispersed. Their interesting findings display how small world networks are able to emerge structural properties ranging from local trust being reputation more associated with micro-level clustering-related to potential diffusion of it by assuring global connectivity through bridges-ties. Similar findings can be traced within further studies

addressing the relation between networks and social capital affirming how such configuration might represent a mix of bonding social capital (Blau 1964; Blau 1994; Burt 2005; Coleman 1988; Coleman 1990; Granovetter 1982; Krackhardt 1992; Putnam 2001; Uzzi 1996) and bridging social capital (Putnam 2001; Burt 2005; Burt 1992; 2001; 2005; Granovetter 1973; 1982; Lin 2001) even if low attention was not paid in terms of small world architecture (Prell 2009). Similarly closure of clusters appears provoking cooperation behaviors (Coleman 1988). Generally it seems that through bond ties clusters generate trust anyway paying in information and resources diversity whereas weak ties compensate by allowing to other kinds of information flows to enter and maintaining a certain overall connectivity. Such peculiar configuration leads to social and economic benefits. Weak ties represents a good mean for problem solving within organizations too (Stevenson and Gilli 1991). Starting from Gans (1965) Granovetter (1985) showed that without weak ties communities appear less trusting in leaders even loosing the occasion to join political movements or mobilize. At the same time they do not receive proper information on time in case of emergency (Zanette 2001). Clusters in turn appear relevant in countries economic success. Concerning the latter issue Fukayama (1995) argues that being good conduits of trust they limit transaction costs in exchanges leading to a more efficient economic performance. In the same way during 1990's German firms resisted to internationalization economic pressure owing to a certain internal connectivity due to weak ties (Kogut and Walker

2001). It seems the same for US banks (Baum et al. 2003). Relevant research showed how interlocking directorates in corporate boards play a determinant role in coordination problem permitting stability of the system (Palmer, 1983; Mintz and Schwartz 1985; Mizruchi 1996; Davis et al. 2003; Scott 1986; Bertoni and Randone 2006) in virtue of structural holes compensation (Burt 1979, 1983). Moreover small world networks play an important role in innovation diffusion and creation (Cowan and Jonard 2003). Beyond the above mentioned studies on artistic creativity there are further research showing how small world morphology positively affect transfer technology (Verspagen and Duysters 2004; Schilling and Phelps 2007) and patenting (Fleming et al. 2007). Alliance of firms can boost innovation (Kogut 1989; Powell et al. 1996; Gulati 2007; Uzzi 1997; Freeman 1991) and produce a virtuous circle like in the case of Silicon Valley (Ferray and Granovetter 2009; Fleming and Marx 2006) or Boston area (Fleming et al. 2004). It seems that small world networked firms enjoy the results of their underlying architecture. Their position in networks in terms of the degree of embeddedness can determine their individual success and also economic performance of territory they are in according a virtuous circle from micro to macro levels. In this sense networks appear confirming their ontological meso-dimension.

Literature reported also a certain array of studies on networks configuration and types of polity. Interestingly networks architecture appears to explain regionalization and federalist tendency (Beckfield 2003) whilst negotiating globalization pressure on a large

scale (Freyberg-Inan 2006). In conclusion small world architecture showed a certain added value in systems they underlie.

3.3. Networked politics

Whilst a large and growing body of literature has investigated the relation between small world networks and organization performance this was not the same for political movement and parties. Despite the fact that politics is intrinsically a network phenomenon it seems that it was largely treated as a solely rational choice or, on the contrary as an electoral polls issue. Scientific research contemplated politics from one hand as a personal affair of presumed atomized individuals rationality driven in their political belief and from the other one as a macro perspective on parties prevalence. Looking at the state of research on political science and networks a vacuum emerges evidently lacking of a third dimension done by diffusion processes in political belief, adherence, join, support and so forth. The lack of scientific reflection increases if referred to how underlying networks parties and movements consisting of affect electoral performance and consequent political success. A recent editorial in the Journal *Social Network* (McClurg and Lazer 2013) claims clearly that relational dimension in politics was no longer debated despite the same small world reflection being politically addressed in its original scope. Nevertheless research development on the topic has been

fragmented until recent new timid interest, probably related to internet studies. It is surprising that potentialities of networks were not pursued more extensively in the last decades and this is probably also due to a certain difficulty in collecting network data on a large scale as well as the problem of growth and continuous change. Nevertheless there are preliminary classics in social theory who started to look at political issues in the light of networks system even if with a certain defined perspective. Recent network literature on sociological phenomena have reported an example is worth recalling. I refer to the political machine broadly treated in Merton's works (1968). Albeit his analysis aimed to indicate how even deviant behavior and structures play a role within system in functional terms what it is relevant respect to the core of such work is that Merton pointed out how network political machine is consisted of determine efficiency within social system at distinct levels. In composing a functionally working structure the political machine acts as a broker between business system and racket system supporting both in their respective scopes. At a micro level political boss as political machine exponent capillary serves surrounding territory while maintaining a privileged relationship with the more central party organization. Even if Merton does not explicitly refer to efficiency in networks in a way he argued how they are able to fulfill functions other official and deputed system cannot do. Despite socially stigmatized in corruption method political boss relational capital seems to work out anyway and better than their complementary systems like public administration aimed to fulfill the same functions.

Beyond proper functionalist perspective what I noticed really interesting is that such efficient system Merton talked about appears very similar to the above-treated small world morphology. Political boss as exponent of political machine enjoys of a peculiar position in network terms. Not only his relational universe represents its key-success being a broker between several and otherwise disconnected clusters but also serves as political mean to spread consensus in periphery where he is well-known. If was possible for Merton providing a network map of boss relationships[2] we probably would have seen a small world morphology made up of high clustering portions corresponding to geographical proximity relations where he greatly acts and few weak ties towards other distant clusters assuring an overall connectedness to the more central party organization. Whereas geographical proximity with its high clustering degree represents a comfortable structure to permit trust flowing general connectivity is assured by central coordination through weak ties. Practically being boss a well-known referent in a certain peripheral area he interfaces party in remote regions owing to its notoriety. In this way personal and directly reciprocal relationships as vehicle of trust because the boss is "one of us". In parallel his connection to further bosses and central party too guarantees an overwhelming capillarity and connectedness. In Merton's analysis small world morphology underlying political machine "works" even if socially stigmatized in its corruption method and consequently reinforcing the normalization of a morally

[2] A graph representing the universe of relationships referred to a single individual is properly called ego-network.

debatable structure. Just to hint it is necessary recalling that such reflection directly crosses other statements relative to organizations efficiency and performance particularly investigated in last decades in management research (Brass et al. 2004; Krebs 2004; Powell 1990; Podolny and Page 1998; Smith-Doerr and Powell 2005). Emergent networks in organizations, flexibility and unfairness in charts are well debated issues within certain academic field in relation to final performance and posing a serious challenge against the universal ideal type of modern organizations whose power lies on a rational-legal system (Weber 1946). In this sense a question might arise: does underlying small world architecture affect electoral performance of a party or political movement or similarities representing a key-solution for potential success? Such controversial question necessary requires further elements to be answered even keeping a huge difficulty in being solved. In particular a brief recalling on diffusion models is needed.

3.4. Diffusing politics

Although political belief can appear a rational personal choice, a part of scientific literature has tried to debate such matters in terms of network diffusion and political contagion. Avoiding a strong determinism there is some fruitful research aimed to shed light on treating political adherence as a question of peer and surrounding influence

(Berelson et al 1954; Campbell et al 1954; Glaser 1959; Straits 1990; Knack 1992; Kenny 1992, 1993; Mutz and Mondak 1998; Beck et al. 2002). The well-known Katz and Lazarsfeld voting study (1955) showed how relations play a determinant role in defining people electoral choice. In this sense they were interested in investigating personal influences between people in relation to media effect. Although academic debate was addressed to understanding how media have an effect on people's electoral choice, surprisingly they found that political preference is bypassed by personal relations regardless any convincing political advertisement. In particular primary group appears responsive in influencing electoral choice. This means that social proximity can be a good predictive in future political choice so that it seems that closer opinion leaders can determine apparently personal choices of their surroundings. Particularly homophilic forces play a determinant role in reinforcing belief so that people appear to be clustered together politically (Huckfeldt and Sprague 1995). Interestingly opinion leaders or influencer enjoys of a peculiar status: in fact mostly they are hubs within network as more researchers showed (Coleman et al. 1957; Barabási 2003). They appear necessary in spreading fads and innovation they catch from more peripheral area of network (Valente 1995; Abrahamson and Rosenkopf 1997; Amos et al. 2008; Dean 1999). It is plausible thinking that hubs small world architecture consisting of seem to favor a more rapid diffusion by substituting direct embeddedness with original source. Simulative models confirm that spreading of a virus is more rapid in small world networks respect to a

random graph regardless virulency (Shirley and Rushton 2005). Similarly scale free networks are effective in permitting virus diffusion surviving (Pastor-Satorras and Vespignani 2001). With respect to the latter point contradictions seem emerge. Taking apart for a moment diseases spreading and talking about innovation diffusion in simulative models further researchers showed that on the contrary a small world topology cannot accelerate flowing of innovations deterministically (Valente 2010; Chiang 2007). Whilst clustered networks appear useful in local spreading at the same manner of boss role in remote areas, if considered alone they are not sufficiently convenient if you are targeting to a overall spreading within a more multi-level global system. In that case you have to insist on individuals able to fill what Burt (2005) called a *structural hole.* Individuals that due to their bridging position within network can connect distinct clusters are properly called *betweeners* and their peculiarity relies on detecting power to union two or more clusters otherwise separated. In doing so they fill a structural hole. It is important to note that the above-mention political boss is nothing but a betweener enjoying of their privileged position who make him/her a broker. Despite network effect can appear deterministic in its conclusion it is necessary to highlight here how micro-dimension is not excluded in these models. Diffusion of things - be them whatever you can imagine - should necessary deal with psychological micro-aspect that some authors previously contemplated without escaping from them. In this sense they recurred to construct their spreading model assuming that agencies are

not the same in terms of availability to accepting a certain thing (adopting a behavior or purchasing a good i.e.) but are described according a distinct level of individual threshold whose overcoming determine the act itself (Granovetter 1978; Granovetter and Soong 1983; Gladwell 2000). As a results it is important to be careful and take into account also a micro-dimension within diffusion models especially for what concerns political adherence or supporting. Turning back to more specific diffusion dimension Kadushin (2012) states that in successful diffusion there is a balance between the embeddedness of the leader in a dense group that promotes a certain thing or having a position as a bridge between groups, so that flow can go out of its original circle. Such principle appears used also by marketing studies affirming that in spreading online social networks two effects are relevant. Firstly, an individual who is connected to many adopters has a greater adoption probability (degree effect). Secondly, the density of connections in a group of already adopted consumers has a strong positive effect on the adoption of individuals connected to this group (clustering effect) (Katona et al. 2011). Other research on diffusion models can result useful in completing puzzle. In fact even if innovative technology, goods or similar cannot be easily assimilated to political participation or party official supporting being those efforts requiring activities, there are previous researchers attempted to treat them as contagious phenomena taking apart any rationally-driven choice dimension and putting the accent on peer influence. Yet, despite vast amounts of research into political decision making, very little attention has

been devoted to its relational dimension. In this sense there are only few studies concerning contagiousness of political adherence (Nickerson 2008; Sinclair 2012) and only one of them explicitly refers to small world framework. In deep the latter one (Fowler 2005) recurring to simulative model showed that cascade effect in political attitude spreading can occur in some cases: particularly they highlight how homophily can reinforce political action. They affirm that the more like-minded befriending is, the more motivation in participating increases. In addition they noticed that turnout cascades are primary local phenomena occurring in small parts of the population whose degree separation is low. Once again small world topology confirms its powerfulness revealing that political norms and information tend to circulate mostly within groups rather than travelling between them if network is high clusterized. Transitivity whose clusters are based on permits to reinforce belief at a local level but risks to close it within a vicious circle without any possibility of escaping from the borders of cluster. Then weak ties towards other clustered regions are needed for diffusion of political ideas on multi-levels. In the light of that the key-problem rests the same illustrating in these chapters. How is it possible that *at a certain point* a some phenomena – be it properly political, economic or whatever considered - explode and spread everywhere even if with different intensity or rapidity? Is really small world architecture the key? These are dilemmas to be solved yet even if some preliminary answer has been provided. Anyway the reason why social network analysis is beginning to rise only

recently within political discourse rests a controversial question. Beyond the difficulty in isolating a presumed network influence with respect to other potentially intervenient variables and not to mention the hardness in collecting network data, what makes really difficult to pursue on network research is the continuous growth and change networks are unavoidably subjected together with an ongoing theoretical reflection. Moreover what networks emerge by connecting is currently a debated dilemma shared by a massive amount of disciplines. For this reason networks are still seeking its final theory (Collins 1992) whilst other scholars claim it was able to give birth to partial and situated laws like Granovetter's strength of weak ties. Hence, networks are what more intricate it can be imagined. Partly chaotic but also ordered at the same time, they range from the infinite complexity underlying their formation at a micro level, to the self-organization they display in those structures emerging from them at a macro level. They are ubiquitous playing a crucial role in permitting a system to work. Their complexity plausibly obey rules still unknown but anyway worthy of being explored just for this reason. In a such as arduous as fascinating dimension like that, the only way you can pursue is adding a piece in this intricate puzzle whose final image is not revealed yet.

CHAPTER FOUR

A methodological protocol made up of network data

The long-term aim of this research is to provide a contribution to the small world theory specifically referring to political phenomena. In the light of the previously broadly discussed scientific literature, I argue that social research on political issues can be ameliorated by looking at underlying network structures concerning political movements. Such a perspective can potentially reveal how some parties resist change regardless of historical circumstances whilst others do not and provide key-answers to questions on the extent network to which configurations are responsive to a supposed electoral success. In this sense small world topologies have been successful for maintaining efficiency and functionality within a wide arrange of complex systems. This leads us to pose the same questions in reference to social formations such as specific political movements. Since small world architecture seems to assure global connectivity by making shorter paths between individuals while keeping high clustering areas, the key question is whether they represent a determinant factor for electoral success within parties or movements whose underlying network structure so constructed in this way. Such a fundamental macro-question cannot be answered unless several

exploratory research is undertaken with a view to the same final scope. As has been said political science currently lacks specific attention to the relational dimension and networks in the rise and spread of parties. This appears more evident if you refer to small world theory as a theoretical framework encapsulating such data. This research aims to fill the gap providing a preliminary empirical contribution by examining a peculiar case-study I will illustrate. Here I will discuss my method of using social network sites to generate data for a social network analysis. In addition the case study is of a relatively new local political movement called CambiaMenti and located in a small sea-town in the Western Sicily called Castellammare del Golfo.

4.1. Collecting network data: the new challenge of big data

Plausibly the most relevant reason why social network analysis has not seen a certain diffusion within academic political discourse until now can be ascribed to the difficulty of collecting network data. Intuitively it seems that reconstructing the total number of relations underlying not only the official members of a given party but also their immediate neighbors would require great effort particularly since networks always grow, change and modify themselves over time. For this reason especially in its origin, social network analysis was broadly used to refer to relatively small groups of mutual

interactions where the collection of data is more practicable[1]. Until now most of the research based on social network analysis has been conducted through data collected by recourse to questionnaires whose content was addressed to reveal who knows whom and mutual relations among a certain given sample. Specifically the former is what is called a *name generator* technique while the latter is defined as a *name interrelator* technique. It is easy to imagine that in the most fortunate of cases every individual can indicate a limited number of acquaintances and barely the total one of people already met and known in own life. Regardless of any qualitative aspect that is able to reveal the intimacy of a given relation, what is relevant in my study is understanding a general structure of a given political movement that I take in consideration as a case-study. Apart from any qualitative aspect concerning network formation, I conduct my analysis on a more structural level unveiling its underlying network from the rise to the official launch according a growth network perspective.

Dealing with social networks always involves an unavoidable compromise due to a necessary choice in selecting the level of analysis, from micro to macro or viceversa: just like a zoom lens on intricate networks you have to previously select the minimum unit from a certain individual with his/her immediate neighbors adding in turn their respective neighbors and so on. Every piece of social network research compels you to limit network borders within a certain level that you want to consider for your analysis,

[1] In this sense it can be useful to recall Moreno (1964), Mayo (1949), Homans (1950) and their preliminary studies about relations configurations within small communities.

depending upon data availability and the general scope proposed. Intuitively research on a small sample permits a modest ease in collecting data even if paying a price in terms of generalizability. But hoping to construct several levels of analysis from a certain basically given sample of people to their friends and friends of friends plus their respective acquaintances can be really hard to pursue. Before the advent of social network sites relational data were collected by the above mentioned questionnaires and manually located into a matrix called an *adjacency matrix* or a *sociomatrix* able to visualize a graph of relations by using appropriate software. Beyond their pervasive diffusion and use the real challenge of social network sites belongs to their potential capability of designing relations on several levels in a previously unimaginable way. Practically social network sites represent a fruitful dataset for the future and not only for network-addressed research. For their enormous large-scale potentiality they are defined as big data even founding a large array of applications within marketing, economics, sociology, communication research and so forth since they are assumed to have the power to explain our social world. Big data are never raw, but always cooked (Bowker 2005); they do not proper exist, but need to be produced and emerged (Manovich 2011). Nevertheless big data are often believed to 'just exist', and their representation through visualisations are taken as windows onto the world, even though some scholars have recommended due caution. For example Crawford (2013) states that 'the map is not the territory' in order to warn us against seeing visual representations of things as

the things themselves. But as can be easily seen this represents the core of ontological dilemmas of the whole of science and it is not peculiar of big data. This is also due to the fact that online interactions seem obey to specific rules not necessarily the same as those occurring within face-to-face interactions. As a result a certain caution in treating them has to be desirable by avoiding any naive enthusiastic or strongly deterministic position. Beyond any intrinsically ontological limitation, network data collected through social network sites appears to provide remarkable advantages together with drawbacks on a methodological level. I will briefly list here those related to the social network site I considered for my analysis.

To aid comprehension imagine your network of acquaintances, how they are mutually acquainted, and attempt to provide a relational map of them through a graph. Every acquaintance is a node and every pair of them are connected by an edge in case of effective acquaintance. If a network is related to a specific individual it is named an *ego-network* because it belongs to "ego" and his/her immediate neighbors. Properly an ego-centered network consists of a focal actor, termed *ego*, a set of alters who have ties to ego, and measurements of the ties among these alters (Wasserman and Faust 1994). In order to construct an ego-network you should ask people to indicate the total number of people they already know (*name generator*) and in turn how they know each other (*name interrelator*). As already indicated such requirements can appear really hard to reach perfectly not only in listing a considerable number of people that one individual

knows but also considering the fact that it can be unknown whether two of their own acquainted are in turn already acquaintanced within an already existing but unknown relation. It is in such missing possibilities that big data can fill a gap in a way even if recommending due caution and carefulness. Specifically referring to such research I first collected Facebook network data belonging to a sample of politically involved individuals I will broadly describe in the next sections. In detail everyone online with a Facebook account disposes a certain array of online acquaintances directly connected with this given account. This is the list of online friends related to a given ego. Hence, in the case that online personal acquaintances correspond to real friendships or relationships it can be easily understood how a Facebook account can appear to be a fruitful dataset collector for social network analysis. In order to use them several benefits accompany even existing drawbacks. The most notorious weakness in referring to online data is the well debated digital divide in that you unavoidably achieve a self-selected sample amongst individuals already possessing a Facebook account or merely having access to the Internet. Consequently it cannot reveal non-user egos, nor their respective no-user acquaintances. Such consideration compels us to give sense to Facebook network data only in the light of these known limitations by considering them a necessary partial picture of relationships. But such epistemological restriction does not differ greatly from other existing techniques such as interviews, questionnaires and so forth where respondents might in any case omit certain information for any number of

reasons. In addition the fact that they are reported online does not assure their realness beyond the virtual world and the possibility of fake identities should be taken into account. Further qualitative aspects appear to affect Facebook network data: acquaintances listed within a Facebook account do not enjoy the same intimacy in respect to a given ego but also raise controversial situations involving negative acquaintances or broken relationships that previously exist. Potentially the reason why a certain individual is chosen as Facebook friend can be described by an infinite number of personal convictions. But such latter information may not matter depending on the scope of the research especially if mainly structure-oriented. Nevertheless despite the drawbacks gathering network data from Facebook accounts presents striking advantages. Firstly they represent "big" data namely they permit what was previously unimagined in terms of numbers, complexity and levels of analysis. In fact sociomatrix is already registered within every Facebook account so that it can be fast and easy to obtain an enormous graph in a short time not to mention the fact that they can supply respondents memory in remembering huge amounts of acquaintances. Moreover they can reveal how ego's own neighbors are in turn acquainted regardless of individual reconstruction or effective knowledge. This means that you can easily reconstruct several levels of analysis revealing the already mentioned existing relational maps that would be useful in reaching a given individual through a definite number of intermediate steps that would otherwise be unknown. And just as stated by Christakis

and Fowler in their *Three Degrees of Influence* theorization (2011) friends of friends of friends can have an effect on us, it can be plausibly understood how such big data can reveal more than anyone might expect leading to a due, even if careful consideration. In any case being aware of such strengths and weakness you can choose to reject or accept them always tending towards a good compromise aiming to give sense to what it is available.

4.2. A political case-study

At the beginning of 2013 I happened to be witness to the rise of a brand new local political movement located in a little sea-town in Western Sicily named Castellammare del Golfo whose official inhabitants are slightly short of fifteen thousands. Its name is CambiaMenti and it was officially raised to run for local administrative elections would have occurred in June 2013. Having been informed by one of the founding members I began to follow its political campaign ranging from attending official assemblies where decisions were made to assist public speeches of the movement[2] aimed at political promotion. Using participant observation I had occasion to understand how the movement was born and developed thorough a few months leading to an increase in consensus. In few months CambiaMenti was able to recruit several hundreds of people

[2] The same ethnographic approach was used by Dr. Toni De Bromhead from Goldsmiths University of London who attended the same whole of political activities too.

of two distinct generations. This is was not a case if one of the official claim of the movement was "CambiaMenti can involve even two generations. In our case parents follow children and not the contrary". But I will not consider these proper ethnographic aspects in the present discussion unless in the light of a better overall comprehension. What I aim to do is give a sense of the expansion of CambiaMenti in terms of growth of their members' social networks.

Most people officially belonging to CambiaMenti were and currently are active within deputed online spaces with their own personal accounts. In particular a private Facebook group is used to plan activities, discussing issues, launching ideas etc. only for inner members. Access for external people is not guaranteed. Every personal account is nothing but an ego-network referring to a specific member called ego. By recourse to gluing[3] their members' Facebook ego-networks topology it can be possible to reconstruct not only relational patterns between members themselves but also in turn a second level made up of their acquaintances' networks. In only two distinct levels it can be easy to visualize a final structure where connections between those officially politically involved are clear alongside people immediately linked to them. The relevance of these two levels is not negligible at all being structured by those who are

[3] Gluing ego-networks means to reproduce relational maps related to distinct egos having in common at least one acquaintance-node. For example if I have a certain number of friends (my ego-network called X i.e.) and a friend of mine has his/her number of friends (my friend's ego-network called Y) gluing our ego-networks mean to overlap them. Common friends, namely mutual relationships-ties are not doubly reproduced being redundant. "New" or "unshared" acquaintances are mapped related to me, my friend and in case my friend Y's friends but not to my friend Y himself/herself.

already political members and even by their closest neighbours that could potentially become supporters or even activists or simply informed on the existence of CambiaMenti. It is worth mentioning that previous research on cascade models and social contagion showed how people strongly embedded within a huge number of people who were already converted are likely to be converted in turn because of passing a critical point which reached determines a global cascade as in the case of groupthink (Gladwell 2000; Janis 1982). Overcoming the tipping point appears to be like overcoming the phase transition of physical phenomena previously mentioned. But the aim of this research is not to measure this presumed influence to the extent that it enables behaviours or belief but solely to visualize an underlying network structure on which to advance a preliminary hypothesis. Even if one was sceptical of such means I argue that such networks might represent a good approximation of real networks because the totality of respondents claimed they only add Facebook friends if already known or acquainted. In any case such Facebook network data represent a useful means for making an efficacy and efficiency-oriented communication plan. Even though this research is partial in its results and does not pretend to aim at generalizability I hope that new insights for future research on political movement diffusion and success in electoral performance can emerge from the research.

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Self-declaring as independent from any right or left orientation CambiaMenti was publically launched in March 2013 following an official foundation that occurred one month before for original founders and previous supporters. People who wanted to join the movement could register by paying a fee of few euros which permitted them to take part in official assemblies where political strategy and decisions were discussed and deliberated. In Spring 2013 CambiaMenti decided to run for local elections acting in alliance with the national party Il Megafono[4] and a further local new civic list named Avanti Veloce. As a result CambiaMenti was part of a political coalition made up of two civic lists and one national party. Each of them counted 20 candidates for the Consiglio Comunale (roughly corresponding to a local council), one common Mayoral candidate as expression of the coalition and two executive members nominated by the latter one. In June 2013 CambiaMenti did not win local elections but achieved a second position and currently represents the political opposition at Consiglio Comunale di Castellammare del Golfo having obtained two seats. The list was chosen by 1050 voters becoming the most voted list within coalition and the second most voted among the fifteen running for election[5]. It should be said that the electoral system is majoritarian for the Mayoral candidate whose supporting lists obtain 2/3 of seats in case of success.

[4] This party was officially founded in Autumn 2012 for running to regional campain. Il Megafono was launched and is actually supported by the current Presidente della Regione Siciliana Rosario Crocetta.
[5] For a general summary of electoral polls see http://www.ilgiornale.it/elezioni/comunali/2013/sicilia/trapani/castellammare-del-golfo_081005/comune.html

The rest 1/3 is proportionally divided between the most voted lists. Being Castellammare del Golfo a less than 10.000 voters town only one ballot is provided by law. In the light of the previously mentioned literature the key question is: can CambiaMenti electoral performance be ascribed to its official members networks? This question will be partly answered here with due caution.

4.3. Methodological Protocol

As I said I had occasion to take part CambiaMenti political activities as participant observer. This represented a good occasion to better frame the phenomenon in its increasing expansion and also obtaining useful qualitative information for social network analysis. I had access to the official register where all members are reported alongside their entry date into the movement. This represents a good indicator for reproducing the political expansion through weeks in terms of social networks change and enlargement. The dataset was gathered between April and October 2013 by collecting members' Facebook ego-networks and visualizing them using Gephi software. In order to have access to such data I asked members to kindly provide me their matrix files. As already mentioned a Facebook ego-network represents a graph visualizing the whole number of online connections existing between a due X user/

member and his/her online “friends” either in relation to the user they referred to, and both to others. The diagrams below show several ego-networks related to three distinct members (Figure 19, 20 and 21). Shaded areas represent high density in numbers of connections being redundant and highly clustered. This means that ego network is related to has neighbours sharing huge number of mutual relationships. In other words his/her acquaintance are highly clustered. Approximately high clustered regions correspond to community because of a massive commonness in sharing relationships.

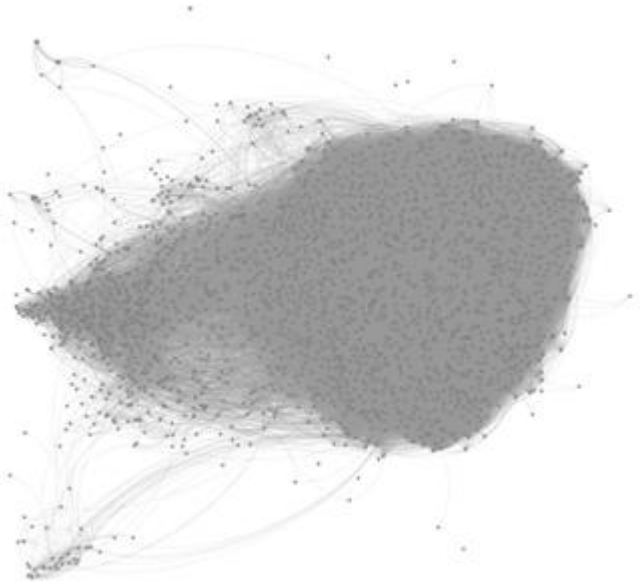


Figure 19. Ego-network referred to a male member, aged 29.

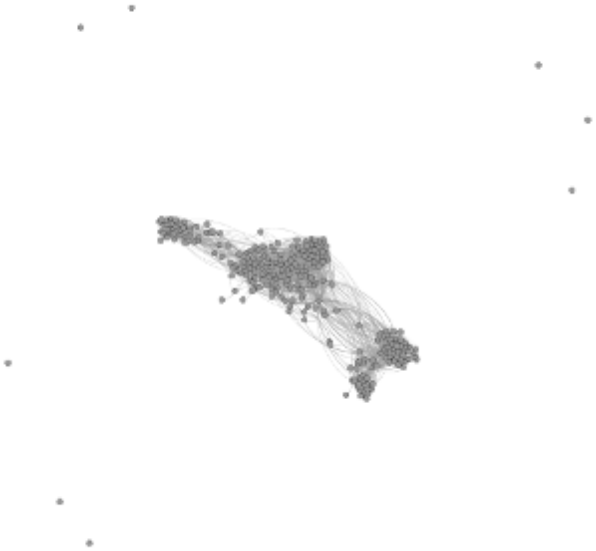


Figure 20. Ego-network referred to a female member, aged 50.

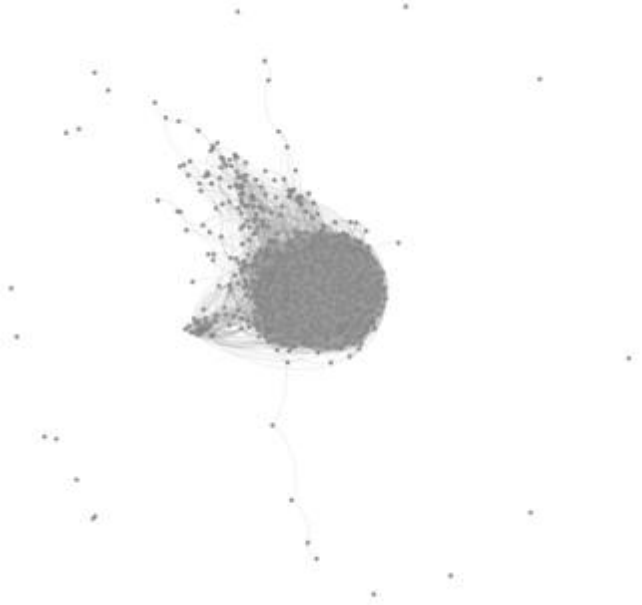


Figure 21. Ego-network referred to a female member, aged 43.

The totality of members I considered claimed that their Facebook connections are “real” in the sense that they decided to connect to other users only if they were already known to them. No further qualitative information on why they decide to connect to others are provided here. As can be seen the three cases differ in terms of numbers of nodes, namely Facebook friends, and especially in terms of neighbors connection. The first and the third case are in fact characterized by more shaded areas indicating a high density in number of connections. The more the nodes are reciprocally connected one to each other the more such areas become darker. This means that ego-user they referred to is embedded within high close relations so that the more triad close up, the more redundant connections are, the more darker area results. In contrast the second case presents visibly three distinct areas corresponding to several communities. The more individuals share reciprocal relationships the more likely it is that they belong to the same community. All of these features can be shown mathematically as will be shown in the next chapter.

Analyzing each ego-network requires methodological tools that are different from a structural analysis of other kind of networks. In fact as was said in the first chapter structure is not merely a sum of single parts. In network terms the final structure is not the sum of single ego-networks but it is something ontologically distinct to be treated differently. For this reason I will not focus on proper personal network analysis but starting from such ego-networks I reconstructed the CambiaMenti topology “adding”

and gluing together ego-network by ego-network in the same order as their official entry within the movement. Roughly beginning with few founders-related ego-networks I add each member's ego-network so "reproducing" not only the official entry of an X member (the first one, the second one etc. i.e.) within the movement but potentially designing all his/her acquaintances eventually involved in a cascade of political information and active support. This means that final output will reveal not only members connections themselves but also their immediate neighbors relationships too generating two levels of connections namely the "sum" of members connections plus their immediate neighbors.

I consider in depth only official activists regularly reported within the official register of CambiaMenti. Currently it numbers 118 members ranging from ages 19 to 62 years. The movement is not gender balanced being represented by 49 women and 69 men. Of them 117 possess a visible Facebook account whilst only one member does not. I asked all of them to kindly provide me their matrixes. I received 89 matrixes in total corresponding to a further 89 ego-networks. Consequently the drop out is equal to 28 missing ego-networks that I did not receive. This research refers to preliminary results being focused on the first 63 ego-network already glued and analyzed. The final structure made up of 63 ego-networks corresponds to the "sum" of each member ego-network glued together in the same manner of entry order into the movement. This means that a time T is considered within which network expansion passes from an

original triad of a few founders to the final structure of 63 active members' ego-networks. This research represents a preliminary empirical attempt to give sense to political contagion, namely in terms of network diffusion, and in second hand explain electoral performance in the light of political movement networks. I hope that this research offers new insights for future research on networks and politics. In the next chapter findings will be discussed by referring to social network analysis tools. Each mathematical property of the graph corresponding to further social meaning will be illustrated and then empirically unveiled and discussed in the light of the scientific literature previously reported.

CHAPTER FIVE

Discussing findings: expiring or expanding?

This chapter illustrates preliminary research findings contributing to small world theory by referring to a specific political case-study already briefly described in the previous chapter. It is divided into two parts. The first is dedicated to illustrating how the mathematical properties and topology of the network structure has changed from the foundation of the political movement until its official launch held in March 2013. The second focuses first on the analysis of the structural properties related to the final network that consists of the 63 ego-networks' members glued together, and second aims to shed light on the movement of members' structural attributes within that. The key-question of whether small world topology emerges is answered alongside a further partly qualitative aspect on who has the most relational power. Being mainly explorative in its core these findings aim to advance further hypotheses and insights for comprehending the relationship between the underlying network structure and political performances.

5.1. The origin was a triad

As reported by the official register of the movement or by members' official speechees CambiaMenti was originally founded by M. (male aged 33), together with two of his friends. They are C. (male aged 29) and G. (male aged 29). In network terms they form a triad here assumed to be the preliminary state of network expansion of two levels namely a triad of the three of them plus their own acquaintances. This second level is relevant to the extent to which potential new activists or supporters can be encapsulated. Every one of them has a certain number of personal acquaintances some of whom are probably shared by all of them. This is shown by the fact that gluing together their ego-networks the sum of all nodes is not equal to the sum of their own acquaintances but lower. This is due to the fact that being already friends they are more likely to share common friends and acquaintances. Following cascade models literature such common friends might be more likely to be converted due to a embeddedness within CambiaMenti political activists whose closeness might eventually determine their joining the movement. This analysis does not focus on such dimension but rather on a structural analysis of network growth. What it is observed now is how CambiaMenti networks changed from its beginning to the official launch. Visualizing the two steps can be useful (Figure 22, 23).

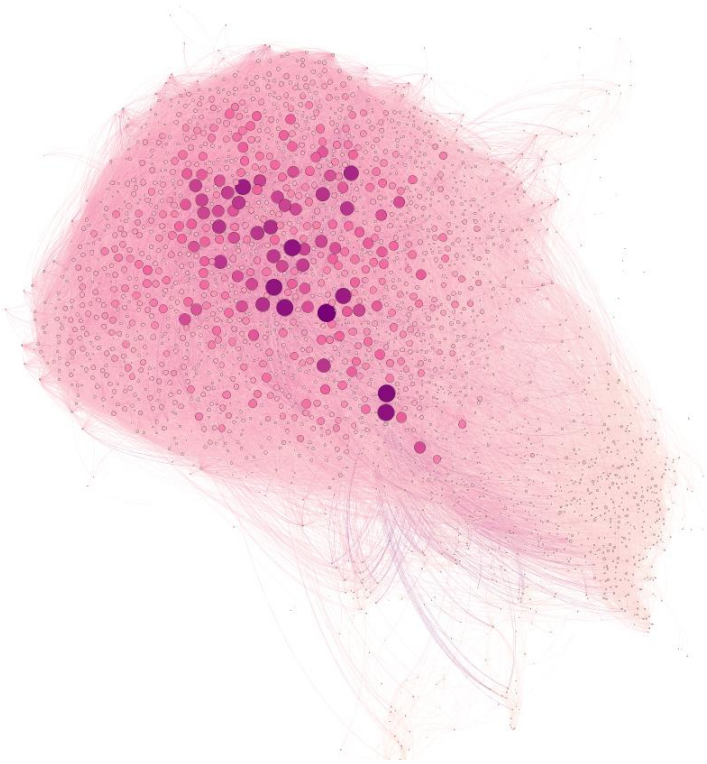


Figure 22. Glued ego-networks of the first three founders of CambiaMenti. The darker and greater nodes are hubs. Two of them are founders. They are adjacent and bottom-right located (see below).

Figure 23. Glued ego-networks of 63 CambiaMenti members. These 63 members are located in a defined left central-area (see below).

In addition further graph visualizations can be useful to better comprehend intermediate steps from the original triad (top-left) to the provisional final network (bottom-right) (Figure 24). I cannot insert all the distinct phases due to a lack of space, but these of them can be sufficient to catch network enlargement and change.

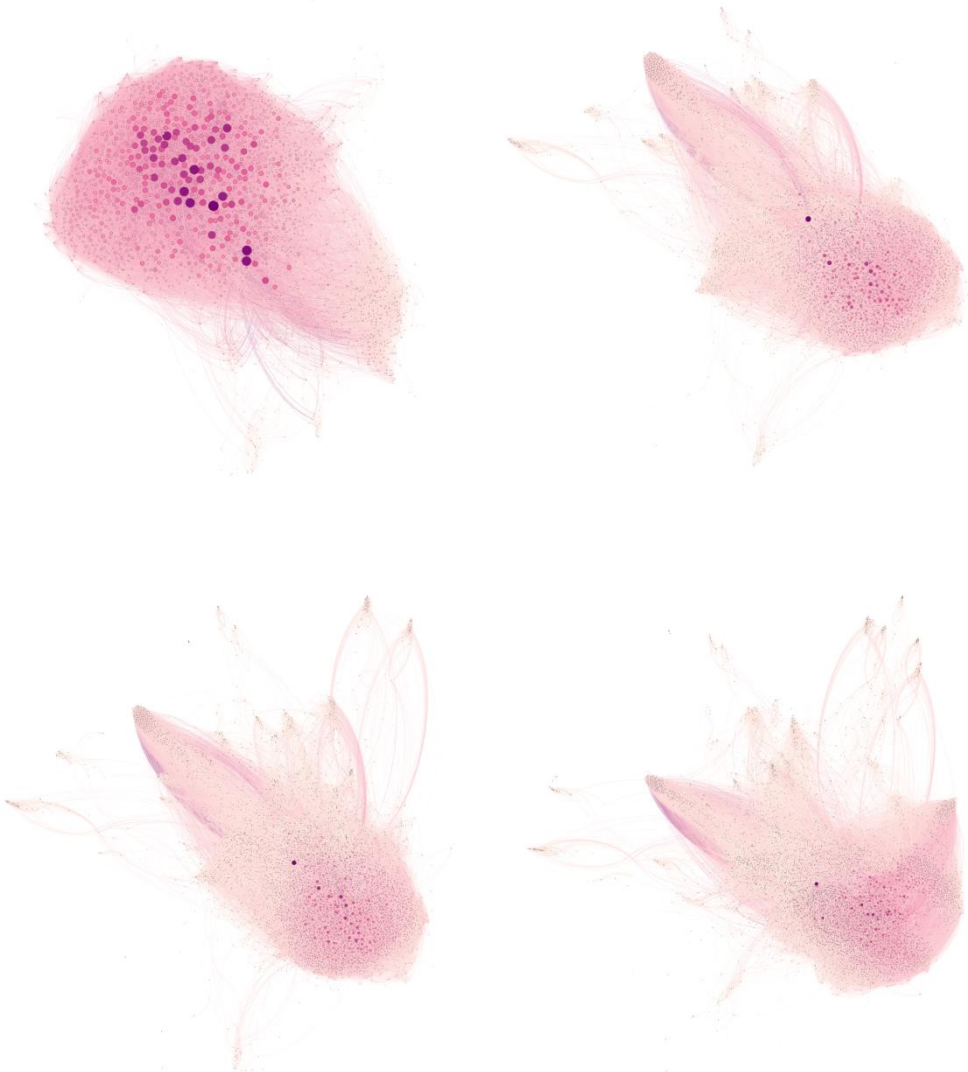


Figure 24. Distinct steps of network expansion from triad to the final topology.

It is visible how something has changed from the foundation to the official launch specifically in relation to immediate neighbors of an always increasing number of members who officially join the movement. What does happen exactly? Firstly and obviously there is an increasing in number of some descriptive features of the network. Originally nodes potentially to be converted or merely directly informed are 2,735 (founders included), whilst at the final step the total number is 16,524 vertices immediately connected at least to one of the 63 already officially involved members within the movement. On X axis lies the value standing for progressive entry order of each ego-member within the movement. On Y axis the total number of nodes. As soon as each ego joins the movement he/she enlarges the number of nodes potentially to be engaged (Figure 25).

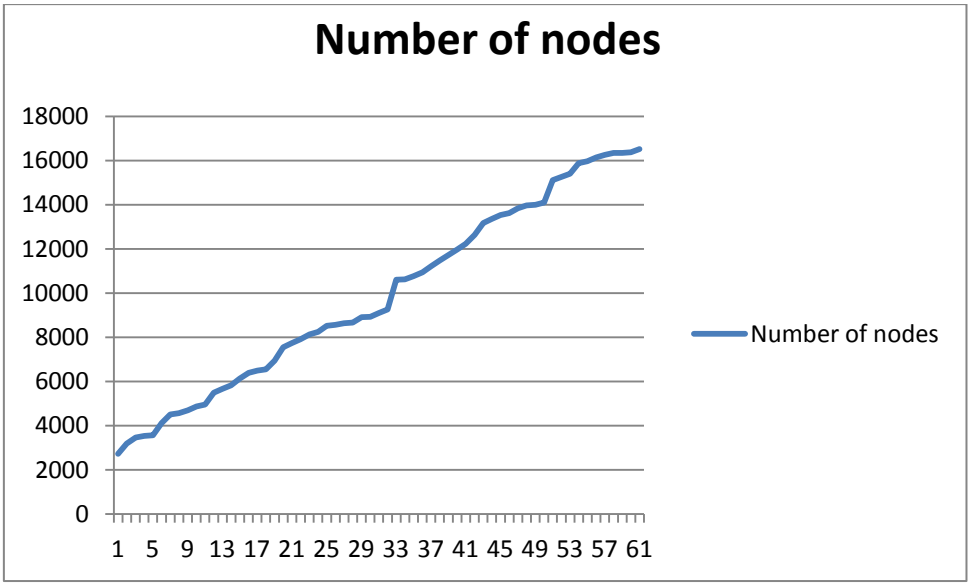


Figure 25. Number of nodes depending upon network expansion. Close to the 32nd and 50th members valuable peaks in increasing the total amount of nodes can be noted.

Similarly the number of edges (connections) increases following an analogous trend (Figure 26). These connections represent the number of conduits through which political waves can be potentially spread or merely used to diffuse political information. Far from any attempt to determine the power of structure over agency to determine the reason for choosing to join the movement would require qualitative data unavailable here. But despite that these conduits are the locus where agencies act, move and interact one with other.

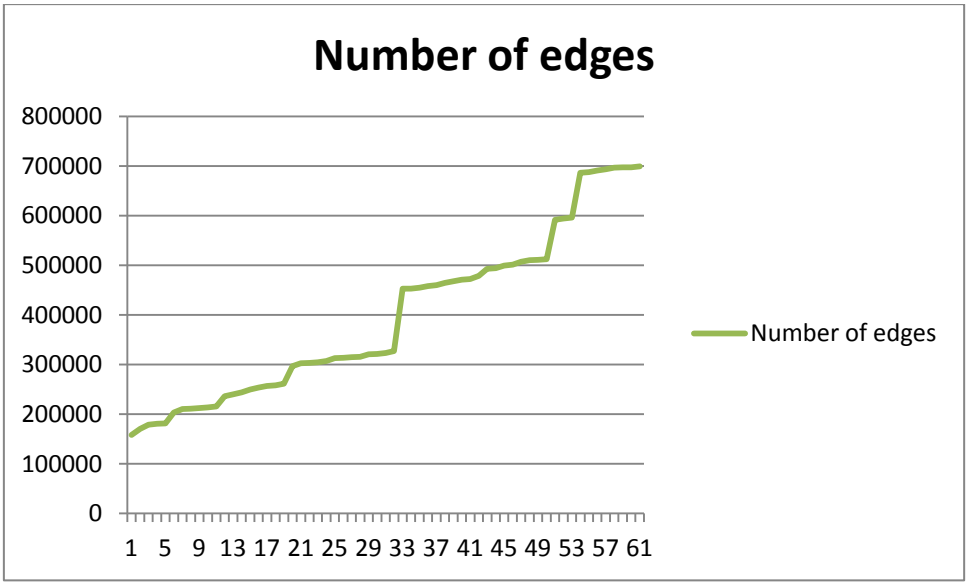


Figure 26. Number of nodes depending upon network expansion. Three notable peaks are evident in correspondence to the 32nd, 50th and 53rd members meaning that their ego-networks contribute by significantly augmenting the total number of connections.

Looking at these distributions as well as an overwhelming increasing trend is clear but further aspect are worthy of note. Referring to the number of nodes two peaks are evident corresponding to the 32nd and 50th members. These two new entries provoke a significant increase in number of new nodes potentially informed or engaged. It is important to notice that the mere fact that an ego is rich in number of acquaintances does not assure a general increase in the total number of nodes. This is due to the fact that being already known most of them share a certain number of mutual friends and relationships. In that their contribution in opening access to potentially new activists is not very high because their acquaintances are the same as the members previously entered leading to redundancy in connections. Although they can indeed act as

individuals reinforcing belief and participation within their immediate neighbors. In this sense the fact that they do not possess new relationships external in respect of the other members (the already mentioned weak ties) confirmed by a low level of increase in number of new nodes leads to consider them as nodes able to closure communities augmenting relational density within their immediate neighbors. In network terms they favor the increasing of strong ties. As previously said this is an important step for creating highly clustered areas where trust and information can spread easily to due an always greater embeddedness. In line with this latter dimension it can be understood how numerosity in nodes is not sufficient alone but it is relevant to understand how much ego's acquaintances are interconnected in turn. In this sense the number of edges provides further important information on their entry showing a parallel augmenting in number of relationships. This means that not only do they enlarge the potentiality of the network in informing or in engaging new activists, but, being their ego-networks notably dense in connections and not sparse, the possibility of closing triads is greater by tending to saturation in relationships. Practically in joining the movement they not only add their high number of nodes but import individuals highly connected with each other. If several nodes share a huge number of mutual and redundant relationships for the triadic closure principle they are likely to belong to the same community. This latter aspect can be relevant to the extent that they can reveal a probable greater embeddedness of nodes within specific portions of networks. In fact in line with the

previous reported literature nodes highly embedded within already converted individuals are more likely to be converted in turn and in this sense a high number of edges might suggest to pursue this direction supported by the triadic closure principle.

5.2. Adding nodes is not enough: from individuals to group expansion

Intuitively each individual is a conduit to new relationships and new potential members who can be immediate neighbors already involved (a conduit for weak ties) or a reinforcing member within communities to be further relationally saturated (a conduit for strong ties). For this reason it is relevant to grasp the general economy of network expansion according to further structural measures. In the previous section I referred to measures able to make sense of the general interconnections of a graph. *Graph density* is one of them and represents an estimate able to reveal how many relationships are effective and how many are instead uncompleted then potentially closed. In addition density assesses cohesion in the network permitting one to unveil an average estimate of how saturated the graph is and so to understand how many weak ties are present. Being the proportion of actual ties in the network to potential ties density is equal to 1 in the case of all possible ties being effectively present. At the contrary is equal to 0 in the opposite case. Density is simply the ratio of the number of adjacencies that are present divided by the number of pairs, namely what proportion of all possible dyadic

connections are actually present. As reported in Figure 27 density has changed through the process of new members entry.

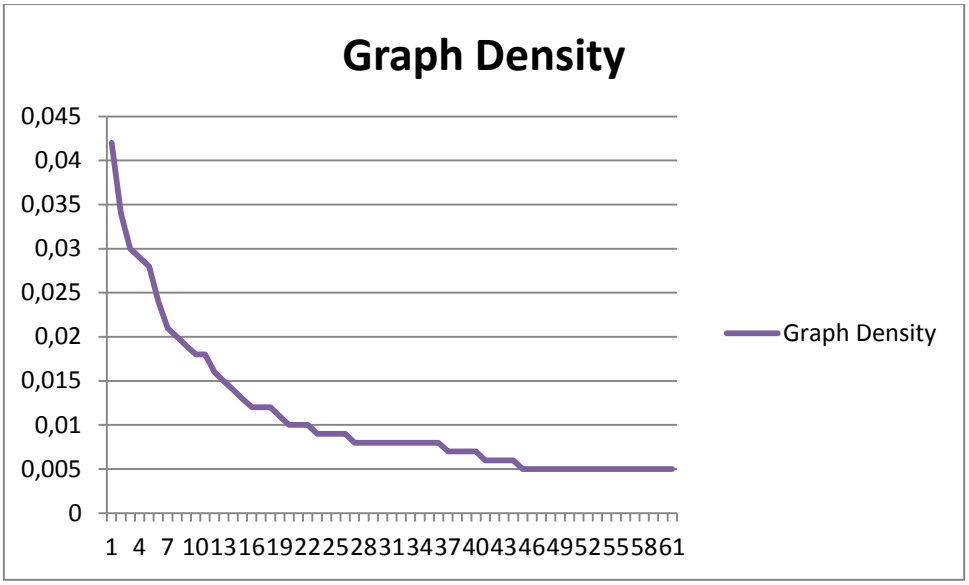


Figure 27. Graph density shows descending trend even if portions of constant value are visible.

Here it is very clear how graph density presents a descending trend proceeding on new members entry. This curve provides very important information in terms of enlargement capability. This means that whilst at the foundation time density reached a maximum value equal to 0.042 probably confirming that the originating members were well connected and embedded one with each other this was not the same for the rest of consecutive members. Except for negligible constancy in correspondence to the 10th member the first part of movement expansion is characterized by an increase in weak

ties inclusion and consequently decreasing density. This means that original expansion was supported by the well known weak ties which are responsive of the expansion and global connectedness in small world architecture. These weak ties prepared a comfortable structure for following engagement within networks owing to their expansion capacity. Following this enlargement it seems that *at a certain point* density trend tends to shrink and become constant. This aspect is relevant to the extent that it provides information on individuals engaged after the original foundation even if before the official launch. The tendency to become constant means that in those phases people engaged were embedded by strong ties within previous ego-networks. They were not out of their predecessors acquaintances but plausibly strongly embedded within their predecessors' ego-networks as strong ties. It is noteworthy that density appears showing two distinct phases for movement expansion. A first phase appears characterized by a large expansion of the underlying structure and a second phase where people already existing within this structure as members' neighbors decide to join the movement. If density rests constant means that enlargement capability beyond already existing borders of network was potentially reduced in that phase. Despite that it can be plausibly affirmed that these phases probably correspond to a relatively modest engagement by individuals within the already existing communities made up of strong ties even if they do not increase the number of new weak ties. In particular it can be noticed how this dialectical co-existence of density decreasing, corresponding to the

inclusion of new weak ties and density constancy corresponding to a settled phase reinforcing the already present strong ties, appears from the 16th member to the final step. After this preliminary analysis of the first 63 ego-networks members in the future I will analyze the rest by estimating how a trend is configured until the eve of elections. This value refers to the structure expansion from the original foundation to the official launch.

Together with the density graph, another important estimate provides information on network expansion capacity. Including nodes is not merely encapsulating individuals but agencies within their respective groups and communities they belong to. Even if it not properly correct to refer to groups or communities within the graph due to the fact that they have own definition, the number of connected components can support a general estimation of how many sub-graphs are present within the network. Particularly a *connected component* is defined as a sub-graph in which any two nodes are connected one to the other by paths, and which is connected to no additional vertices in the super-graph. The higher this value the more new nodes are present and the more they are far from the origin of graph being represented by new peripheral weak ties. The number of connected components should follow an opposite trend in respect to graph density as is showed in the Figure 28.

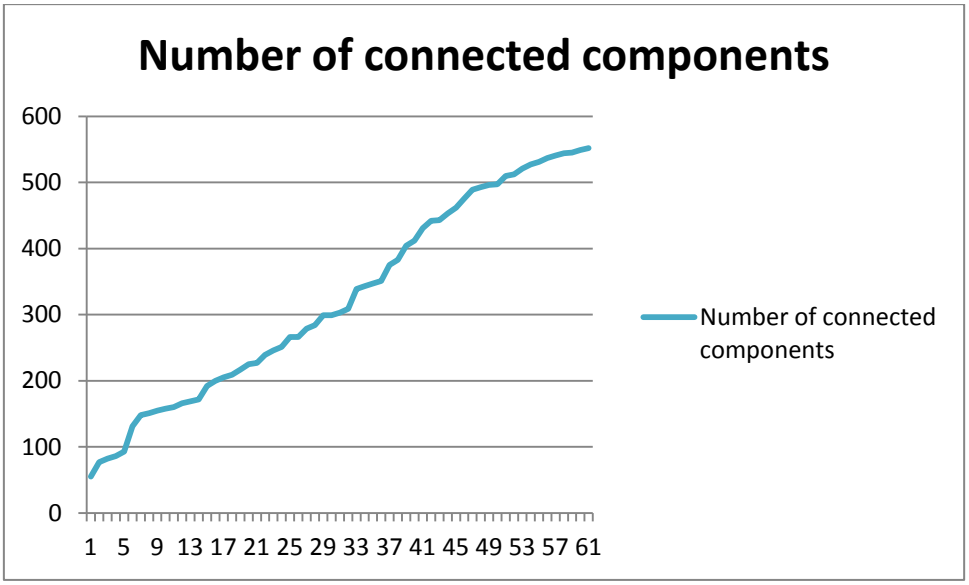


Figure 28. Number of connected components shows an increasing trend.

This is due to the fact that whilst density stands for tendency to closure within already present nodes, the increasing of connected components represents an estimation of how many new nodes are added, potentially opening access to new further communities acting as potential gate-keepers. A node is not merely a node, but a door open to new communities. The increasing trend shows clearly how CambiaMenti and its second level of relationships created an expanded structure made up of several new weak ties. It is important to recall that these weak ties are the key for succeeding in broadening the network beyond immediate neighbours and relationally closer individuals.

As briefly announced there are relevant structural measure related to the presence and numerosity of communities within networks. The fundamental principle which the algorithm revealing their presence is based on lies on the assumption that nodes which share a massive amount of mutual relationships presumably belong to the same community or module. In addition modularity is calculated with reference to the estimation expected in case that relationships were chosen by chance. Even if such an index is well-debated in its mathematical possibility of detection, modularity is defined as the fraction of the edges that fall within the given groups minus the expected fraction if edges were distributed at random. It is positive if the number of edges within groups exceeds the number expected on the basis of chance. For a given division of the network's vertices into some modules, modularity reflects the concentration of nodes within modules compared with random distribution of links between all nodes regardless of modules. In substance networks with high modularity have dense connections between the nodes within modules but sparse connections between nodes in different modules in the same manner as the small world model. Looking at our case it is possible to visualize a complex increasing trend even if not so sharp (Figure 29). In depth even if this case trend is confirmed as being coherent with the previously illustrated measures. In fact at least four distinct phases can be traced. Proceeding on new members entry the general topology of network presents a succession of the same

pattern already visible in four distinct phases: a preliminary negligible change easily to be approximated to constant values followed by a sudden peak of increasing modularity.

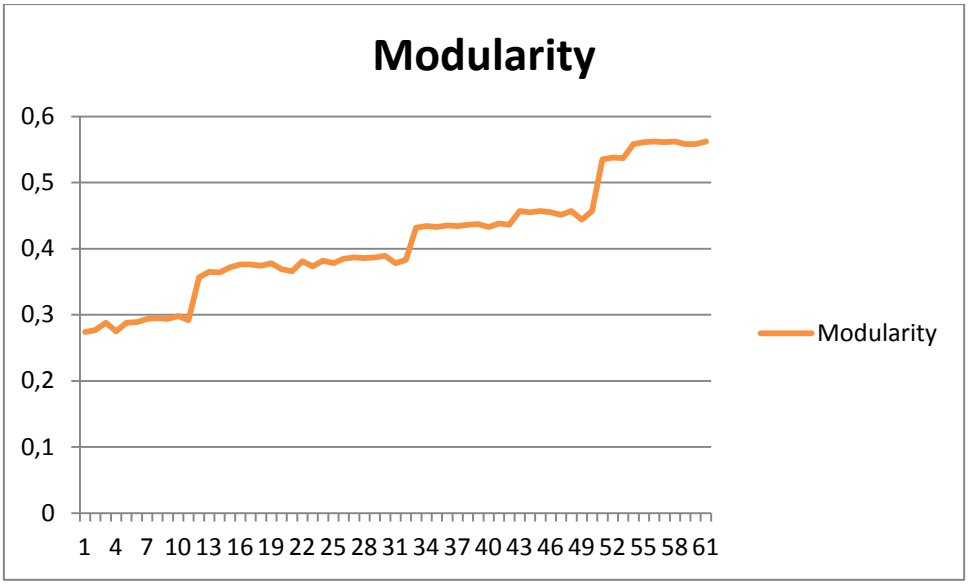


Figure 29. Modularity trend is ascendant too even it is less sharp.

What does it mean? The answer is not unexpected and lies on the same ground as the measures previously discussed. The peaks correspond to the saturation phases where connections within communities tend to further close up on themselves completing and making effective the potential ties already mapped by precedent members' ego-network. When modularity augments the nodes within the same community it increases their number of mutual relationships as prescribed by the triadic closure principle. In parallel few weak ties are added beyond the border of the single module to connect the other

modules already mapped within the graph. This trend permits us to advance a preliminary hypothesis on the existence and persistence of a small world topology through the whole of steps. But in order to prove that further relevant measures are necessary.

5.3. Small network or small world?

The key-aim of this research lies on the need to confirm the existence of small world topology within a political network. In answering this question another dimension will be taken into account, namely growing dimension thorough time expressed in terms of network progressive enlargement. As already explained in the previous chapters small world architecture is characterized by high clustering values together with relatively short path lengths in respect to the total number of nodes within a graph. In order to confirm or eventually confute the existence of small world architecture within CambiaMenti networks some structural measures are needed to be displayed and recalled. A general index of network extension referring to relational shortcut can be expressed by network diameter. It permits us to estimate how a couple of nodes are relationally distant within the graph, namely how many intermediate nodes are needed to reach a given vertex[1]. Even if it can be easily admitted that a pair of nodes might be

[1] Vertex stands for node. They both mean the same concept.

tied through several types of paths differing in length, the shortest of them is the most relevant for unveiling small world topology. The shortest path between two nodes is properly called *geodesic distance*. Considering the largest geodesic distance between any pair of nodes in a network the diameter is the length of the largest geodesic distance between any pair of nodes. Its estimation is relevant because it permits to evaluate how far apart the farthest two nodes in the graph are. I calculated network diameter thorough progressive entry order as visualized in Figure 30.

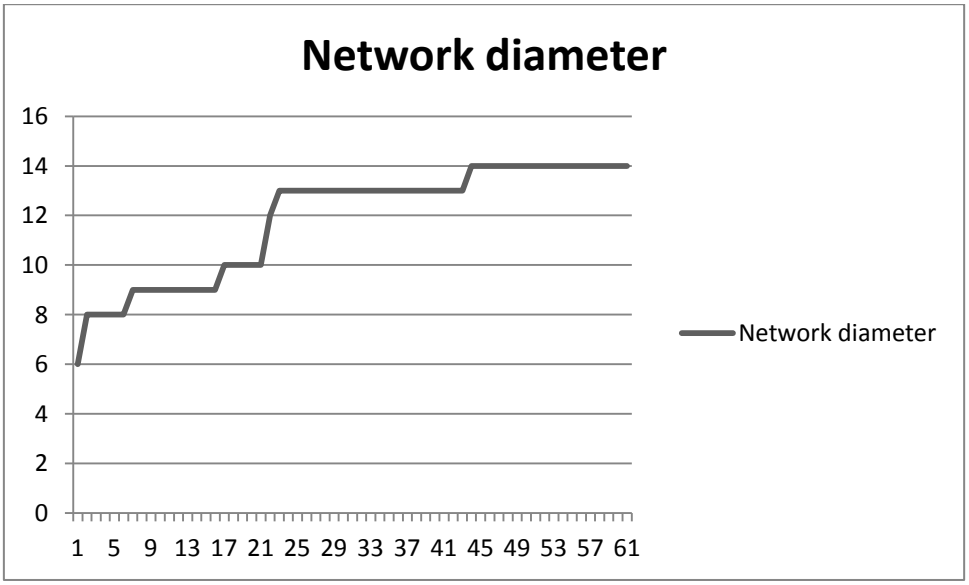


Figure 30. Network diameter trend.

Even in this case trend appears to be ascendant but serious portions are evidently constant especially in the second phase. This means that generally the network tends to expand its diameter leading to lengthening in the distance between nodes. This trend

reveals a certain capacity to go beyond immediate neighbours by increasing the number of external new nodes especially in correspondence to the most relevant peaks in the first phase but this does not assure inner cohesiveness nor general good connectedness. Mention should also be made of the fact that in small world topology at *a certain point* a decreasing trend in diameter is expected together with relatively lower values in geodesic distances regardless of an increase in number of nodes. It should be said that diameter represents the largest value and not an average estimation. For this reason this measure should be discussed together with the key-estimations of small world architecture. I referred to the previously discussed average clustering coefficient and average path lengths. We have already seen in chapter three that they represent the two important values needed for measuring and evaluating the emergence of small world topology. A small world network has to show high clustering values and relatively modest average path length to be referred to enlargement in number of nodes. Just to recall the latter is defined as the number of edges in the shortest path between two vertices, averaged over all pairs of vertices. The former is referred to a node and ranging from 0 to 1 is computed as the proportion of connections among this node and its neighbours which are actually realized compared with the number of all possible connections, averaged over all nodes within the graph. For a better comprehension of their trends in reference to small world topology it is useful to observe both values at the same time (Figure 31, 32).

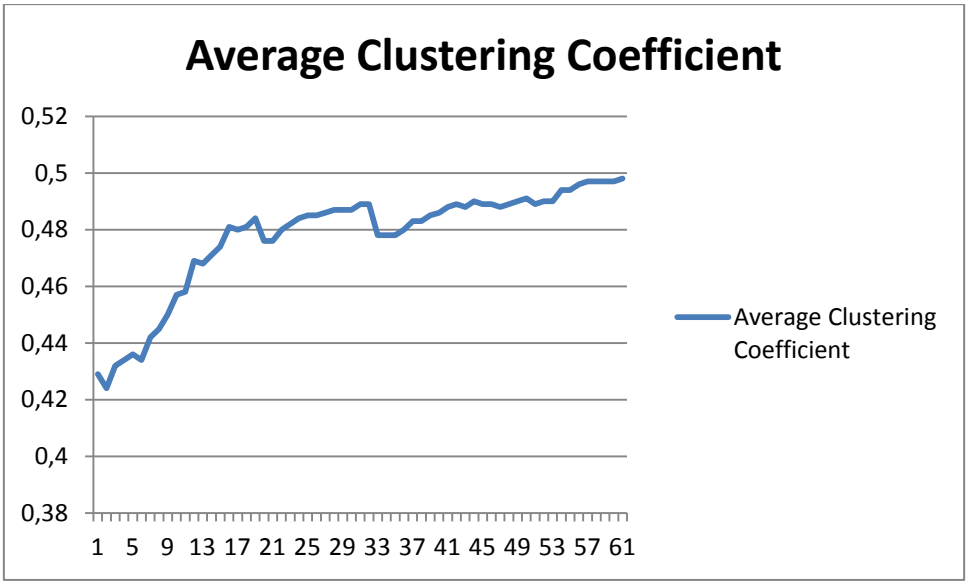


Figure 31. Average clustering coefficient trend.

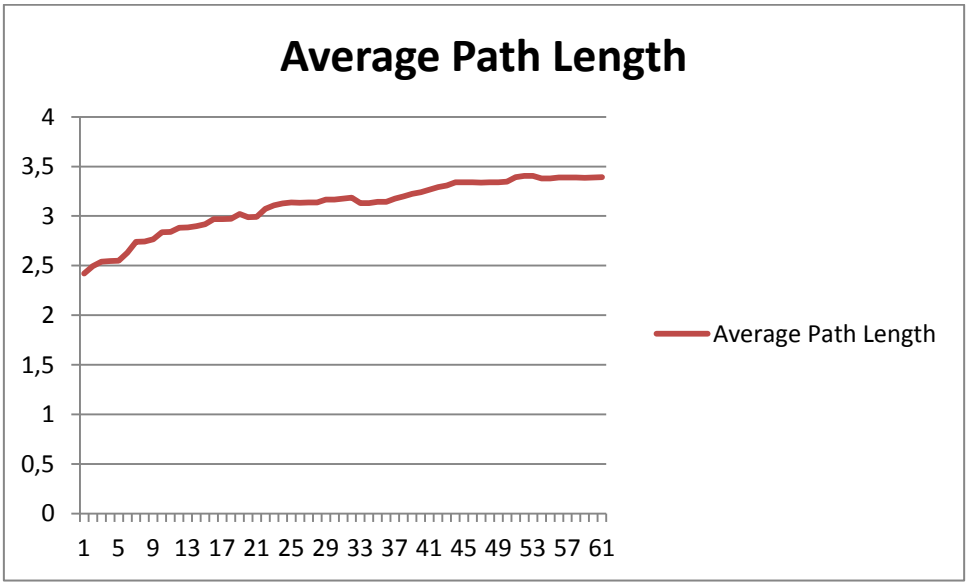


Figure 32. Average path length trend.

As plausibly expected the increase in length results are more modest than that in clustering coefficient, supporting the hypothesis on the presence of small world architecture. As long as new members enter the movement the underlying structure increases in both clustering values and in path length. The fact that the network does not reach the value 1 in clustering coefficient means that relational saturation is not completed yet but that the tendency to close up relations on themselves is evident especially in the first phase where peak appears more prominent. This leads one to think about a preliminary phase where people joining the movement were not only already mapped within founders' ego-networks but probably relatively highly embedded with them. I anticipate that looking at structural properties in the final sections this hypothesis will be further supported and confirmed. In order to confirm the presence of small world topology, average path length should be expected to be relatively modest if referred to the total number of nodes within the graph. This is the case of CambiaMenti networks whose members and their immediate neighbours are averagely connected by a range of 2.4 intermediate in the first phase and 3.4 in the second phase in the face of more than 15,000 nodes. The trend confirms an increasing value even if the average number of intermediates ranges from 2.4 to 3.4 as long as new activists join the movement. What should be noted to notice is that in the final phase the trend tends to be constant even if a descendant tendency could appear more convenient in terms of general connectedness. In this sense in order to assure an overwhelming and efficient

diffusion and a greater likelihood of being reached, average path length should be as low as possible whilst maintaining a high clustering value. The fact that increasing in average path length becomes modest in the second phase in the face of a more relevant increase in average clustering coefficient can be welcome for advancing the hypothesis on political belief diffusion in terms of underlying structure. Albeit in this preliminary foundation phase values can appear modest there can be a plausible likelihood for assuring CambiaMenti networks reached its more convenient small world topology only after the official launch. Further data can confirm that but are not considered here. Looking at both values it can be surely affirmed that CambiaMenti underlying network tends to small world topology as long as new members enter the movement. The picture is so recalling the whole of previously discussed measures. The movement seems characterized by a preliminary phase tending to relational closure within already mapped individuals confirming the importance of strong ties in engaging new activists especially in the absence of original certainty on goodness in assuming a new social behavior like joining a new political movement can be considered. When uncertainty is higher because of a new belief to adopt the need of trust in doing that can plausibly spreading within strong ties according to a reinforcing action system. In parallel weak ties appear predominant in the second phase permitting the extension of the potential underlying structure beyond the immediate neighbours of the local community. In this sense weak ties play a key-role in eventually expanding consensus namely “exporting” a

movement beyond the immediate relational borders of the original nucleus. But as will be illustrated in the following sections no member settles out of the original cluster even if the general underlying structure can be potentially convenient for spreading the movement beyond the local level. In a more general view this data can potentially support the idea that people originally engaged are tied together by strong ties probably due to a lower degree of trust owing to greater uncertainty and lack of information on a new phenomenon (political in our case). Strong ties act as reinforcing conviction within people strongly embedded one with each other. In order to better understand it is noteworthy how penguins plunge into the fatal icy sea only if at least one of them and further most of them do. When lack of information is predominant being unaware of sea conditions penguins do not immerse and prefer to wait for their surrounding actions. When information is more than sufficient in that most of penguins are already immersed (namely embeddedness is almost complete) they merely act in the same manner as their closer friends completely trusting in them and decide to plunge in turn. This can presumably explain the original diffusion within founder members embedded within strong ties but as explained weak ties beyond the immediate cluster are needed to expand consensus far from the original nucleus. As will be seen this was not the case of CambiaMenti at least until the official launch having all the members within the same module. Until that time none of other nodes already mapped and relationally localized far from their original cluster were officially members. This means that until the official

launch the capacity of expanding beyond the original nucleus was low with relationally further nodes still officially unengaged.

The presence of small world topology can be further confirmed by looking at the existence of hubs as illustrated in the next section.

5.4. The rich get richer phenomenon and the power of hubs

It has been widely argued that hubs play a relevant role within small world networks being responsible for general connectedness and easier reachability even if they represent Achilles' heel in case of targeting attack. Hubs are qualified according to own high degree values, namely they detect the most of connections within a given graph being described by power law distribution. Related to the several steps average degree distribution gives sense to how on average the whole of nodes are rich in terms of relations as long as new members enter the movement (Figure 33).

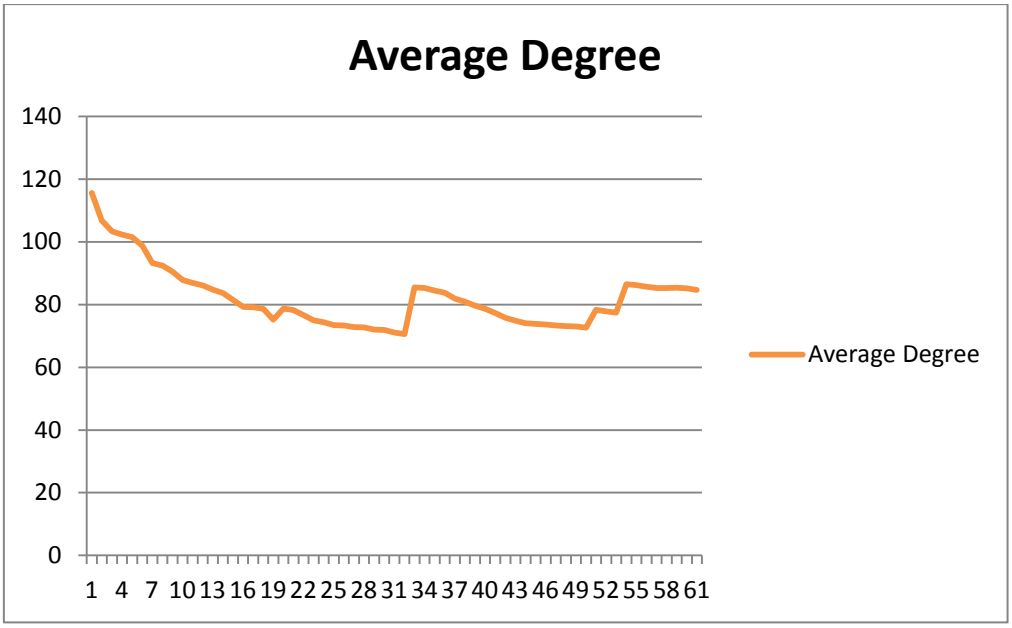
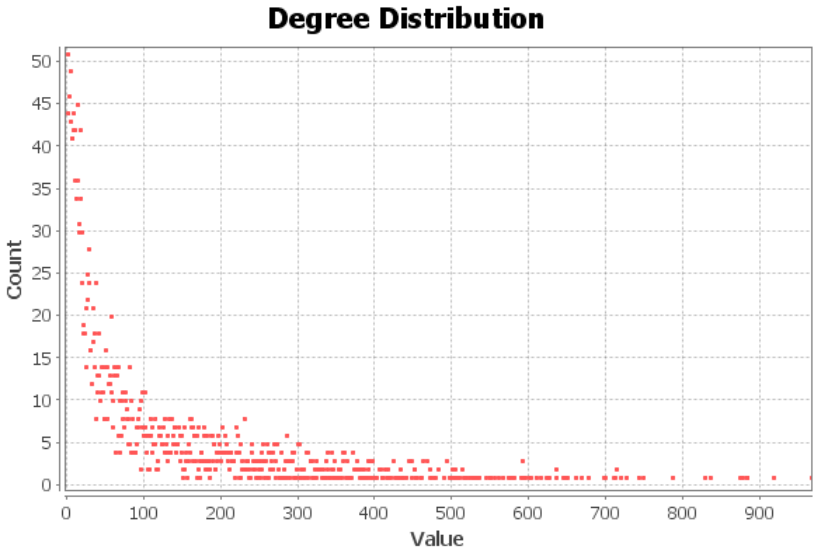


Figure 33. Average degree trend.

It should be said that this measure should not be taken into account in the case of some types of network. In fact for a single ego-network hubs do not provide the same information as in the case of a collection of several glued ego-networks. Within ego-networks hubs are more likely to be people sharing a certain intimacy or closeness with ego due to the fact that people living together are more likely to have the same kind and numbers of common acquaintances. In addition hubs cannot be considered absolutely and definitely but are always referred to portions of existing networks. The trend appears modestly descendant in the first phase but this preliminary distribution does not make relevant sense within a global consideration as explained above. In the second phase trend does not appear to diverge strongly as long as new activists join the

movement except for a central peak. It can be noteworthy that in correspondence to the 32nd member average degree value increases due to the fact that a hub already mapped within previously entered members' ego-networks decides to officially enter the movement. There are other factors that arguably counted for more in order to discuss hubs relevance. I refer to their presence in terms of numerosity related to the whole amount of mapped vertices. Each step of growing degree distribution shows a power law configuration regardless of increase in number of nodes, further confirming the persistence of small world topology. Even in this case few hubs detect the largest amount of ties within a graph no matter how many new nodes are added and enter the underlying structure. The trend stays the same in all steps considered from the original triad to the final one. A sample of six progressively ordered power law distributions concerning six intermediate steps is calculated here (Figure 34).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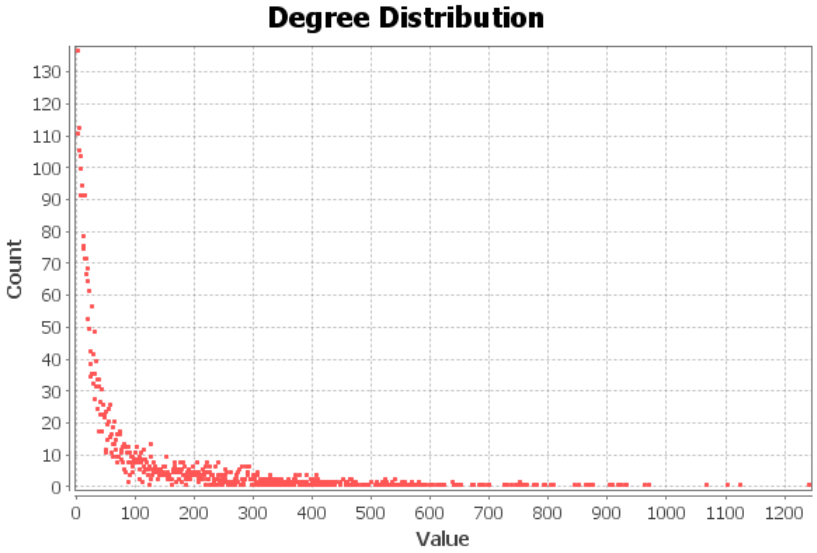
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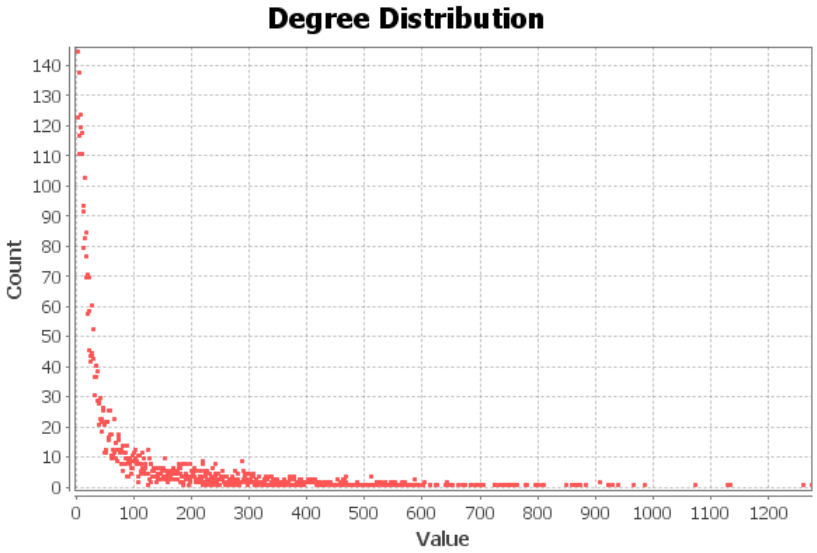
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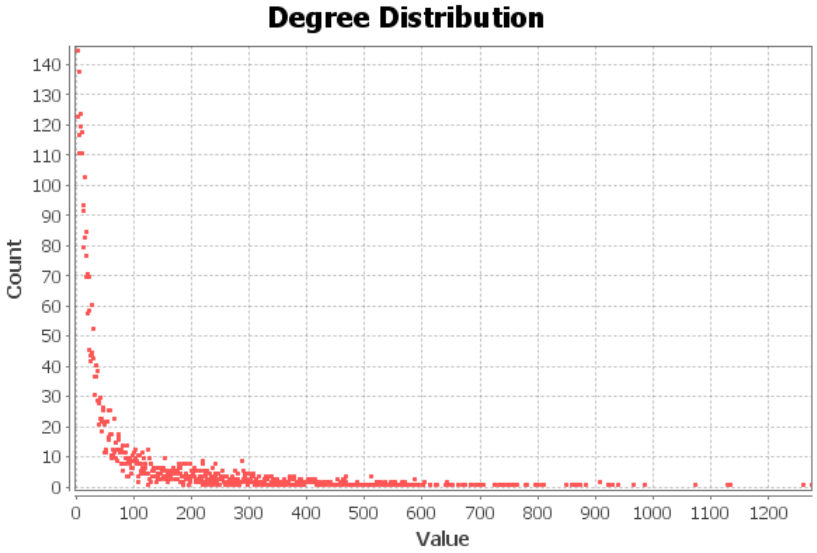
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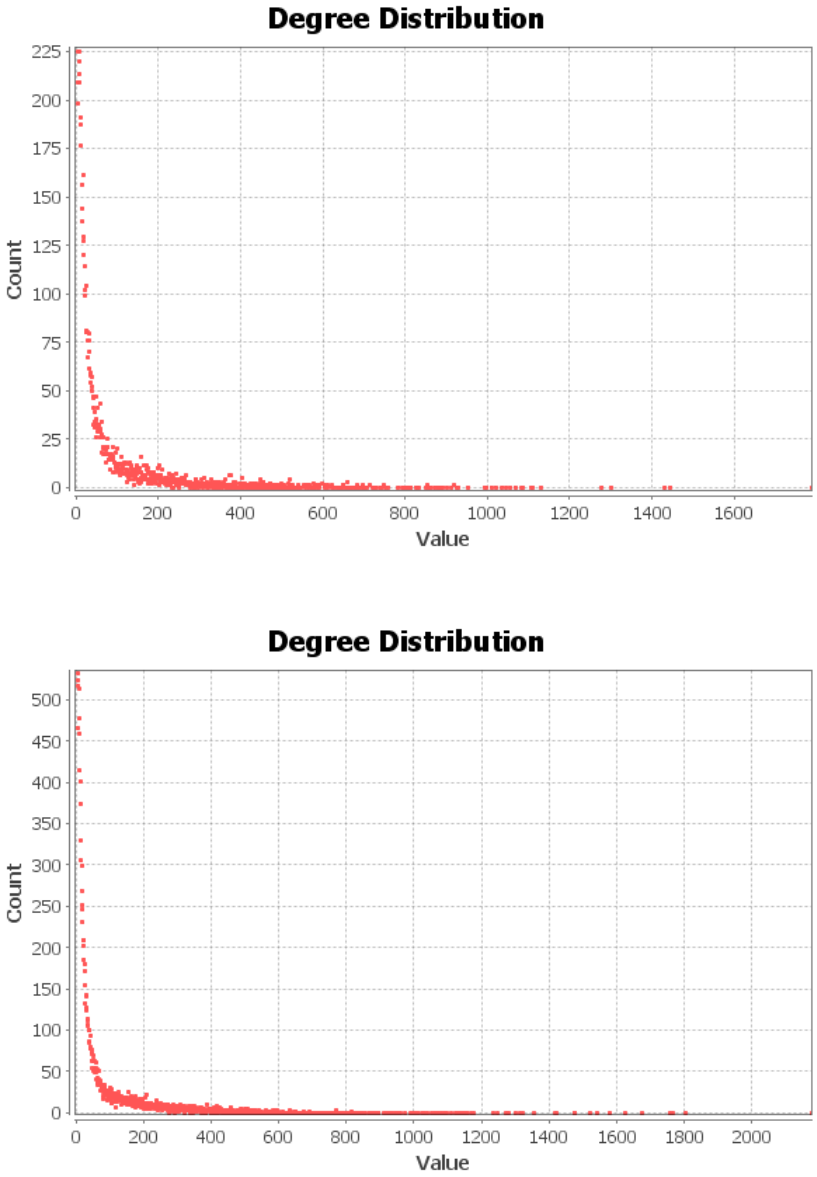

Figure 34. Power law degree distribution in six distinct intermediate steps. The top distribution corresponds to the original triad whilst the bottom one is referred to the last step.

Hence, talking about growing at the global level we should discuss what occurs at micro level. This takes us to the heart of the matter by questioning whether original hubs

enrich in terms of new added relations even in the case of new members' entry. This latter point seems to occur too due to the fact that the original mapped hubs tend to earn more ties through steps that keep their predominance for all expanding phases. Practically they get richer in relations regardless of any broadening inclusion. Some of them augment degree more than others while others tend to constancy (Figure 35).

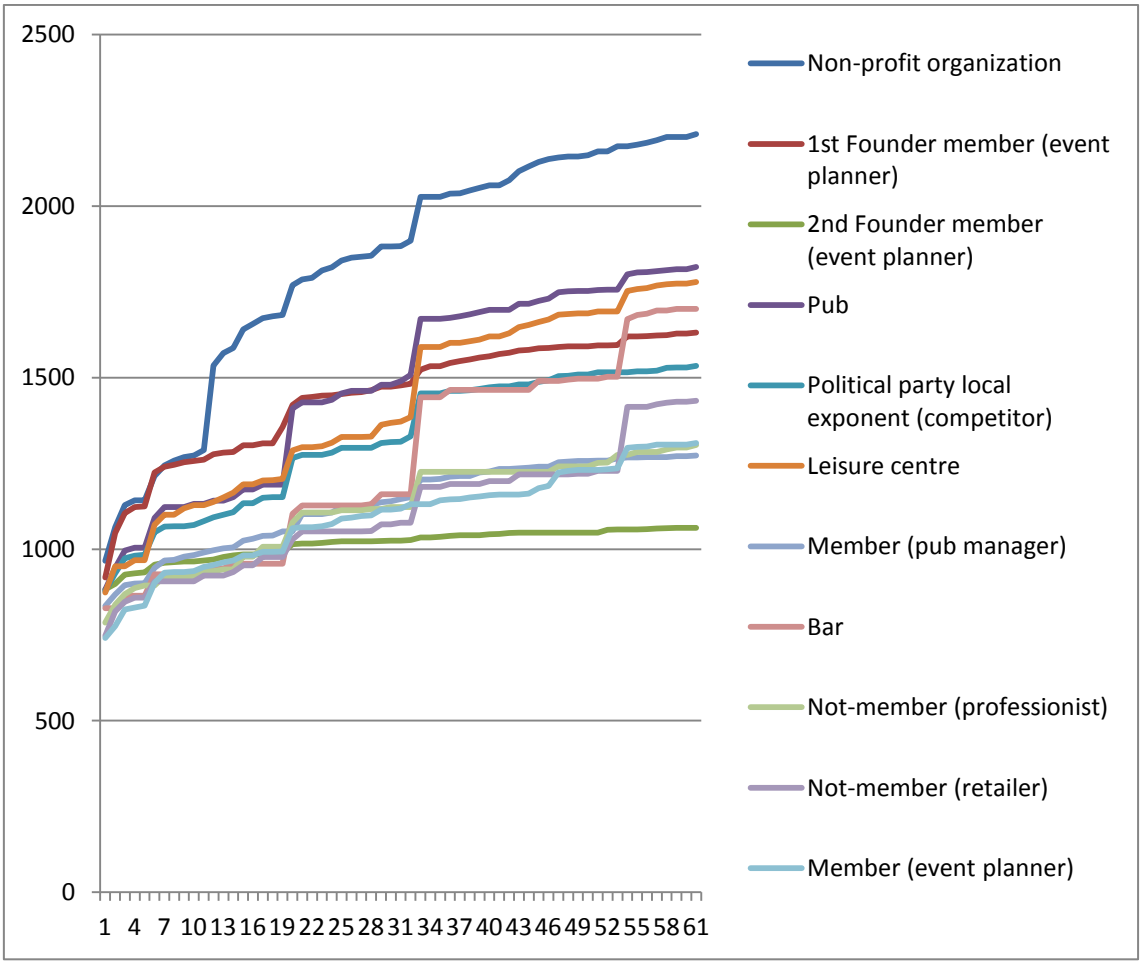

Figure 35. Degree trend for the first eleven hubs.

As expected several early comers not necessarily already official members are hubs and remain hubs even if with distinct types of trend: this is due to the fact that considering hubs within growing processes means always evaluating them relatively and never absolutely. We should recall the concept mentioned above, that is, hubs within ego-networks (the micro-level/preliminary phase) have a different meaning than within structural networks (the macro-level/final phase). In addition they can be hubs in relation to the inclusion of closer neighbours included in the movement network but they can eventually change if a map is enriched by further ego-networks. Data available here is not sufficient to support that, since further empirical data would be required. The results obtained from the preliminary analysis allow us to pursue partly more qualitative dimensions helping to solve questions about who are hubs within the network. There is no doubt that one specific hub is predominant in respect to the others. Its first position is unchanged throughout the steps. Plausibly it is not a case if it is referred to a non-profit organization confirming how NPO represent unofficial political factories. They are hubs of relationships and for this reason can account for emerging political issues. But they are not the only ones. This datum should be read together with other data. It can be noted that two founder members and two successive members are hubs but it is not enough. They all deal with event planning and leisure activities further confirming homophily forces in joining people together but not only that. Once again birds of a feather flock together even in political activism and beyond professional activities.

Looking at this data there is no doubt in affirming that hubs are related to leisure venues or commercial activities. They reveal the largest number of relationships in the face of thousands of nodes and further ties. We should recall how power in keeping individuals together appears to be displayed by leisure core-spaces and activities as already supported by the work of Putnam in his *Bowling alone* (2000). In reference to the latter the demise of political activism and civic duty cannot avoid to account disruption of social networks within these predominant hubs where trust and social capital appears to spread easily. Starting from these informal and unofficial space-hubs you can construct and share political issues due to trust-based sharing of leisure activities. Once again leisure venues affect and undermine active civic engagement by functioning to reinforce relations within communities beyond traditionally deputed loci. Whereas the much debated crisis of democracy seems to be of concern even for delegitimization of parties and traditional political organizations, non-profit organizations and leisure venues appear to be enriched by relationships. Even if it cannot certainly be claimed that parties might be functionally substituted by leisure loci there remains the conviction that the latter represent valuable hubs-relationships accounting for political laboratories. The latter point unavoidably crosses ongoing reflection on the nature of the public sphere in modern societies as briefly hinted in the previous chapters. So individuals are citizens within public space but primarily consumer citizens within a (commercialized) public space. Hence, private marketplaces emerge as the primary terrain of civil society being

unavoidably relational pit stops. In other words most of channels converge within hubs turning them into unofficial political factories. In network terms politics, market, civic engagement and leisure have blurred borders. Moreover it should be said that one of top-listed hubs is an official national party local exponent running for elections as political competitor. Its predominant position can eventually provide information on potential electoral success even if relatively given by this type of data. It would not be surprising if he is also a pub manager.

5.5. The final network: structural properties and structural attributes of members. Expand or perish?

After discussing network change in terms of the entry of new members this section focuses on structural properties of the final network consisting of the 63 members' ego-networks glued together (Figure 36). It should be recalled that this refers to network configuration in the eve of the official launch and does not shed light on imminent political success. But it provides preliminary insights on potential political consensus, and possible electoral performance.

Figure 36. The final network.

Firstly the final network counts 16,524 nodes and 699,017 edges in total. It consists of the 63 members' ego-networks meaning that every node included is connected to at least one of the official activists. No meaningful discrepancy is evident in terms of gender as gender balance is clearly evident in the following picture (Figure 37). The

other attributes refer to gender neutral organizations. Globally there is no evidence of significant same-gender regions being well-mixed within the graph. Nevertheless significant bias at micro-levels (i.e. within single clusters) cannot be excluded but further investigations would be required.

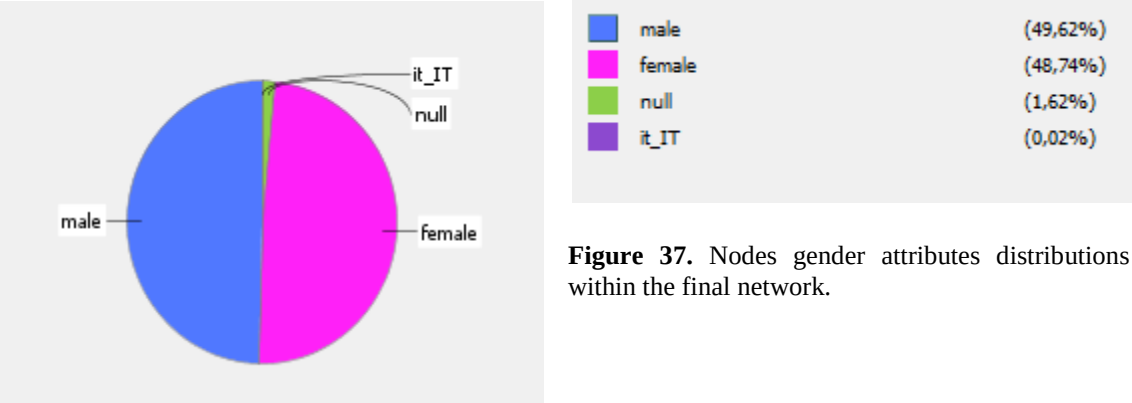

Figure 37. Nodes gender attributes distributions within the final network.

Nodes are inherently nationally diversified being of several distinct nationalities even if with a relevant presence of Italian citizens (Figure 38, 39). This means that foreign acquaintances are connected to at least one member and conversely that structurally the movement is connected with at least one individual from other countries.

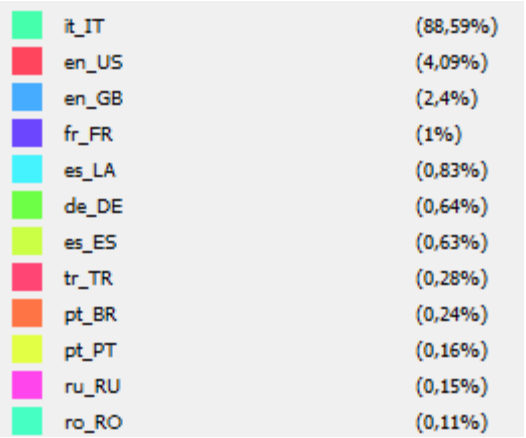

Figure 38. National provenience of nodes.

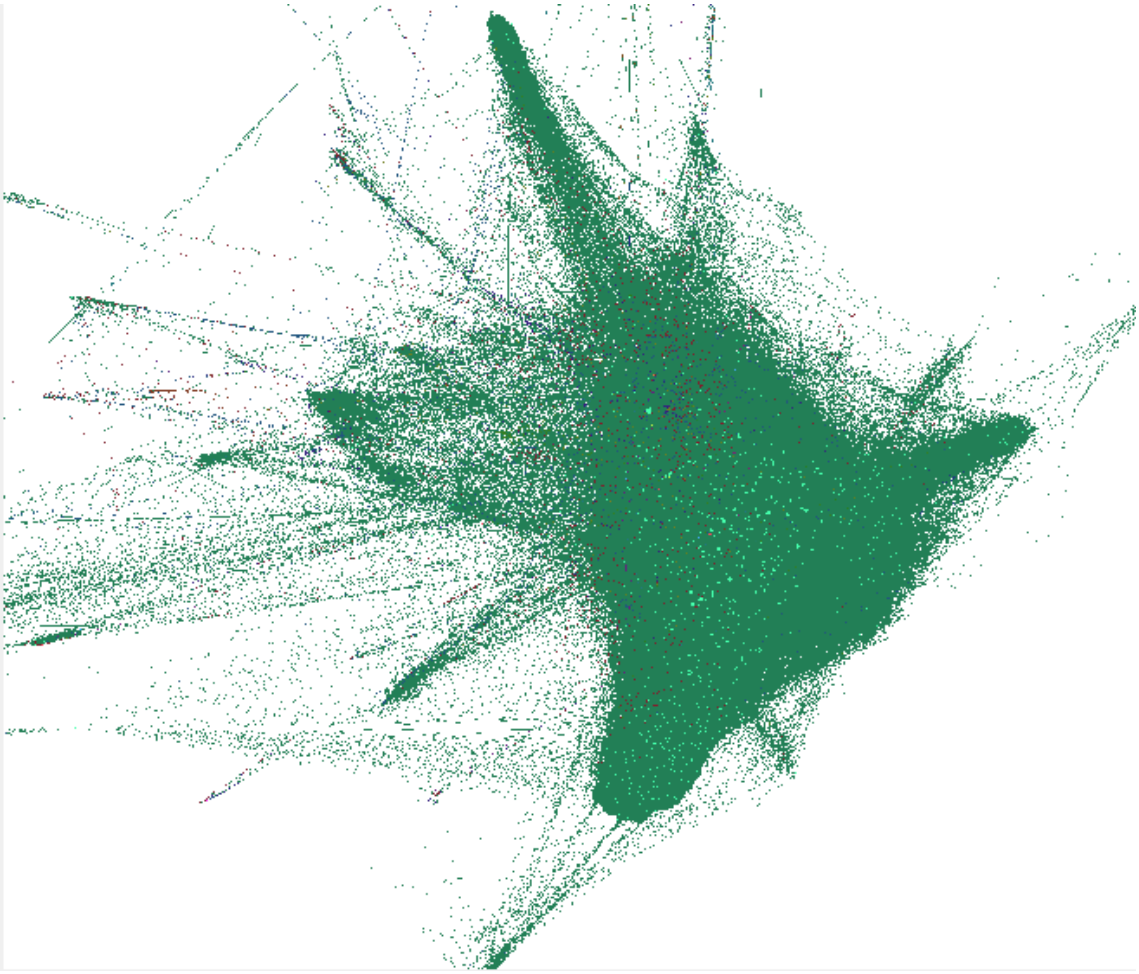

Figure 39. Italian individuals (green coloured) are evidently predominant.

Nodes sharing huge numbers of mutual relationships are classified as belonging to the same community otherwise also called a module. They are cohesive sub-networks within the network. The final graph is described by more than 20 distinct communities that can be easily distinguished in being differently coloured (Figure 40).

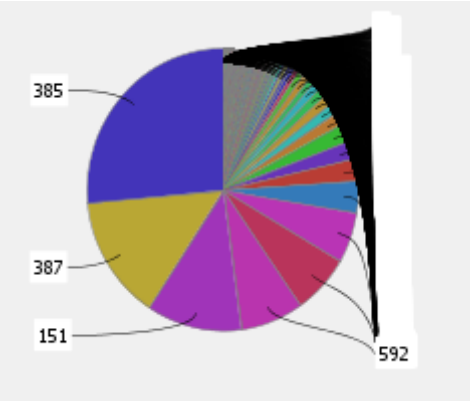

Figure 40. Clusters taxonomy and relative distribution.

The 12 top-listed are here visualized (Figure 41).

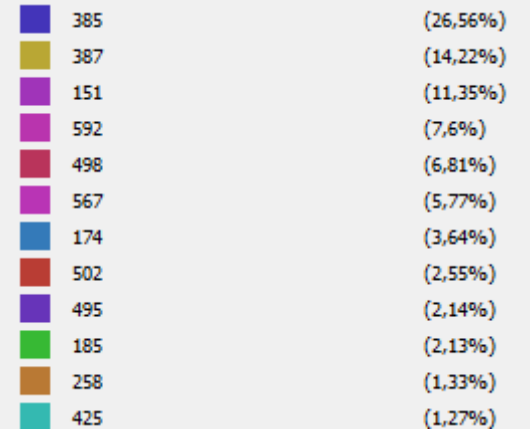

Figure 41. Top-listed modules.

The higher concentration of nodes is evident within class number 385 followed by module number 387. The most striking result to emerge from the data is that official members are relationally confined within the same module (No. 385) in a specific region located centre-left and coloured blue (Figure 42). This means that they have the same structural attribute in terms of cluster belonging.

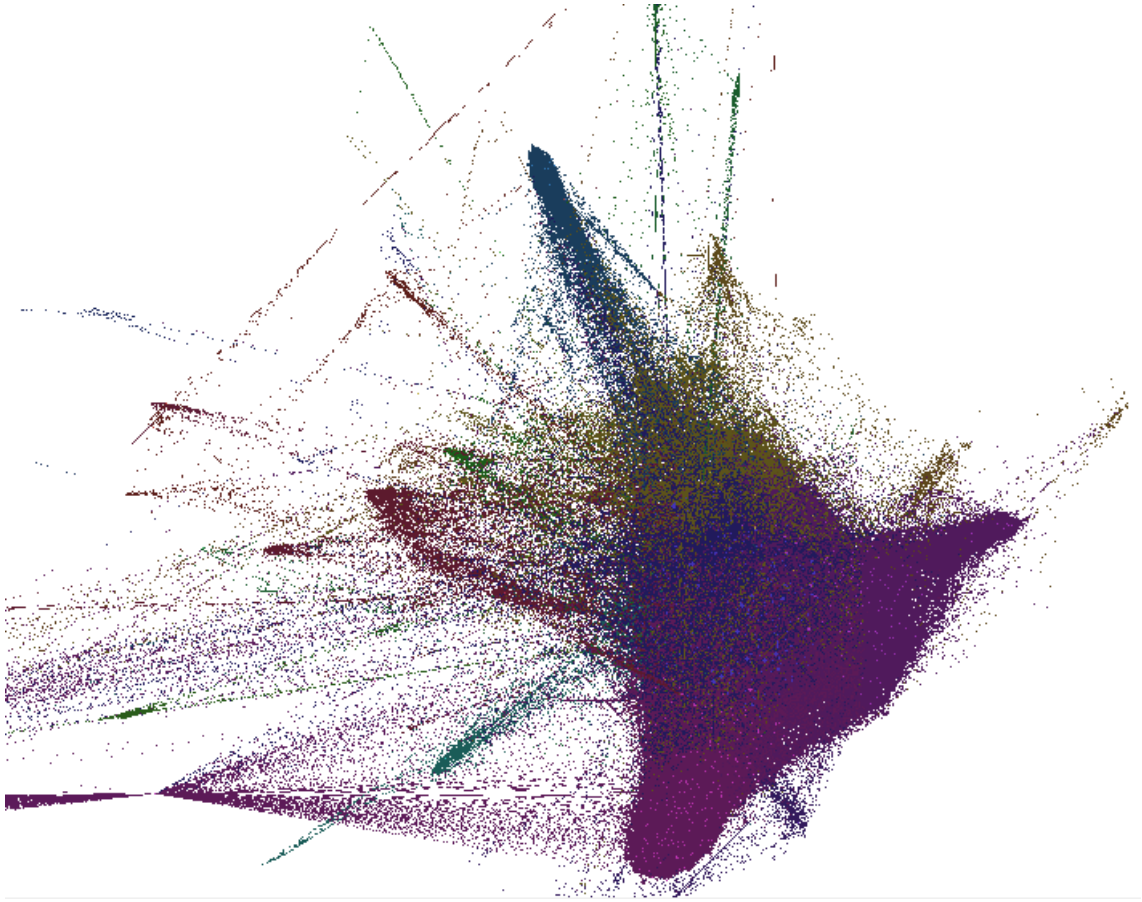

Figure 42. Clusters within the final graph.

They are really relationally close and consequently localized within the same region same-cluster based. Figure 43 shows this area by visualizing members' position (orange-pink coloured) (Figure 43). This confirms that preliminary engagement referred to foundation and preliminary new entries have spread within strongly tied individuals and not outside of them. It is plausible to think that original trust is needed because the adoption of a new political belief might easily spread within a single cluster. In order to spread consensus beyond the cluster at least one weak tie connected to further clusters is needed. Even if members' networks constructed an underlying globally small world topology its degree of "contagiousness" stopped within the original cluster until the eve of the official launch. In order to expand the movement beyond cluster borders bridges-nodes play a determinant role being connectors between the original cluster and other relevant clusters that were officially still "uninfected". Successive analysis of further data will be able to shed light on the following *order* of spread until the election day. It should be said that this allow us to estimate contagiousness in activism but not in terms of unofficial and latent support. It is plausible to suggest that people in turn encompassed within the same cluster are more likely to be unofficial supporters even if not officially registered in the official members' list. This remains an hypothesis that could be confirmed by further qualitative data that are not available nor considered here.

In order to comprehend this bridging capacity referred to each member, further relevant properties of nodes have to be illustrated. They are *closeness centrality* and *betweenness centrality*.

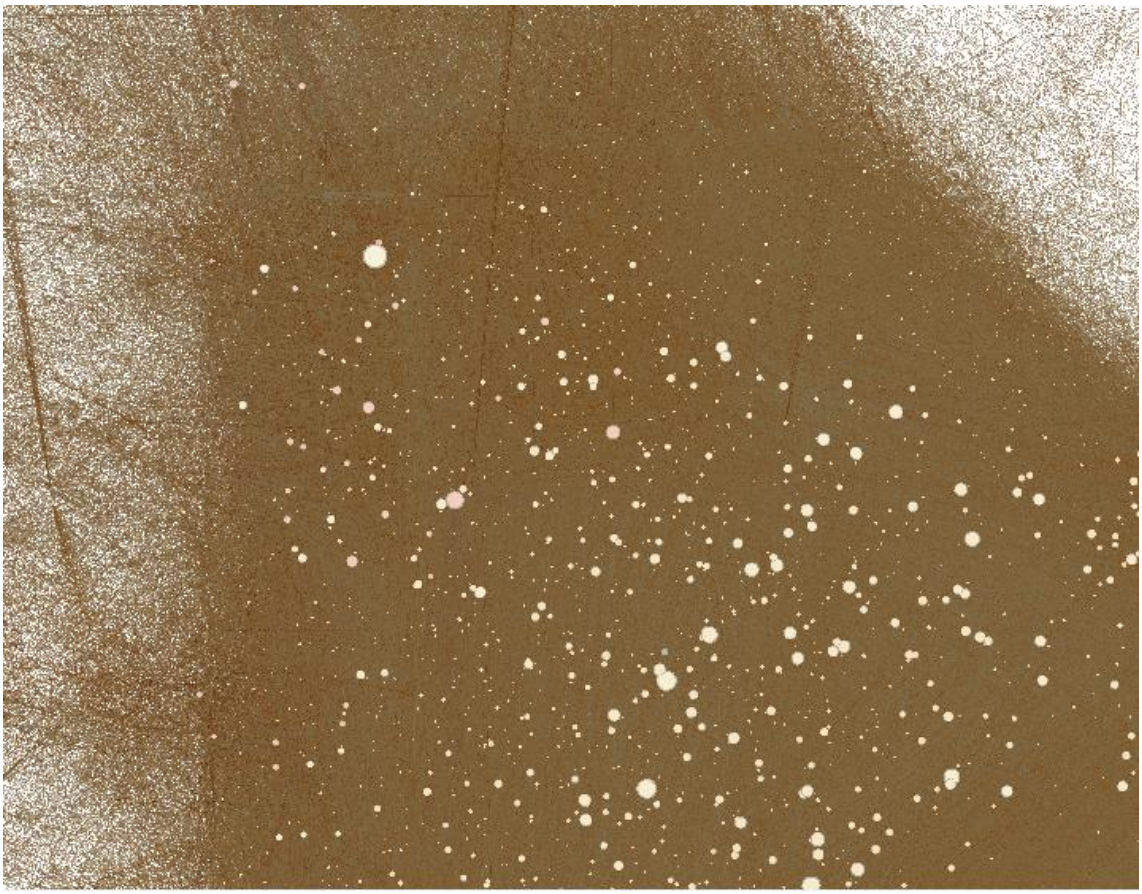

Figure 43. Members (orange-pink coloured) within the graph.

The former focuses on how close an actor is to all the other actors within the graph. *Closeness centrality* measures the cumulative distance that each individual has to travel

to make contact with every other node in the network so that the more a node has a high value in closeness centrality the less it is reachable by the other mapped nodes. Closeness centrality emphasizes the distance of an actor to all others in the network by focusing on the distance from each actor to all others. Hence, a central node is more likely to get information on what is happening in the other areas of the network with less effort. Figure 44 displays closeness centrality values related to each member-node. On the X axis each member is labelled by progressive entry number (node 1, node 2, node 3 etc.) but their mathematical meaning is merely nominal. In the same manner *betweenness centrality* measures the extent to which each nodes lies in the paths connecting every other pair of nodes in the network, such that they represent an unavoidable intermediate to go through. To calculate that all geodesics linking two given nodes are considered and assumed equally likely to be chosen for the path. *Betweenness centrality* of an actor is then the probability that a given node lies in the path between two given vertices considered the total amount of potential geodesics connecting them. Simply if an actor has a large betweenness centrality it means that it lies between many of the actors via their geodesics. As a result a betweener-node does not play a negligible role within network: instead it enjoys a structurally strategic position necessary to mediate clusters or distinct parts. It is nothing but a gate-keeper on inner social networks.

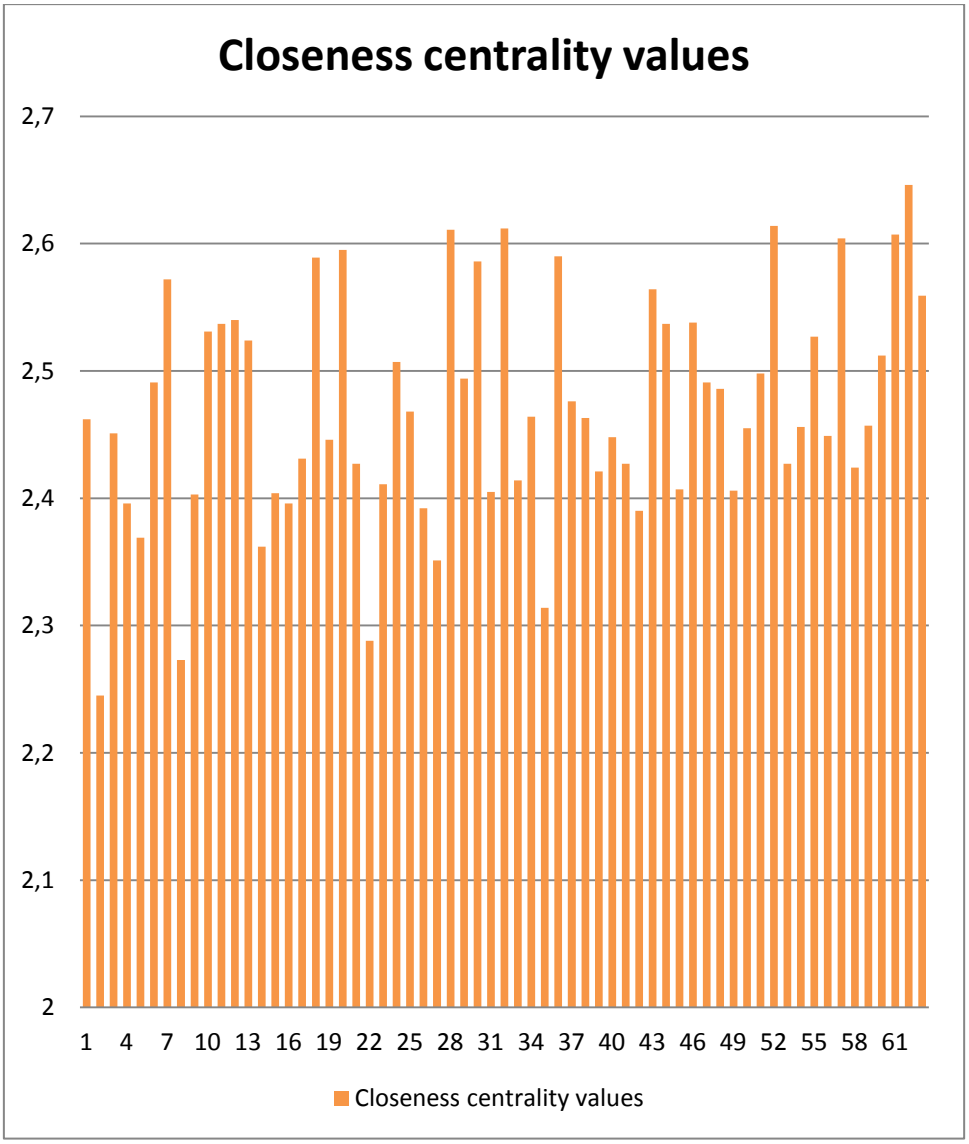

Figure 44. Closeness centrality values for every member-node.

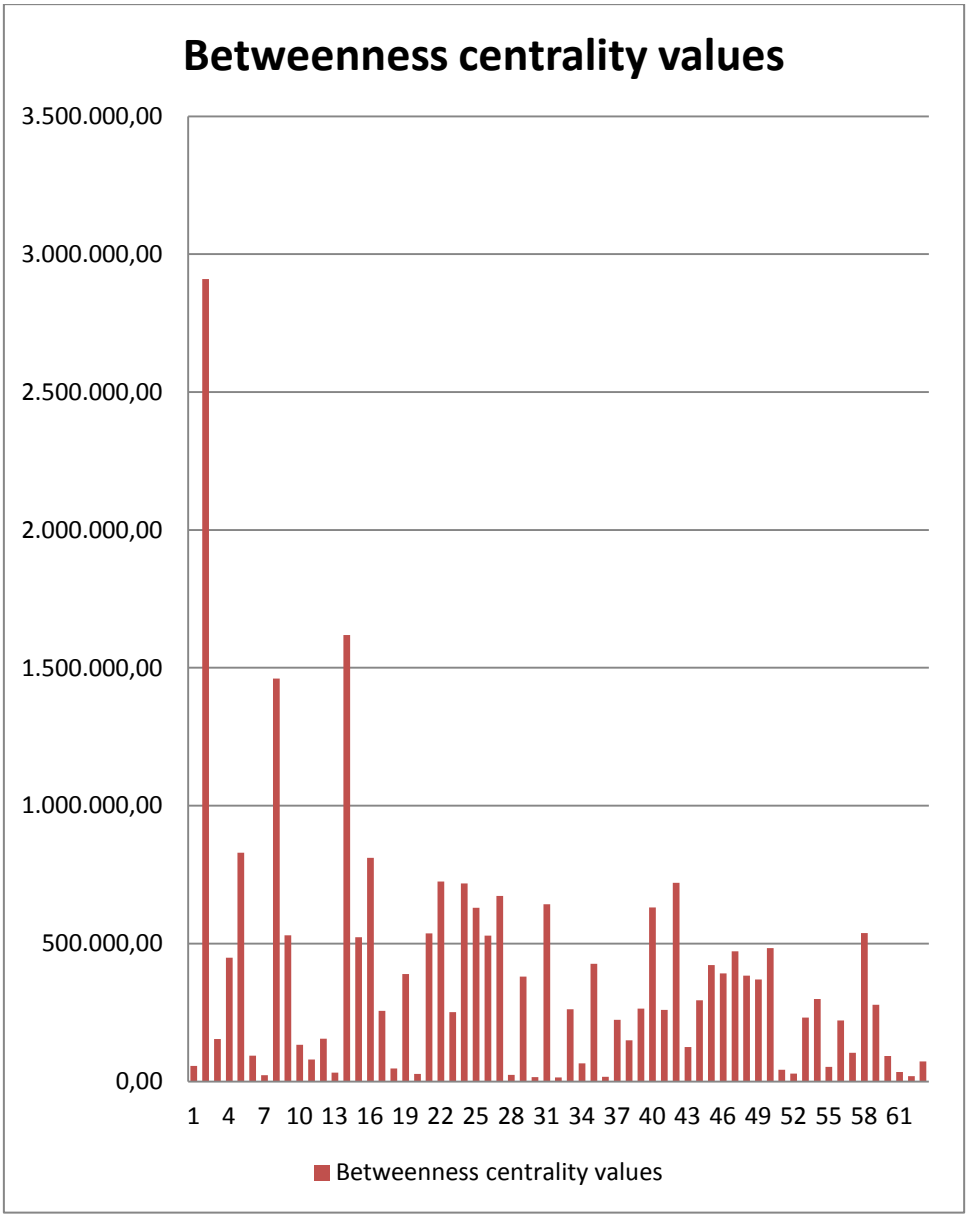

Figure 45. Betweenness centrality values for every member-node.

It is possible to span structural holes in a network leading to the detection of brokerage power through controlling the flow of information and resources. In the case of lacking of relevant betweeners network movement is less likely to expand borders beyond the original cluster. Merton illustrated that bosses within the political machine played the same important role of mediating and connecting clusters relationally (and in that case geographically) distant. They assured connectedness at larger levels permitting the party to operate functionally (see chapter 3). However data available here shed light on potential bridge-members within the movement. Analogously betweenness centrality values are reported below according to the 63 members' nodes (Figure 45). For a general and clearer comprehension both values should be read in the light of the overall distribution of these variables within the graph aiming to define members' position, general variability and consequent standard deviation in respect to the remaining "uninfected" nodes. This will be done in the immediate future. This being a preliminary analysis I focus on providing evidence for some specific aspects. Looking at figure 44 it is clear how members differ one from each other in terms of structural closeness. This means that there are members more central than others in respect to the whole amount of nodes within the graph. Such preliminary data can eventually provide hypothetical insights on members' role within the movement even if they need confirmation by an in deepth qualitative analysis. Continuing in this way first it should be noted how three members present lower than 2.3 values in closeness centrality (members number 2, 8

and 22). This means that they are more central than others, and so more easily reachable than other members. Notice that members number 2 and 14 present the larger values even in betweenness centrality. Plausibly it could be that the first is one of the founder member top-listed in hubs in respect to the whole network (bordeaux-coloured in figure 35). Qualitative data can provide relevant information. In reference to member number 14 it can be said that it represents the first official interface of the movement. So its bridging role is even shown qualitatively and structurally confirmed leading to urgent reflection on relationships between network properties and social roles. This datum has to be read together with its in turn low clustering coefficient value equal to 0.126 (Figure 46). This means that its immediate neighbours are scarcely connected to each other so that relational saturation in triadic closure is far from being completed. As a result member number 14 might play a broker role. On the contrary node 47 and 48 have lower clustering coefficient values (respectively equal to 0.133 and 0.131) but relatively modest betweenness (respectively equal to 471840.39 and 396607.99 that represent the likelihood of being intermediate in the whole of paths between two distinct nodes within the graph). This is not the same for member number 2 on the contrary showing the largest betweenness value (equal to 2910094.67 corresponding to the likelihood of being an unavoidable intermediate) alongside the lower closeness centrality value (equal to 2.245 corresponding to a greater likelihood of being reached) and clustering coefficient value (equal to 0.096 in the face of a maximum of 1).

Moreover its degree value is the second-listed in respect to all the thousands of nodes within the final network (equal to 1,641 ties). As a result its structural position is powerful in every case. Interestingly none of the more "powerful" individuals depending upon each attribute is woman. Even if this is a preliminary analysis that something more can be said about.

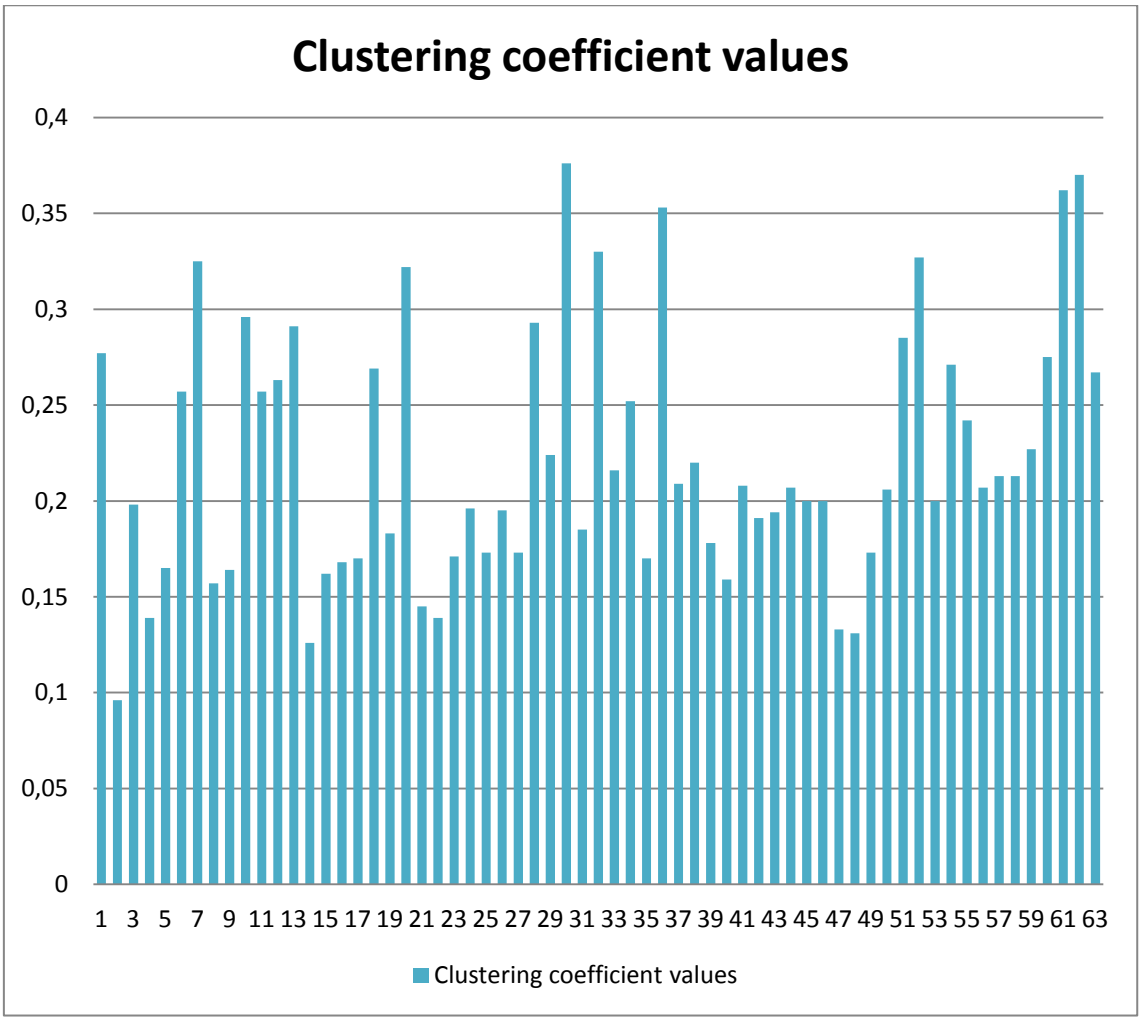

Figure 46. Clustering coefficient for every member-node.

In order to better understand structural discrepancies in network attributes of each member-node it can useful to compare values in terms of a gender-divide. In the face of 63 members-nodes that are encompassed within the final network only 20 of them are women. Hence, gender unbalance is evident in its origin. Nevertheless numerosity is not a great deal in case a node is located within a convenient structural position in respect to the total graph. In depth average estimates in the all of the measures are needed.

Firstly members-nodes average closeness centrality value corresponds to 2.470. Male members on average have a closeness centrality value equal to 2.463 in the face of 2.484 for female members. This means that averagely female members are less central than men. In the same manner their intermediate capacity is further lower: in fact considering the whole of members average betweenness centrality is equal to 346056.44. This value decreases considering the average betweenness for women and increases for average betweenness for man. Both values respectively correspond to 260050.7 for women and 430012.6 for men. This means that on average women might enable brokerage less than men. Conversely on average they show greater values in individual cluster coefficient. Particularly in the face of an average clustering coefficient equal to 0.221 for all of the members, women have an average value corresponding to 0.239 in the face of 0.212 for men. This means that female members' immediate neighbours are on average more embedded than that of male members. This aspect cannot be negligible in the light of women's roles within the movement. So their

tendency is to differ in terms of structural properties, then networking potentialities. In the light of these data women appears less powerful in terms of expansion and bridging capacity but play a determinant role in reinforcing triadic closure and then clustering within a cluster. They are on average less reachable from external clusters meaning that their interfacing capacity can be negatively affected. In addition their structurally given position make them less likely to act as brokers between distinct clusters. Despite that their relationships appear to tend to closure and strongly tied reinforcing. This peculiarity seems to cross feminist theory on the private and public sphere. Whilst men tend to perform a structurally public position like mediating between clusters or being more reachable in respect of the all graph, more visible than women, on the contrary women appear more embedded within strong ties regions with fewer possibilities of being reached and interfaced. On a structural level they are located within high density areas reinforcing strong ties but whose bridging and reaching capability is negatively affected. Albeit this data are needed to be further analyzed and cannot pretend to aim to generalizability, this can eventually explain why women play less public roles within political movement; this can eventually be related to their structural position within a network. Particularly it entails understanding whether and how structure affects performance or, conversely, whether and how performance affects structure. This indicates the need to investigate those meso underlying ontological dimensions discussed in the preliminary chapters, namely those unknown dimensions *in the middle*

of micro and macro. In this sense a network analysis can attempt to provide key-answers for apparent still unsolved questions. This means to understand what type of relation occurs between agency and structure or what allows us to generate social structures from previously apparently rational "atomized" individuals. This means to comprehend how previously isolated oxygen and hydrogen atoms in their union characterized by expanding and still unknown inner organization patterns have been able to generate sea. In the end this means to uncover the most controversial and millenary unsolved ontological dark sides of science and knowledge itself.

CONCLUSIONS

Two roads diverged in a wood, and I —
I took the one less traveled by,
And that has made all the difference.

Robert Frost

This research unavoidably raises more questions than answers because it was undertaken in unknown and less traveled roads. In doing so it has explained the central importance of the network approach first in social phenomena and second in political phenomena by showing how underlying network structure can reveal more than expected. Even if it is a preliminary analysis of a massive dataset firstly it has found that even political network can share a common underlying network structure with other complex systems, and consequently it compels to review ontology in the light of new fruitful "coincidences". Secondly it emerges new insights on the possibility to reconstruct an *order* in apparently *chaotic/disordered* social phenomena diffusion. In this sense networks can plausibly aspire to represent the key-trade off between micro and macro dimensions in scientific knowledge and give sense to emergent micro-

founded and macro-determined phenomena. Definitely both issues draw research into new potential paradigm and for this reason they are indicated as final scopes. Obviously this work did not aim to solve related dilemmas nor providing the final answer. On the contrary it is addressed to encourage future research in pursuing new unexplored roads.

Returning to the hypothesis posed at the beginning of this study, it is now possible to state that not only political networks can be described by small world structures but that they can be represent a key starting point to review related implications in terms of political structure life, potential diffusion, structural network position of a given movement, structural divides inscribed within the underlying network a political movement is consisted of and so on. It is noteworthy that a network analysis can eventually explain why women usually play less public role within political movements and in this sense it can be evidenced the relation between agency and structure, performance and social structure, micro and macro. As a result research implications are negligible at all in terms of ontological dilemmas, gender glass ceiling policies, political diffusion just to mention few of the potential fruitful findings. The only thing to do is accepting new challenges the network approach offers us in the light of a new paradigm to be assessed. It is clear how maturity has still to be reached but time is available and helpful for who is ready to explore new unknown roads. Because in the end research is nothing but a continuous discovery of never traced nor traveled paths.

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