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Interpersonal networks and the archaeology of social structures; using social positioning events to understand social strategies and individual behaviour[1]

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Introduction: spiritual kin, social position and the estimation of prominence

In this paper we demonstrate how spiritual kin, "apadrinhamento", can be used as a source of information about social structure. Our argument is that when a family chooses the godfather and the godmother for a child, they produce a "social positioning event": they assert their perception of their own social position relative to the godparents.

We take as axiomatic that people never invite individuals that they consider to be of lower social rank than themselves to be godparents of their children.. On the contrary, they always choose either from close relatives, who, by definition, are of similar social rank, or from those they perceive as being of higher position, using spiritual kin to reinforce social links associated with potential flow of resources, patronage or protection. To choose the godparent of one's child is to choose a potential surrogate parent and this implies inevitably the choice of someone considered better or equal. Used in this way, spiritual kinship could be considered a compensating phenomenon, that diminishes social distances by creating a link of protection and dependency (Calliert-Boisvert, 1968: 99)

The axiom is confirmed by even a superficial analysis of the sources of the period under study. The most frequently chosen godfathers are clearly people that have a relevant place in the social structure: members of local government, heads of the prestigious fraternities of the Misericórdia (*provedores)*, or local nobility.

This means that parish records are filled with "social positioning events", choices where individuals, or families, define their social position regarding other individuals and families. In a parish like Soure, in the early 18th century, around a 100 baptisms occur every year, providing 200 events of relative social positioning (choosing the godfather and godmother of each child).

Our argument is that this information constitutes valuable data we can use to reconstruct the endogenous image of the social structure. But to reach this objective, we must be able to aggregate the combined perception of a great number of social agents. By devising a methodology to achieve this, we create an alternative to the inference of social positions from individual attributes (estimated wealth, noble titles) or from inclusion in groups that maintain social boundaries (the municipal élite, or the *Misericórdia*).

The concepts and tools of network analysis provide an essential contribution to developing a methodology that uses the "social positional events" of baptisms to gain insights into social structure. Spiritual kin constitutes an example of the type of network that is capable of supporting a formal analysis of "prominence", "prestige" or "centrality", or other concepts that express the general idea of the "importance" of an actor. The web of "apadrinhamentos" can provide ample data for the analysis of what is called

"prestige" in network analysis, a concept that "can only be quantified by using relations for which we can distinguish 'choices' sent from 'choices' received by the actors, and therefore, can only be studied with directed graphs" (Wasserman and Faust, 1999:170).

A direct graph is a network where the direction of the relationship is relevant, in the sense that the existence of a link between A and B does not mean that the same type of link exists between B and A. This corresponds to our situation: the fact that someone is chosen as godfather by another person does not mean that the former will choose the latter for the same role. In most cases, the social imbalance behind the choice prevents the inverse relationship from occurring.

Prestige involves a "nomination" of an actor by another actor. The choice of a godfather is a "nomination". The number of nominations is therefore an indicator of social relevance, especially if the value of a nomination is proportional to the prestige of its author: "prestigious actors not only are chosen or nominated by many actors, but the actors who are doing the choosing must also be prestigious" (Wasserman and Faust, 1999:170).

In this paper we will see that we can in fact infer the social relevance of a person by the imprint that is left on the spiritual kin network. We will show in the subsequent sections that we can use this information to shed light on specific social processes, and to visualize major characteristics of the social structure.

The interpretative relevance of networks of spiritual kin.

In previous work, we have used spiritual kinship to provide an interpretative context in the study of particular historical behaviour. We have found that essential insights into individual processes are achieved when the network of spiritual kin is reconstructed around the actors under study.

In Campos (2003), the information from parish registers, including spiritual kin, was used to elucidate the social impact of the installation of a paper mill in a rural community in the 18th century. The mill and the immigrants that came with it are almost invisible in standard sources, from notarial books to municipal records, but they leave a clear trace in the

social fabric as reconstructed from the network of marriages and spiritual kin. Through the web of spiritual kin and marriages it is possible to see how a family of suppliers of raw materials to the mill manages to make its way up the social ladder, succeeding in marrying one of their family into the best lineage of the community. The spiritual kin ties reveal the close connection of the merchant to the director of the mill, which no other type of source was able to show.
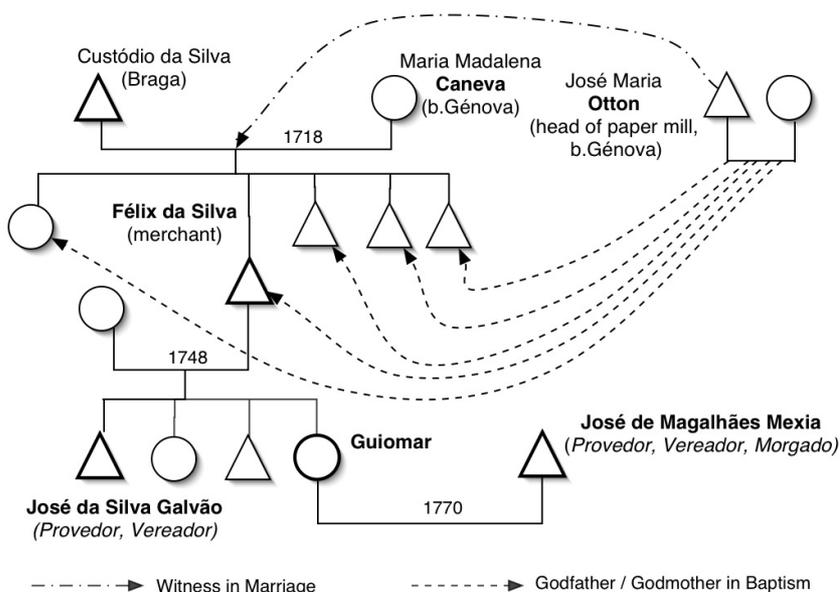

Figure 1: The rise of the Silva family is based on their connection to the paper mill, to which they are suppliers of raw materials, accumulating wealth that permits the marriage of Guiomar with a Mexia, from the traditional local nobility of Lousã. José da Silva Galvão will sit on the City council (*Vereador*) and rise to *Provedor* of the Holy House of Mercy (*Misericórdia*), becoming a "noble person", with his father, Félix, was excluded from the local elections for being a "merchant". The cross linking of sources (electoral lists, minutes of the Misericórdiam parish registers, notarial acts) made the observation of an otherwise invisible process possible: the role of the paper mill in social change.

Carvalho (1997,2004) used the same type of information, cross linked with the illuminating documentation left by the Episcopal visitations on public sinners, to put into context the illicit relationships between upper class men and lower class women. The data led him to the discovery that the flow of resources associated with the collection of land taxes is superimposed on the links of spiritual kin, explaining a bizarre pattern: where we have an illicit

relationship between a man and a woman, we often find that someone in the man's family was the godfather or godmother of someone in the woman's family. There is obviously no causal relationship between spiritual kinship and illicit relations: they are both expressions of a reciprocal process by which actors at different levels in the social hierarchy established channels that facilitated an exchange of resources. Spiritual kinship allows us to see the more complex picture of reciprocal exchanges, with resources and probably protection going in one direction, while concubines and demand for a link go in the other.
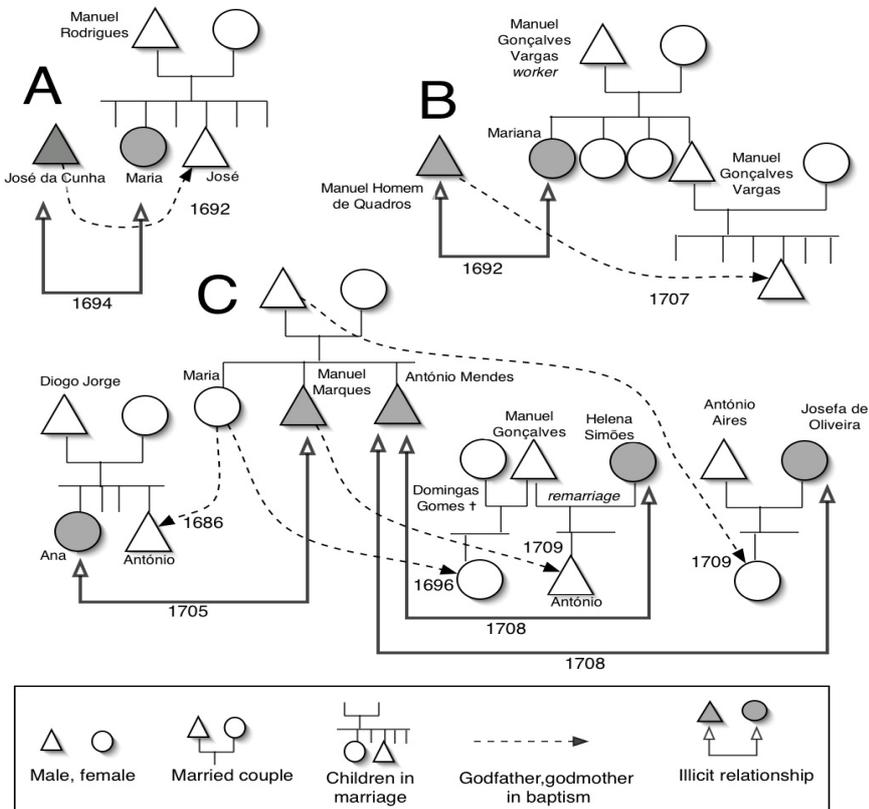

Figure 2: Illicit relatioships in the context of spiritual skin. A recurring pattern can be observed: where we have an illicit relation between a man and a woman, we often find that someone in the man's family was godfather or godmother of someone in the women's family. The pattern implies that illicit relationships correspond to socially unbalanced situations. Closer analysis shows that resources are flowing from the more affluent families to the less affluent in each of those cases. Concubines and demand spiritual kinship flow in the opposite direction.

In both case studies we find that spiritual kinship reveals other types of social relationships that are frequently hard to detect in the sources. Reconstruction of the network of the "padrinhos" (godfathers) allows us to put social agents into context, and also to grasp their relative social roles.

It should be clear that our understanding of the role of spiritual kin in the explanation of social phenomena is purely symptomatic, and we do not attribute any causality, per se, to the existence of particular relationships at this level. We do not think, obviously, that illicit relations are caused by spiritual kin, but rather that the social *topos* that facilitates illicit relationships also expresses itself in the existence of godfather/godchildren relationships.


Is there a geographic logic to spiritual kin?

In this paper we take the inquiry further, and try to look into the structure of the network as a whole. One question that can be raised regards the existence of a strong geographical causality in the construction of the links of spiritual kin. Since the parish records that provide the data cover differently sized settlements, the relevance of godfathers could be connected to the dimension of the population of their residential location.

Analysis of the geographical distribution of godparent/godchild links both in Lousã and Soure indicate that the most relevant godfathers have a wide geographical sphere of action (see Figures 3 to 8). There is, of course, a concentration of connections with the families that live close to the godfather, but this is by no means their main constituency. Relevant godfathers spread their connections over a wide area. This area appears to be related closely to their economic environment: the location of properties or facilities that belong to the person in question.

The geographic spread of the spiritual kinship links ensures that, for instance, just the four topmost godfathers in Lousã have godchildren in 82.4% of the settlements of the parish. In a universe of 57 settlements, one the top four godfathers is present in 43 of them, a number made more relevant by the fact that 8 settlements only have between 1 and 5 baptisms.

In Soure we see a similar pattern, although due to the very dispersed nature of the settlement, a meaningful statistic is not possible (we found almost 500 toponymical forms for inhabited places in the parish in the 17th and 18th century sources).
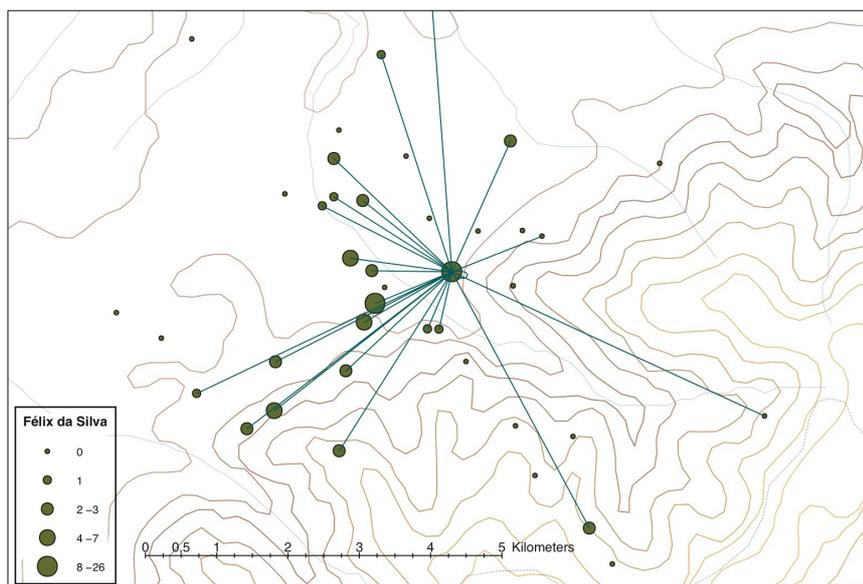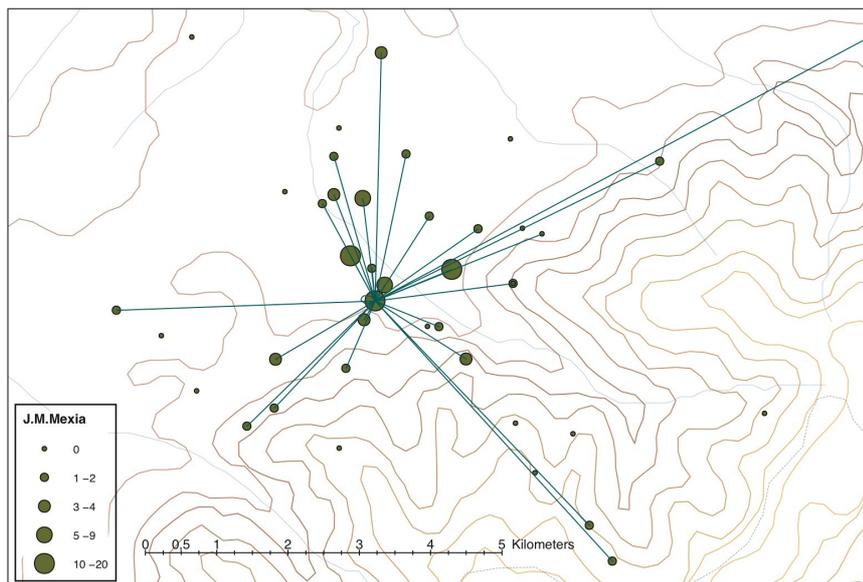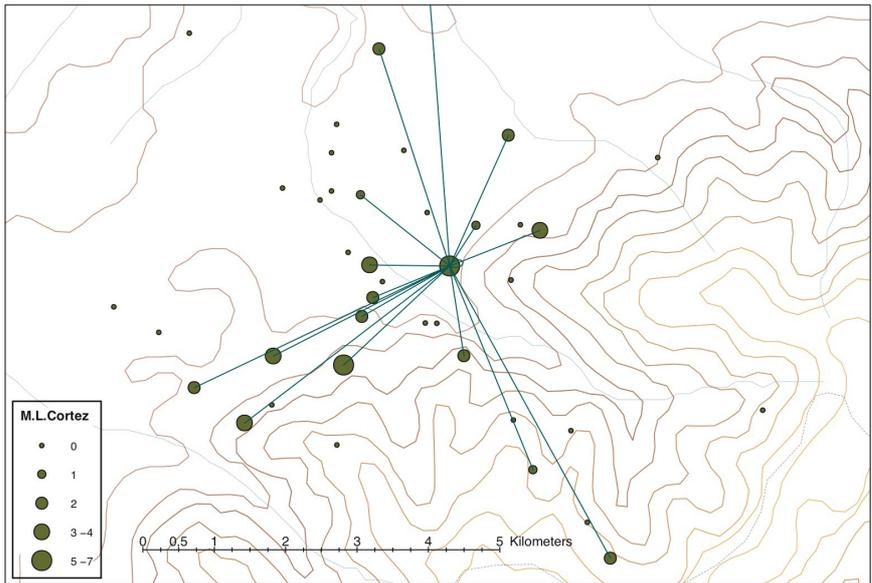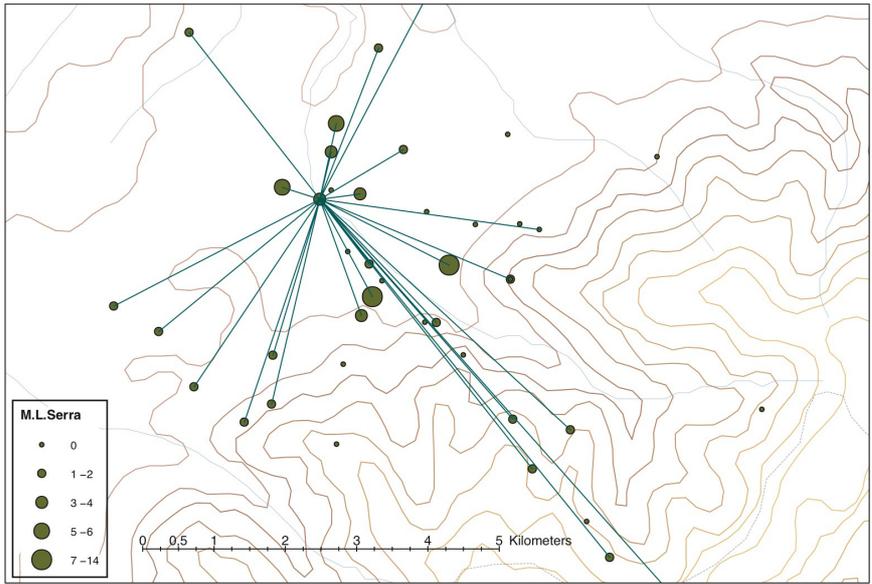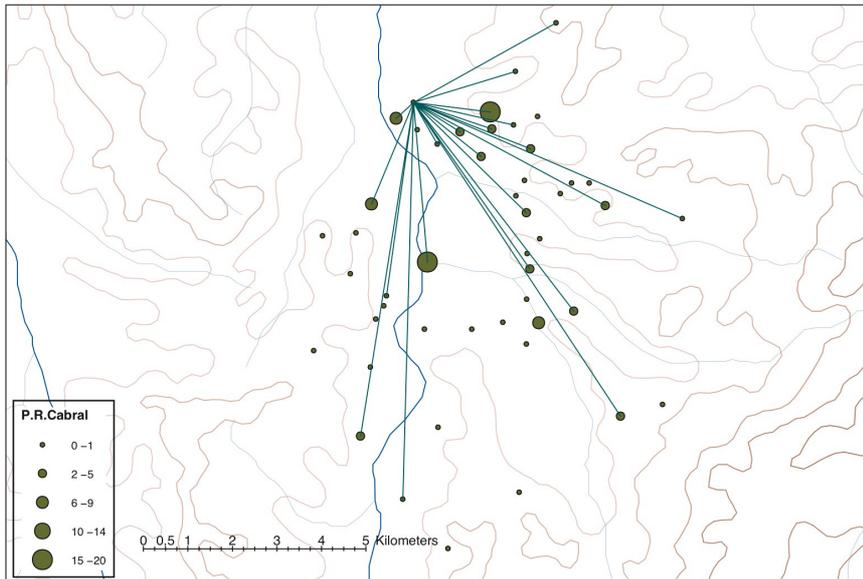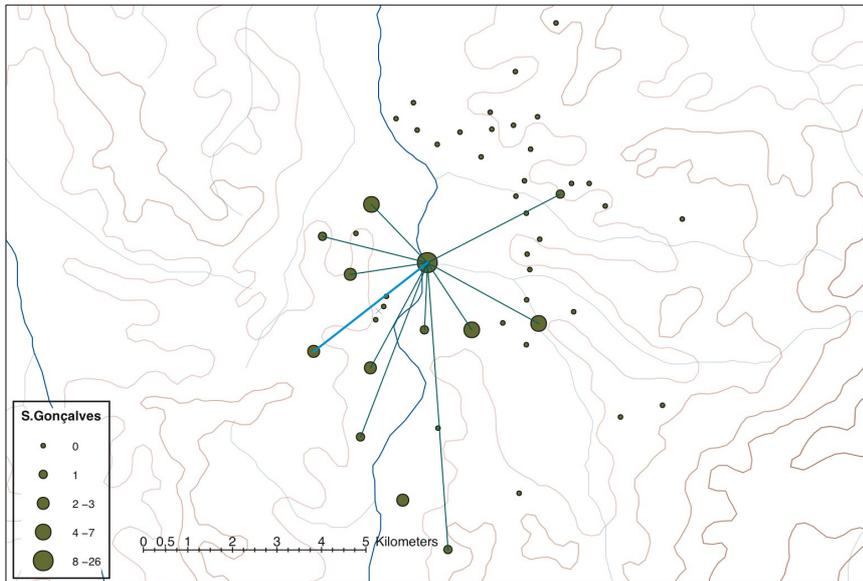
Figures 3-8: In both Lousã (first four maps) and Soure (last two maps) relevant godfathers have a wide geographical reach, even if they have a stronger impact in their area of residence.

Godfathers, power laws and small worlds

We have previously presented results that seem to indicate that the network of godparents has characteristics similar to what is called a "small world" (Carvalho and Campos, 2005). A "small world" is a network where every member is just a few steps away from every other member (Watts, 2003). "Small worlds" are produced when there are nodes with a large number of connections. These "hub type" nodes create short paths between the members of the network, because they concentrate a great number of links and therefore connect in just two steps the individuals that are directly attached to them.

One of the characteristics of "small worlds" is a particular type of statistical distribution of nodes by the number of links that they have. When we order the nodes by number of links we discover that the connectivity of the nodes decreases quickly, creating what is called a "long tail" distribution. In other words, there are few nodes with many links (the "hubs") and many nodes with few connections. We find this type of distribution when we rank godfathers by the number of godchildren they have (see Tables 1 & 2, and Figures). These distributions are called "Zipf laws" or "power laws", and can be found in many social and natural phenomena.

Table 1: Godfathers by number of godchildren (Lousã)

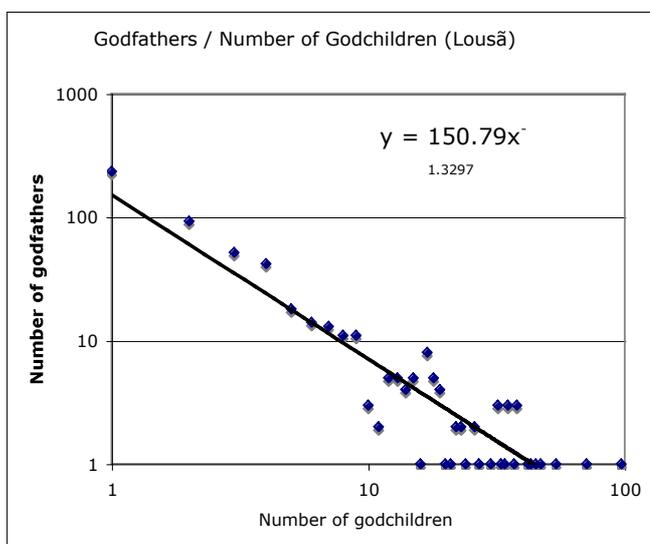| Godchildren	Godfathers
97	1
71	1
54	1
47	1
45	1
43	1
42	1
…	…
18	5
17	8
16	1
15	5
…	…
3	52
2	93
1	235

Figure 9: The number of godfathers with a given number of children decreases sharply from 235 godfathers with just one godchild to just one with over 90. Although exact quantification is difficult, because it relies on extensive identification of people, the overall correlation corresponds roughly to a power law, made evident here by graphing the logarithms of each dimension.

The existence of a Zipf-law type of distribution in the network of spiritual kin indicates that we are observing a self-organization type of phenomenon. The proximity of the Soure and Lousã data to a power law argues in favour of this interpretation. We are encountering here a type of process similar to that which produces the power law distribution related to the size of cities, one of the most notable manifestations of power laws in social phenomena. A general overview of power laws and their importance can be found in Bak (1997).

One type of network where we find a "small world" and a Zipf law relating the number of links is the WWW. The parallelism between the WWW and spiritual kin seems overstressed at first. But in reality there are similarities between the processes that are at work in the development of both networks. In the WWW the probability that a site attracts a new link (a hypertext reference to it) is proportional to the number of links already pointing to that site. The visibility of a node influences in a positive way

the possibility that it will become more visible. It is this self-reinforcing mechanism that produces the particular shape of the Zipf law.

It is possible that this aspect of the Zipf law also plays a role in the choice of godfathers. Godfathers are of course chosen from the existing relations of the child's parents, or their close relatives, but given several alternatives one can assume that the most frequently chosen godfathers, those that appear more often at the church, tend to be chosen subsequently, because of their visibility. This would mean that social prestige is in part a self-reinforcing process based on network events.

In social psychology the concept of "social representation" is based on the assumption that individuals build their own representations of social structure and social differences and auto-locate themselves within the framework of those categories, developing networks of relationships that in turn produce and transform the social representations (Vala, 1996: 381).

Table 2: Godfathers by number of godchildren (Soure)

Godchildren	Godfathers
93	1
66	1
64	1
54	1
41	1
40	1
36	1
…	…
17	1
16	2
15	2
14	2
…	…
3	51
2	120
1	168

Godfathers / Number of Godchildren (Soure)

$y = 144.35x^{-1.4091}$

$R^2 = 0.8646$

Number of godfathers (y-axis)

Number of godchildren (x-axis)
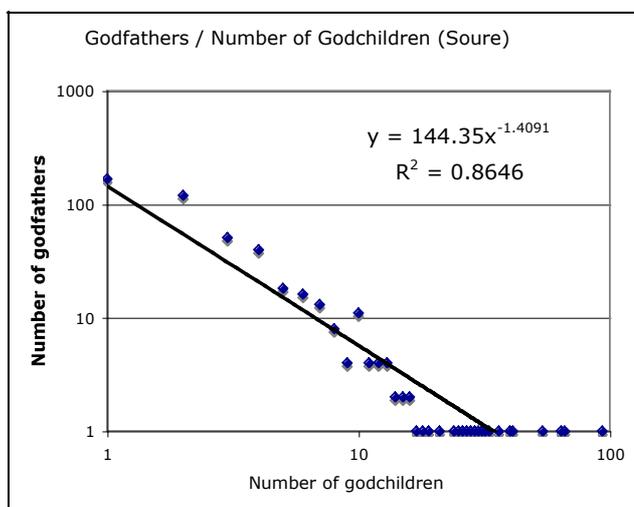
Number of godfathers

Figure 10: Data from Soure has remarkable similarities with Lousã,
in spite of the imprecision of the collection process and the different social environments.
See caption to Figure 9.

Generating a representation of the relative social position through spiritual kinship

One of the most fascinating applications of the spiritual kin data is to try to form an overall image of the relative social positioning of individuals. Since each single godparent/godchild link can tell us something about the perception of the relative social position of two people, by considering all such links at the same time it should be possible to detect the position of each actor relative to all the others that participate in the same network of spiritual kinship.

To achieve this picture we must create a "positional rank" for each actor that we find involved in the spiritual kin network. At first it would seem that the number of godchildren of each godfather is a good indicator of the relevance of that person. We have used this measure in the tables above, which allowed us to detect the traces of a Zipf power law.

However, closer analysis shows that this indicator has its shortcomings. It is true that a person with a significant number of godchildren is someone

that is high in the social ranking, but the inverse is not always true. A person may have few godchildren, but if those children belong to families with a high social rank, then it is clear that the status of the godfather is at least as high. So it is not really the number of godchildren that is relevant to estimate the social position of an actor, but rather the status of the godchildren's families (not just "how many" but "who they are").

The status of the godchildren's families is in turn determined by the number of times they provide godparents to other families. We have therefore a recursive process where the status of godparents is derived from the status of the godchildren's family, which in turn is determined by the status of their own godchildren's families, and so on (see Figure 11).
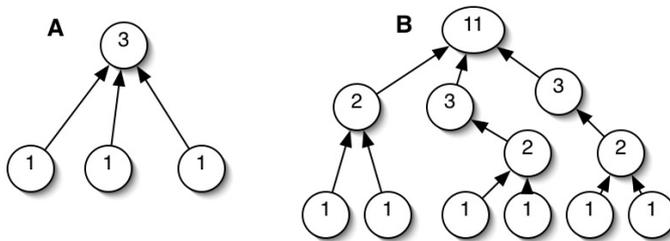

Figure 11: The number of godchildren is just an approximate measure of the prestige of the godfather. Propagating prestige through the network gives a more precise quantification. Two individuals with the same number of godchildren have different prestige because A is being chose by people with no prestige (never chosen as godfathers) while B is chosen by people who, in turn, are also chose by others. The prestige is therefore better estimated by counting the number of persons that can be reached by following the nominations that converge on a godfather.

This aspect is normally considered in discussions about the calculation of prestige in networks. Prestige involves a "nomination" of an actor by another actor. The value of this nomination is proportional to the prestige of its author: "Prestigious actors not only are chosen or nominated by many actors, but the actors who are doing the choosing must also be prestigious" (Wasserman and Faust, 1994:170).

Network analysis software like Pajek (Nooy, Mrvar and Batagelj, 2005), is capable of computing the prestige of every actor in a directed network, if the edges can be reasonably interpreted as "nominations". We provided

Pajek with the combined network of spiritual kin of 467 persons. This network was extracted from a database with parish registers from Soure, between 1680 and 1720. We registered the "choice" as a link between the father of the child, on one side, and, on the other, either the godfather, the father of the godfather, the husband of the godmother, or the father of the godmother. We have very few cases where a godmother would appear in a baptism without a reference to the name of the husband or the father. We need to account for the parents of the actual godparents because in Soure it is common that children and teenagers represent their parents in the actual baptism, and many godparents are registered as "X son of Y" or "X daughter of Z".

Pajek computed the prestige of each of the individuals and produced a three-dimensional representation of the network (Figure 12). In this representation, planar coordinates (x,y) are calculated by an algorithm
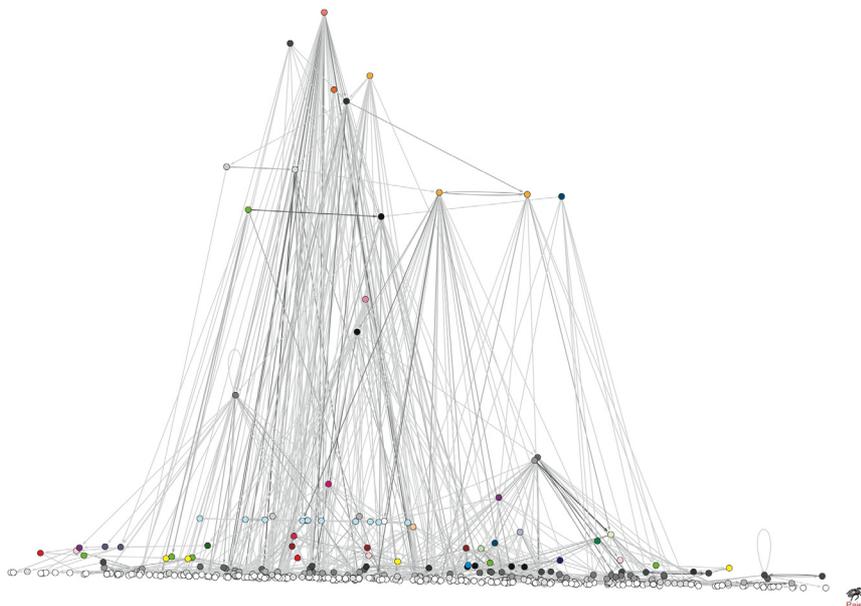

Figure 12: Three-dimensional representation of the network of spiritual kin. The vertical axis represents prestige, calculated in the way exemplified by Figure 11. The software allows for the rotation of the structure, providing a fascinating perspective of this representation of social structure. Colours help to identify individuals with similar prestige.

that tries to place nodes that have common connections close together. The vertical axis corresponds to the prestige calculated as explained before. The software allows for the rotation of the representation, which is necessary to fully grasp the characteristics of the structure.

The analysis and representation of the network by this method confirms the hypothesis formulated at the beginning of this research. The network of spiritual kinship provides a detailed and information-rich representation of social structure. One of the main findings is that there are almost no loops in the network. A loop occurs in situations where family A provides godparents to family B, family B to family C, and family C back to family A. If, as we have assumed, spiritual kin is used to cover socially uneven situations, then loops should be rare, and would correspond to situations of families which are closely related by biological kin. This is confirmed by the network analysis software. The single significant loop is a cluster of nuclear families, closely related by kin since they all have a direct common ancestor (this cluster is shown in Figure 14).
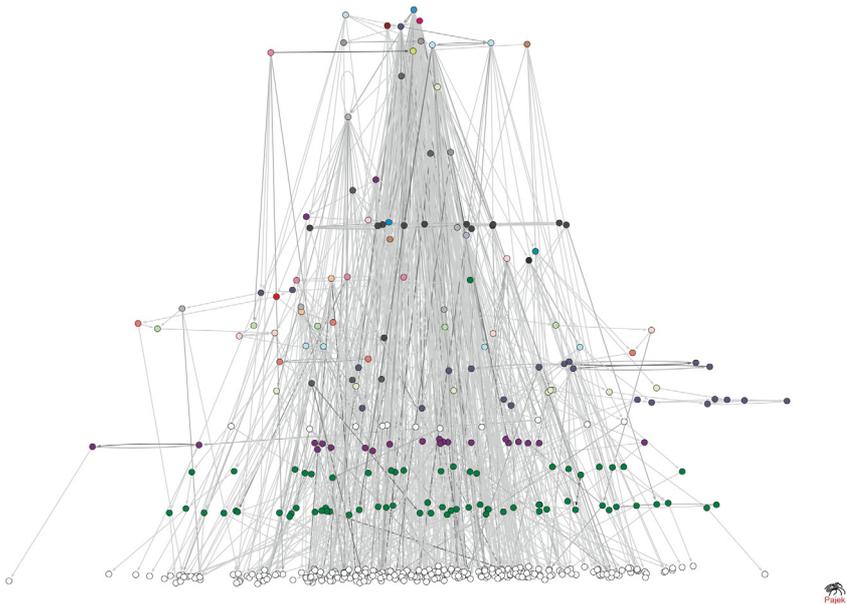

Figure 13: The same structure of figure 12 with a logarithmic transformation applied to the vertical axis. The details of the lower levels can be better examined.

The prestige calculation produces results that "compress" the vast majority of individuals at the bottom of the structure. By applying a logarithmic transformation to the vertical axis, the lower region of the structure is expanded, allowing for a more detailed examination of the "lower classes" (Figure 13).
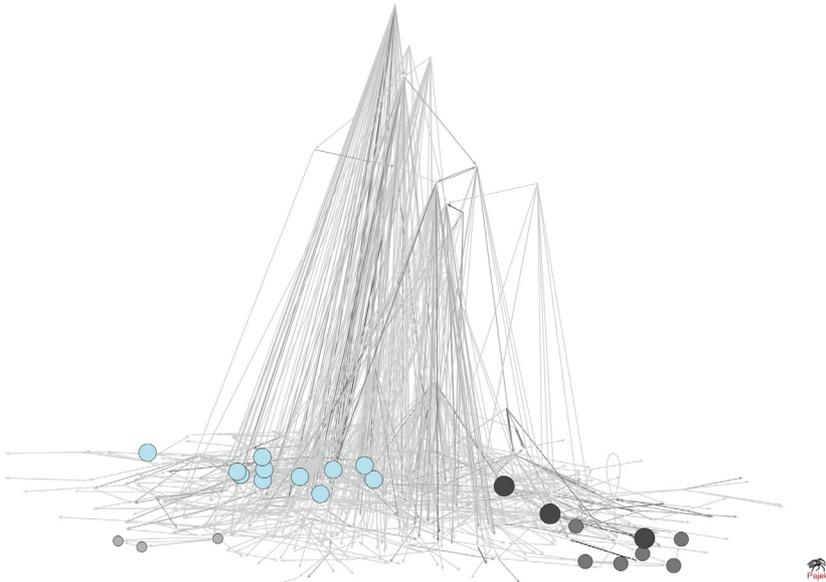

Figure 14: Strong components inside the spiritual kin network.
The light blue component is the result of the reciprocal exchange of godparents between siblings of a large family. The software automatically detects this type of sub-network.

Pajek provides several mechanisms for exploratory social network analysis, and many of them are of a visual nature. Figure 14 shows a tilted structure with strong components highlighted in colour. Strong components are sets of nodes which are very strongly connected. In this example, the light blue component is the result of the reciprocal exchange of godparents between siblings of a large family.

Another very useful exploratory device is the representation of repeated links between two individuals by means of a proportionally wider line. Repeated choices of the same godfather suggest that the lower ranking family is totally dependent on the higher ranking one, to the point of not

desiring to enlarge the network of upward links to other families (Figure 15). A specific case studied in detail by Carvalho (Carvalho, 1997: 139-150, and Plate 21), demonstrates how a clerk to the King's tax collector in Soure (escrivão do almoxarifado), invited his employer to be godfather of almost all his children, and proceeded to climb the social ladder rapidly under his patronage. This specific relationship, between the tax collector and the clerk, is clearly highlighted in the Pajek representation, by a thick black line.
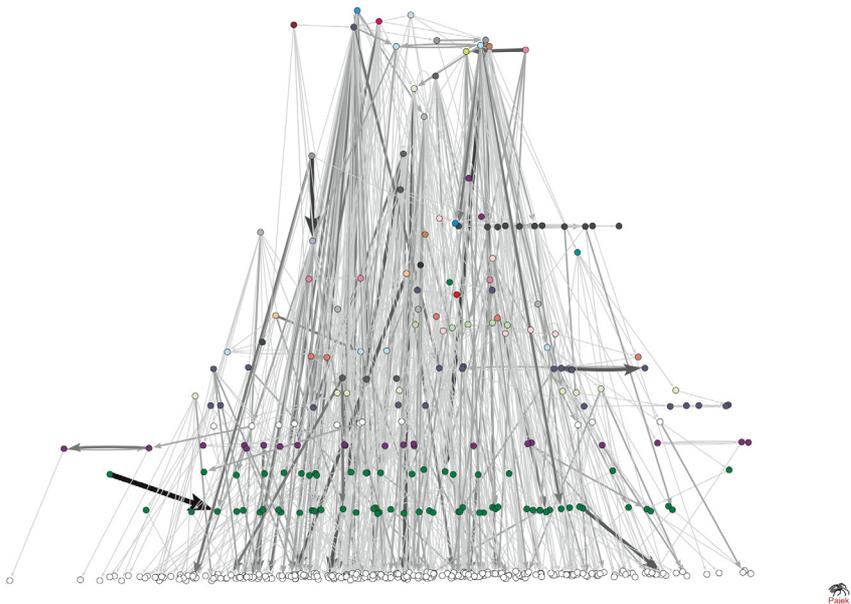

Figure 15: Wider lines identify situations where one family invites the same godfather for more than one of their children. When those lines are horizontal they are normally associated with inter-family exchanges. But when they are clearly connecting families from different social levels, they highlight situations of strong economic and social dependency.

Conclusion

The fascinating three-dimensional representation of the spiritual kin network is a striking confirmation of our initial hypothesis. Produced directly from data obtained from parish registers, it constitutes an extremely

effective tool for exploratory analysis of social structure. Considering the wide availability of parish registers, this methodology can certainly give a new dimension to social and economic history at the local level.

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