Personal network structure predicts migrants' cultural backgrounds

José Luís Molina,[1] Juan Ozaita,[2] Ignacio Tamarit,[2] Angel Sánchez,[2,3] Christopher McCarty,[5] and H. Russell Bernard[5,6]

[1]GRAFO-Department of Social and Cultural Anthropology, Universitat Autnoma de Barcelona

[2]Grupo Interdisciplinar de Sistemas Complejos (GISC), Departamento de Matemáticas, Universidad Carlos III de Madrid

[3]Institute for Biocomputation and Physics of Complex Systems (BIFI), Universidad de Zaragoza

[4]Department of Anthropology, University of Florida

[5]School of Human Evolution and Social Change, Arizona State University

In the study of societies from an antropological point of view, culture and social structure have long been considered as two separate phenomena. However, in the 1960's the study of cultural manifestations as a complex product of society emerged. One of these approaches, the so-called Grid/Group theory [1], describes a society as defined by two dimensions, a *group* dimension, characterized by the connections between members (i.e., by the network structure), and a *grid* dimension, characterized by the distribution of social roles, often identified with cultural variables [2].

In this work, we provide for the first time empirical support for the Grid/Group theory. We draw on the idea that individuals are characterized by a "social signature," i.e., a specific manner to allocate their limited cognitive capabilities to relationships with others [3] that is stable in time. We then hypothesize that it is possible to find such a correlate at the same-culture aggregate level, i.e., a "cultural signature." To validate this hypothesis, we used a dataset of personal networks from migrants in USA and Spain (Fig. 1 shows an example of these networks). Specifically, using the country of origin as a proxy for the diverse languages or other cultural institutions, we study the correlation with personal network structural measures, such as closeness, clustering, betweenness, average degree, or assortativity. We understand this problem as a inference/prediction problem, hypothesizing that the social structure around an ego may be a good predictor for its nationality.
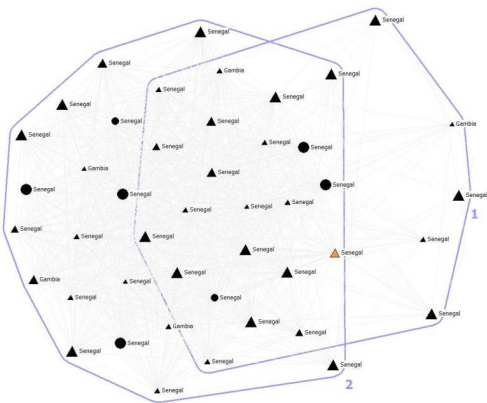

Fig. 1. Personal network of a Senegambian migrant in Spain with 45 alters (ego is not represented in the drawing)

We used three different prediction methods to try and answer this question: a multinomial logistic regression, a random forest algorithm and an artificial neural network. Results from these techniques are in good agreement and provide support for the idea that it is possible to predict the country of origin from network measures reliably, with a 50% improvement in accuracy over the best alternative model. Furthermore, clear interpretability of the results in the case of the random forest comes from looking at the

SHAP values [4]. Using SHAP combined with the coefficients of the multinomial logistic regression, we can extract correlations between the nationality of subjects and a characteristic range of network measures, which turns out to be different for nationals of different countries. The range of the distribution of SHAP values is related to the relevance of the predictor, and the correlation can be obtained when the range of the magnitude (in this case a range of colors) and the range of SHAP values show a good concordance. As an example, Fig. 2 shows the distribution of SHAP values according to their relevance in the argentinean subpopulation (Fig. 2). High SHAP values are related to larger probabilities of belonging to the class, so in this case that low average degree and high clustering are correlated with being argentinian.
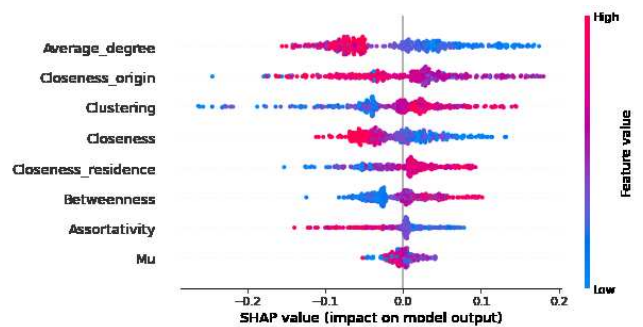

Fig. 2. SHAP values, or contribution from the different network structural measures, on the prediction of the nationality in the case of argentinians.

In conclusion, our analysis shows that it is possible to infer not just their country of origin but also that each of them exhibit a particular combination of network measures compared with others. This finding is relevant theoretically because it suggests how to overcome the duality of culture and structure and support the Grid/Group analytical framework. In addition, our results suggest that personal networks can be conceived as samples of the social structures that frame the group dimension, capturing the effects of cultural institutions (the grid dimension) in the alter-alter matrix of interactions.

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