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Characterizing the geographical organization of the International Institute of Intellectual Cooperation via network cartography

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Extended Abstract

From 1924 to 1946 The League of Nations (ancestor of the United Nations) delegated the International Institute of Intellectual Cooperation (ancestor of the UNESCO) with the task of fostering mutual understanding and the maintenance of world peace through its work in the cultural and intellectual domains [1]. Therefore, the International Institute of Intellectual Cooperation (henceforth IIIC) archives' constitute a treasure trove for scholars studying the intellectual cooperation during the so-called interwar period (*i.e.,* the time lapse between the two World Wars). Despite that, the amount of quantitative studies of the information stored in the aforementioned archives is rather small.

In this contribution, we leverage the information stored by the UNESCO digital archives to study the geographical organization of the IIIC by using methods from network science to address questions like: "which countries played a pivotal role in the IIIC's internal organization?" To this aim, we apply the *network cartography* technique [2] to the network of sender/receiver locations generated from the correspondence related with the IIIC's national committees, as well as that related to literary and artistic matters.

After parsing a set of more than 18,000 digitally scanned documents, we have automatically identified over 6,000 letters with a sender and a receiver address and extracted the corresponding countries. The resulting undirected weighted network is made of $N = 76$ nodes (countries) and $K = 236$ edges whose weights, $\{w\}$, denote the number of letters exchanged between two countries.

The purpose of the network cartography is to assign roles to nodes by studying the distribution of their connections across different groups (partitions). More specifically, given a partition of the network into N_c groups $\{c_j \,|\, j = 1,\ldots,N_c\}$, for each node i we compute two indicators: 1) the z-score of its *within group degree*, z_i, and 2) its *participation coefficient*, $p_i \in [0,1]$ [see Eqs. (1)].

$$z_i = \frac{\kappa_i - \overline{\kappa_{c_i}}}{\sigma_{\kappa_{c_i}}}, \qquad \text{and} \qquad p_i = 1 - \sum_j^{N_c} \left(\frac{\kappa_i(c_j)}{k_i} \right)^2 . \tag{1}$$

The former quantifies how many connections, κ_i, one node i has within the group it belongs to (*i.e.,* its within group *hubness*), whereas the latter quantifies how the connections of node i split across distinct groups (*i.e.,* $p_i = 0$ if i's neighbours belong to the same group, and $p_i = 1$ if i's neighbours belong to different groups). To identify the groups, we used a modified version of the *Louvain method* called *Leiden algorithm* [3] which identified $N_c = 33$ groups.

We divide then the (p,z) plane into six regions, each corresponding to a distinct role R. In particular, we slice the p coordinate (axis) into the *peripheral*, *connector*, and *kinless* regions, and the z coordinate into the *non-hubs* and *hubs* regions. The distribution of countries across roles portrayed in Fig. 1 gives us some insight about the IIIC's geographical organization. Specifically, we notice that more than half of the countries classified as kinless hubs ($R6$) are

European, including France (FRA) and Switzerland (CHE). The presence of these countries confirms not only their pivotal role within the IIIC, but also the hypothesis of an excess of "Eurocentrism" within the IIIC [1]. We also observe a strong prevalence of South American countries in the $R5$ role whereas, we do not find any country in the peripheral hub role ($R4$) suggesting that: there were no countries having a broad interchange of correspondence exclusively with those belonging to their own group. The members of roles $R2$ and $R3$ are, instead, more widespread over the globe, with countries like: the United States of America (USA), United Kingdom (UK), Austria (AUT), Japan (JPN), Germany (DEU), Morocco (MAR), and Spain (ESP) being non-hub connectors ($R2$). Countries like Canada (CAN), China (CHN), Portugal (PRT), Denmark (DKN), and Mexico (MEX), instead, are classified as kinless non-hubs ($R3$). Finally, we observe that some countries like Russia (RUS) and Australia (AUS) are peripheral non-hubs. This is due to the fact that around 66% of the nodes have a self-loop (*i.e.,* at least one letter whose sender and receiver lies in the same country).

Overall, these observations allow us to: i) make an inductive reconstruction of the IIIC institutional fabric, avoiding the pitfall of generalizations and, ii) postulate hypothesis about the role played by countries in each of the IIIC's areas of interest. In particular, the latter point provides a complementary view of the geographical organization of the institute available hitherto, and allows a cross-check of our findings with other sources (*e.g.,* the archives of national institutions bound to the IIIC).

References

[1] J.-J. Renoliet, *L'UNESCO oubliée. La Société des Nations et la coopération intellectuelle (1919–1946)*. (Publications de la Sorbonne, Paris, 1999).

[2] R. Guimerá, and L. A. N. Amaral, "*Functional cartography of complex metabolic networks*." Nature, **433**, 895–900, (2005). DOI:10.1038/nature03288

[3] V. A. Traag, L. Waltman, and N. J. van Eck, "*From Louvain to Leiden: guaranteeing well-connected communities*". Sci. Rep., **9**, 5233, (2019). DOI:10.1038/s41598-019-41695-z

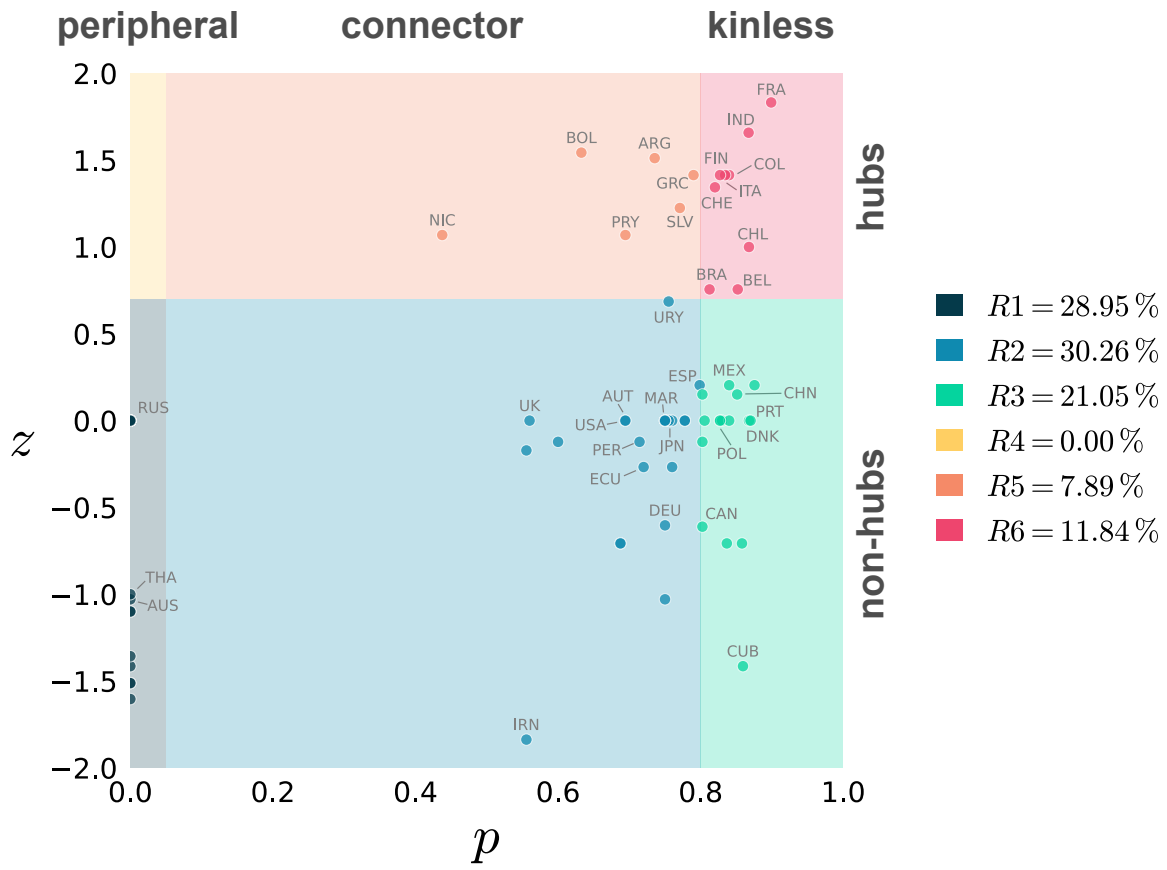

Figure 1: Localization of countries (nodes) on the (p, z) plane. For each point, i, we report the values of its within module degree z-score, z_i, and participation coefficient, p_i. The color of each patch/point denotes its role, R, assigned according to the network cartography technique. The legend reports also the percentage of nodes belonging to each role.