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Martin Grandjean

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Using Network Analysis to Question the Concepts of Centrality and Periphery in Complex Historical Structures

Keynote lecture

“Cultural Organizations: Between the Local and the Global (1880s-1960s)”

November 18 2020, Universitat Oberta de Catalunya, Barcelona

Martin Grandjean

University of Lausanne

Video: <https://youtu.be/CTXrVchm05M> (HD, subtitles available)

Today, we will try to make the link between historical questions related to the concepts of centrality and periphery and certain uses of network analysis and visualization.

In the field of global, intellectual or transnational history, the use of the ‘network’ metaphor to describe the organization of a group of individuals and/or institutions is relatively common. This image of the network, a concept that seems to describe any complex, intricate situation, is particularly suited to historical sciences, whose objects are often divided into several levels, deploy their ramifications in large numbers of clusters and mix different historical sources expressing interpersonal or inter-institutional relations.

But can we go beyond the metaphor and put these networks at the center as formal objects? It turns out that graph theory, formal network analysis, is all about finding ways to calculate centrality in graphs. It's up to us to articulate this theory and our historical questions.

Introduction

A Case study: The Intellectual Cooperation at the League of Nations (1919-1939)

This presentation will take the form of a methodological reflection on the basis of a case study: a cultural, scientific and above all political institution from the interwar period. This institution, which is the forerunner of UNESCO, was created within the framework of the League of Nations, the first large multilateral organization of the 20th century. In this short introduction, I invite you to discover this case study and how questions about the centrality or the periphery of its actors are articulated.

The Treaty of Versailles was signed in June 1919, it aims to develop an institution capable of avoiding any new war like the one the world has just experienced between 1914 and 1918. The League of Nations is created in the form of a large world parliament. It brings a lot of novelty in diplomatic relations and raises a lot of hopes. Even if its most visible activities are political, the League of Nations also has technical missions, linked to the coordination of different sectors. The Cooperation in the field of science, education and the arts became one of its missions in 1921.

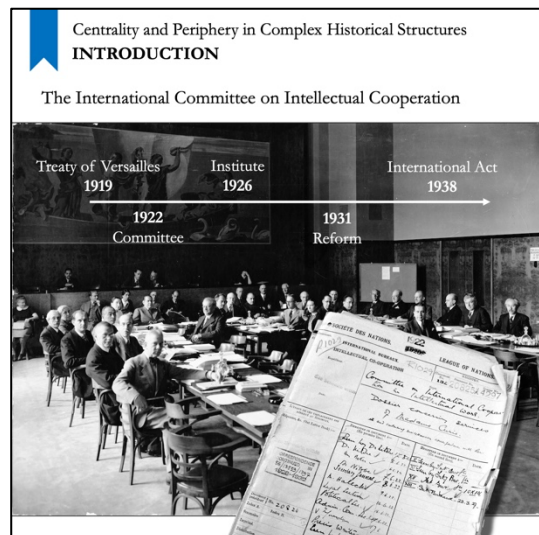
As this is not an urgent priority, the Assembly of the League of Nations does not immediately create a complete organization but sets up a committee responsible for assessing the situation and making scenarios for the establishment of a stable structure. This is the International Committee on Intellectual Cooperation, whose first meeting takes place in August 1922 in Geneva.

France, one of the major players in the League of Nations, proposed in 1924 to finance a branch of the committee in Paris, to help get things done. The Institute is therefore inaugurated in 1926 in Paris. It is a way for France to take control in this field and to develop its own cultural diplomacy.

But this institute will become so large and independent that the League of Nations and the Committee in Geneva will reform the organization in 1931 so as to better control its activities.

In the second half of the 1930s, confidence in the League of Nations deteriorate and a number of States prepared an international Act aimed at making intellectual cooperation independent of the League.

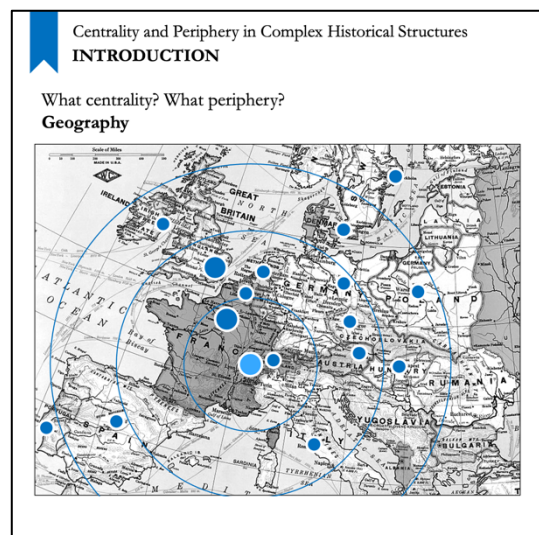
The act is signed in 1938, but war breaks out soon after, before it could even come into force.



There are several ways of analyzing the relationship between center and periphery regarding intellectual cooperation. The geographic aspect is an obvious one. We have a duel between Geneva and Paris and, more generally at the League of Nations, between Geneva and the capitals of its two main powers: Paris and London. But intellectual cooperation is also taking root in dozens of countries through national committees.

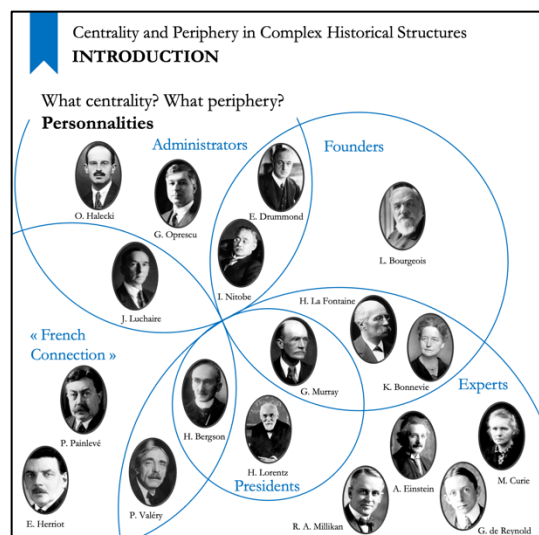
Moreover, intellectual subjects are often the scene of clashes between countries of Latin languages and those of Germanic or Anglo-Saxon languages.

If Geneva logically appears as the official center, competition from the Paris Institute shows that we cannot say that it is always also the center of activity.



Intellectual cooperation is first and foremost about people. From the outset, the intellectual cooperation committee was designed as a meeting place for leading scientific figures. First chaired by the French philosopher Henri Bergson, it is made up of experts representing all disciplines, including several Nobel prizes, in physics, chemistry, literature and peace. You see a few here in the lower right circle, including Marie Curie, Albert Einstein, Hendrik Lorentz, etc.

But intellectual cooperation is also an administration: general secretaries, directors. The circle at the top left shows a few of them, including the Japanese Inazo



Nitobe, Under-Secretary-General of the League of Nations and Director of the Section of International Bureaux, on which the committee reports.

Between these two groups, who is central? Those who think or those who act? Those who lead or those who apply the instructions?

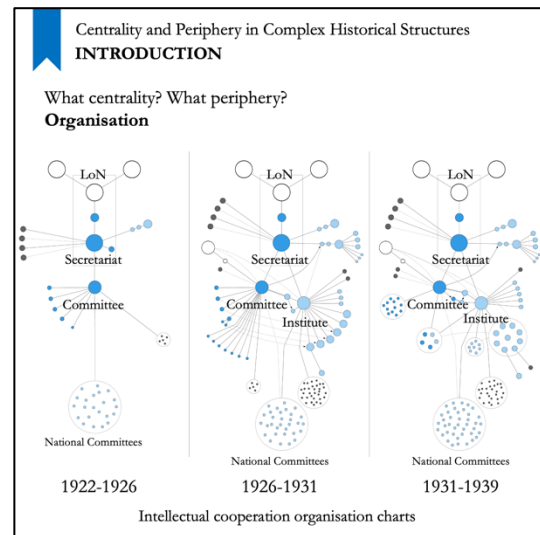
Of course, there are other groups, the political personalities of the Assembly and the Council of the League of Nations, those who founded intellectual cooperation. But also, for example, the French network, which is working to strengthen their soft power.

Another way to try to understand the balance of this institution, and therefore the relationship between center and periphery, is to take a look at its concrete organization. The organization charts presented here represent the three phases of intellectual cooperation: we see the main bodies of the League of Nations in white at the top (Council, Assembly and Secretariat), then the Committee in dark blue, with its thematic sub-committees and national committees.

The irruption of the International Institute for Intellectual Cooperation in Paris in 1926 considerably modify the organization. In the central chart, in light blue, the Institute is represented with its sections, which are meant to be the counterpart of the Geneva sub-committees. We can also see that it is now Paris which maintains relations with the national committees and a multitude of experts and delegates.

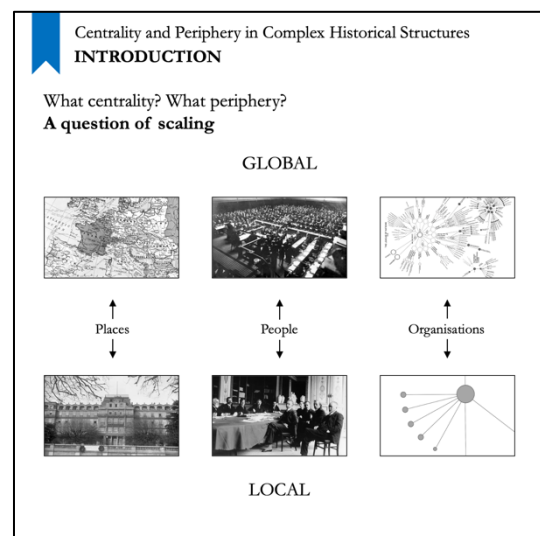
The director of the Institute, Julien Luchaire, personifies the French ambitions and goes so far in the development of its activities and in its independence that other States show their dissatisfaction and concern. He is forced to resign in 1930. The new structure of 1931 introduces some control bodies and dismantle part of the formal structures of the Institute. In a way, it redefines the center, which had moved from Geneva to Paris, to find a viable in-between.

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We therefore see in these three facets of intellectual cooperation that what is central or peripheral is according to a point of reference, and therefore according to the level of precision at which the observer is placed.

If, as a historian, you analyze, for example, the network of relations created by the Spanish national committee, it is no longer Geneva which is at the center but the Spanish scientific and cultural microcosm. And Geneva is only one of the places in which they are represented. And if you analyze the whole League from a global point of view, you will probably see how intellectual cooperation is only one element among many others and that it is very



marginal in the debates. But in doing so, this global level does not tell you much about what is happening at the local level, at the level of committee debates for example.

Without replacing traditional approaches, we will see that the whole point of network analysis is to provide context around the element that interests us, and play with scales of analysis to avoid being locked into only one dimension of our object.

Graph theory

A way to contextualize relationships and measure the centrality of actors in a network

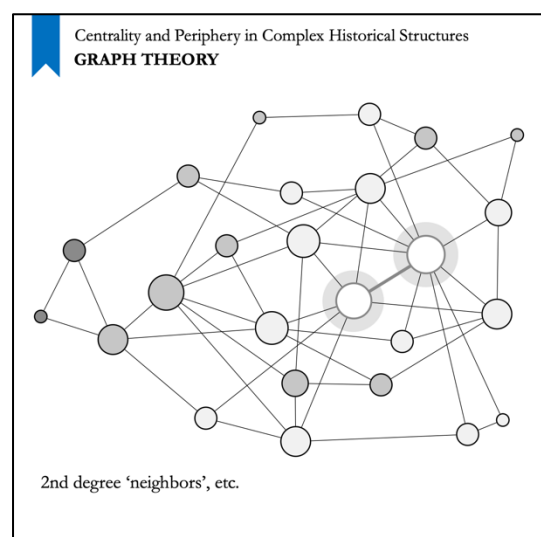
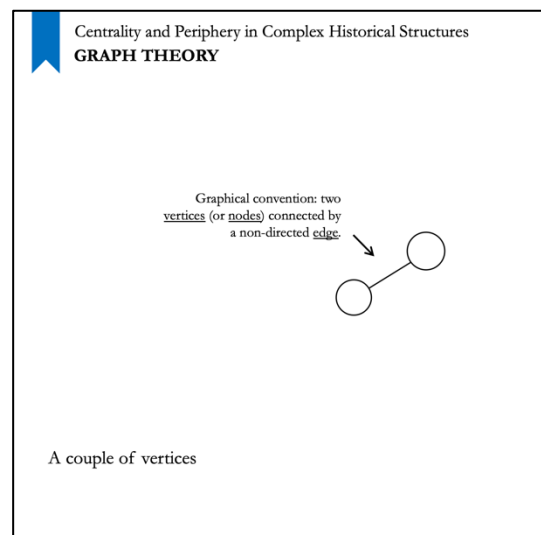
Thus, this is why this second chapter is devoted to graph theory and its capacity to help us discuss the centrality of actors in a network. The goal is not to go very far into details but to make you understand how structural analysis allows you to give context around a person, a particular relationship.

We will start with a very simple example, which allows us to approach the way we graphically represent a graph: here, two vertices connected by an edge represent an undirected relation between two elements. A directed relationship would be visualized with an arrow marker. It is a type of representation that we are used to because we often see it around us: a metro map, an airline advertisement, a network of connected objects, etc. This can of graph can be a network of people, organizations, places, objects, your imagination is the limit.

For the purposes of this demonstration, imagine that it is about two people writing letters to each other, for example Albert Einstein and Marie Curie within the framework of intellectual cooperation.

This relation therefore represents a certain number of letters, say ten. We can obviously qualitatively analyze the content of these letters between Einstein and Curie. But they can also be placed in the context of other letters written and received by these two individuals.

As soon as we add the other people who correspond with our two subjects, people we could call “neighbors” of Curie and Einstein, we realize that some of them can be common relations. It's very interesting to know that there are people (in this example, three), who can make the "link", or be a "bridge", between our subjects.



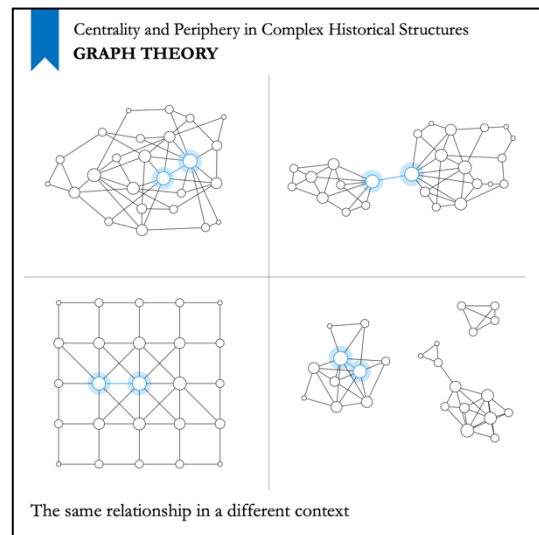
Of course, these neighbors can also have relationships with each other, regardless of the relation between Einstein and Curie. And knowing that these relationships exist is very important to take some distance, to realize that even if it is Albert Einstein and Marie Curie who interest us, they are not the only factors of relationship, they are the center by default.

This decentralization is even stronger in a situation where people can send and receive letters without ever having a connection with the two people we are interested in. It's an additional level of context. And so these neighbors of neighbors can also have neighbors, etc. And we can imagine going much further than that, it all depends on the corpus of archives we are working on.

To make you understand how important the context is to understand this relationship between Curie and Einstein, these ten letters, let's imagine that it appears in different situations, structurally speaking.

These four graphs all contain exactly the same number of people and the same number of relationships, or letters exchanged, but they are not distributed in the same way.

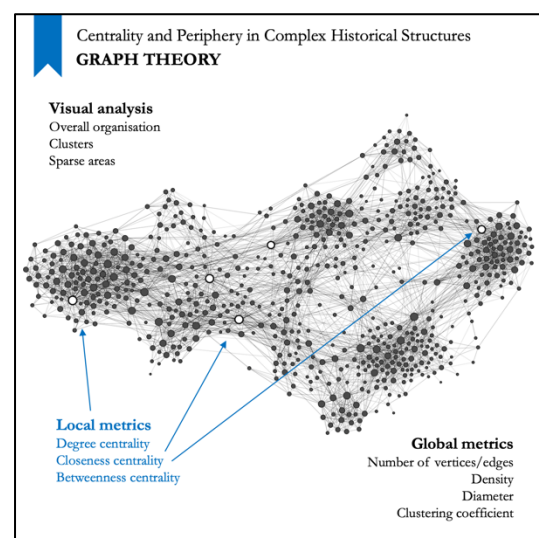
Here, we understand that this relationship between our two scientists, highlighted in blue, takes on a completely different meaning if these ten letters are exchanged at the center of a network built around our two people (top left) or if they connect two groups that have nothing else in common (top right). Or if this relationship takes place in a group that is not connected to other groups (bottom right). The content of these ten letters between Curie and Einstein never changes, so that if we limit ourselves to analyzing them qualitatively, the interpretation will always be exactly the same. But their context of appearance is so different that we can give them another meaning, or another status.



Now, when working on larger networks than these examples, how do we work on this contextualization and correctly interpret what is central and what is peripheral?

The first level of reading is visual analysis. It consists of reading the graph as a diagram, following the paths and highlighting the position of one vertex or another, or, if it is a large complex network, reading it as a map, to identify the global patterns. These "topological" observations can go quite far. Here, we can clearly see clusters and more sparse regions between them.

As we speak of such a network a bit like a geographical map, the notions of center and periphery are quite easily transposable in the field of visual analysis. Even if one can validly ask the question of knowing whether it is more central to be at the "geographical" center of the graph (or



the barycenter), even if it is a less densely connected region, or to be in the middle of a very dense cluster.

Another level of reading is to measure the object that we have in front of us. Its size, its number of vertices and edges, its density, its diameter or its clustering coefficient are all metrics that allow us to have a first idea of its characteristics. This is particularly useful for comparing several networks with each other, or for measuring the evolution of the same network over time.

But the most accurate reading level is probably the use of local metrics. These tell us about the position of each vertex with respect to neighboring vertices or the entire graph. As they apply individually to each vertex of the graph, these measurements can be very good allies for the interpretation of individual situations. They help to judge the position of an element relative to the entire structure. Interestingly, these metrics are called centrality indicators. We will therefore see how the historical sciences can take advantage of what mathematics defines as centralities. We will now take a look at some of these metrics that will be useful in our case study.

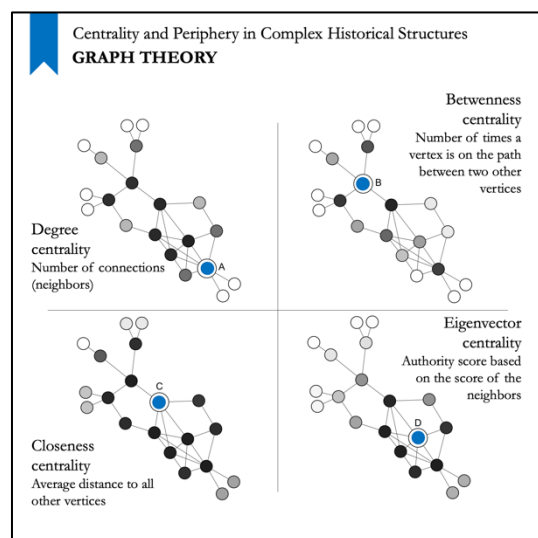
To explain how these centrality measures are calculated, let us take a very simple network. Here, it is duplicated to compare the result of the calculation: the darker a point, the higher the score. The point highlighted in blue is the vertex of the graph that gets the highest value.

At the top left, we find the degree centrality, a metric that is easy to understand since it consists in counting the number of connections of each vertex. If we are still talking about a network of letters, then this value is simply the number of people who correspond with the selected individual. Here, the highest score is reached by individual A, who has 7 connections. In this conception of centrality, an individual is central if he has many connections.

At the bottom left, we find the closeness centrality. It consists in measuring how far are all the vertices of the graph from each other. The one who has the smallest average distance with all the others is therefore the one who is closest to all the others on average. Here, vertex C has the greatest mean proximity. In this conception of centrality, an individual is central if he is in the middle of the graph, in terms of overall topography.

At the top right, the betweenness centrality consists in detecting all the shortest paths between the vertices of the graph and then counting how many times a vertex is on the path between two others. We can therefore say that the most central individuals according to this measure are those who connect different parts of the network that would not necessarily be connected to each other. They are the "bridges", the "information carriers". Here, it is vertex B which is most often on the path between all the possible pairs of vertices. In the case of a correspondence network analysis, we would probably not focus on this vertex B, but the betweenness centrality reminds us that it is the only path to 5 vertices of the graph (above it, on this image), which represents 25% here!

We will now see that the interpretation we can make of this statistical and structural information depends on how our data has been extracted from historical sources.



From sources to network

The 'datafication' of the archives of intellectual cooperation

Let's go back to our International Committee on Intellectual Cooperation of the League of Nations. And let ask ourselves: what do we want to analyze? what are the relationships we want to work on? at what level? on the basis of what sources? to transform them into what type of data?

The first step in this research process is to be clear about the approach we want to use. This is why I am proposing a typology of the different uses of archive sources to produce historical network analysis.

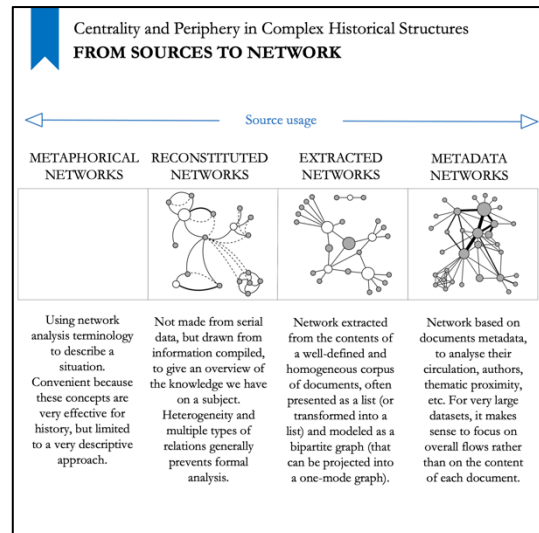
This typology is indicative, it covers most practices but only distinguishes them from each other in a fairly general way: the aim is in fact to serve as a decision aid rather than to definitively categorize all the methods.

I distinguish between four main uses of network analysis in historical disciplines. The first is the metaphorical use, which consists of using network terminology without actually doing any analysis or visualization. It works well in some cases, because these concepts are very popular in history, but it's obviously very limited.

The second is the creation of "reconstituted" networks. A bit like when you take a large blank page to write down everything you have found on a certain subject, draw links between this information, etc. It is not data visualization but more some kind of drawing that gives an overview of the knowledge you have on the subject. The data heterogeneity and multiple types of relationships usually prevent formal analysis. In the case of intellectual cooperation, we could very well build the network of all the relationships that the experts have together: common projects, same universities, friendships, common disciplines, etc. It is very heterogeneous and the information is not available for every people in the same way, but it allows an overview of what we know.

The third category concerns networks produced from the content of archival documents, in general a well-defined and homogeneous corpus, often presented as a list (or transformed into a list). This often results in bipartite networks. In the case of intellectual cooperation, we can take the attendance list of all committee meetings to create a co-presence graph and find out who has met who and when.

The fourth and final type of network no longer relates to the content of documents but to their metadata: the circulation of a letter, its authors and recipients, an analysis of the proximity of language, etc. This is especially appropriate when working with large datasets, when it makes sense to focus on information flows more than on the content of each letter. With regard to intellectual cooperation, we can, for example, map all the Committee's document exchanges. And that's exactly what we're going to do now.

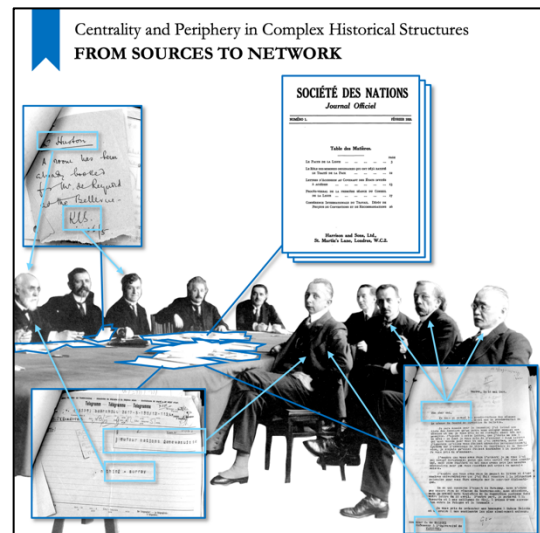


So, we are no longer directly interested in the content of the discussions of the experts around this table. We know this content because the minutes are very well kept and the reports available. Now we want to know how these people work on a daily basis.

Committee documents can be of different types: official documents and their drafts, letters received and copies of letters sent, telegrams for the meetings preparation, internal notes between the secretaries, etc.

What matters to us here is that these documents tell us relationships. Several secretaries worked together on a draft of an official report, a letter was written by the president to several experts, a telegram was sent by a diplomat to the secretary-general, a note was slipped by a typist on the desk of a translator, etc.

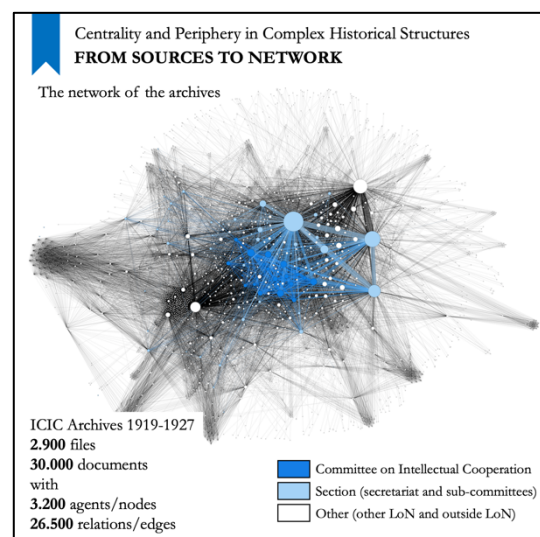
We can already see the network appear in this illustration, relationships that are created, circulations that are established. All that remains to be done is to collect - by hand - these metadata for the tens of thousands of documents of the Committee on Intellectual Cooperation, in the United Nations Archives in Geneva. Quick note by the way: these archives are currently being digitized.



Here is the network of the archives of intellectual cooperation between 1919 and 1927, a temporality chosen because it allows to show the key moment of the creation, the establishment and the rise in power with the Institute of Paris. You see here more than three thousand dots, which are all people involved in these documents. Not the people mentioned, but those who are the senders and recipients. In dark blue, we see the members of the Committee. In light blue the members of the Section of the League which includes intellectual cooperation, secretaries and ad hoc experts. And in white, the vast majority of those involved, whether they are members of the organs of the League of Nations or whether they come from diplomatic delegations, universities or civil society.

This network is exactly what is called a hairball, a complex network which is unreadable at first glance. It is a ball of wool with which the cat has played and which will have to be patiently untangled. However, we can already observe some structural characteristics. We see for example that the distribution of the number of connections per vertex (the size of the dots) follows a power law: there are few very connected nodes and a lot of people who exchange only a handful of documents with the Committee.

We also immediately see that the members of the Committee – the dark blue vertices - are not the most connected people, but they still appear in the middle of this mapping. We will therefore have to find strategies to read this network, visually and statistically.



One way to untangle this network is precisely to play with its power of contextualization. We can take the case of Albert Einstein and Marie Curie, as in our example earlier, and compare their personal networks. They are not only very close on the graph, but they have an ego-network that has a lot of similarities, they look a lot alike at first glance.

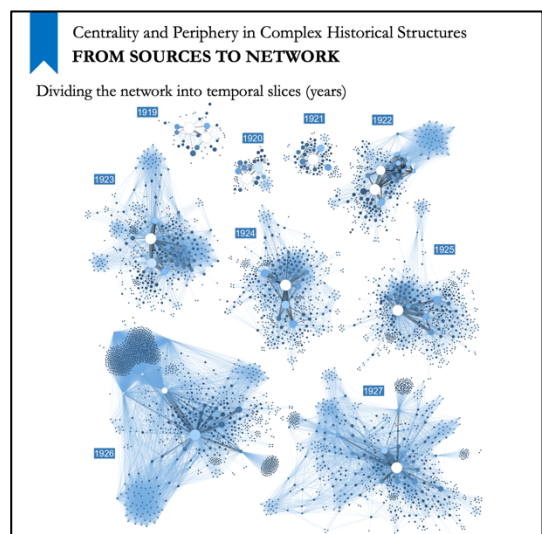
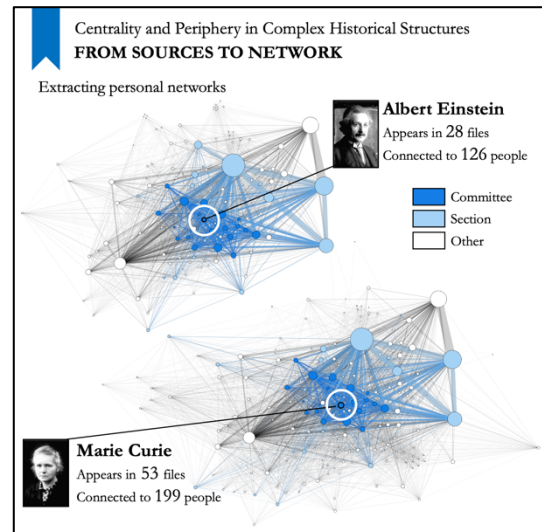
However, the two scientists show a very different engagement in the Committee. Marie Curie is a pillar of the Committee, she participates very actively but tries to avoid publicity. Discreet and wishing to save time for her research, she is a person who inspires her colleagues a lot while not being reluctant to do her part of the job. She sat for 11 years on the Committee and died while still in office, in 1934.

Albert Einstein, for his part, had a very remarkable but little involvement in the Committee on Intellectual Cooperation. Without going into details here, he takes a long time to be convinced by the League of Nations before accepting. Then he leaves and comes back several times, for personal or political reasons. If he has allies in the Committee, Marie Curie in the first place but also Hendrik Lorentz who was his professor, he maintains a strained relationship with the first president of the Committee, Henri Bergson with whom he is publicly in conflict about his scientific theses. To sum up, we can say that he participates little but that he lends his own international reputation to intellectual cooperation.

Here, the comparison can therefore be made on details: Curie appears in almost twice more documents than Einstein and is in relation with 50% more people. But since most of the documents concerning the committee as a whole are received by both, the overall structure is similar. So the fact that this is not immediately visible is interesting: their statistics are very different, but you have to go and look in the margins of Marie Curie's network - in the periphery, precisely, rather than in the center - to see how much more active she is.

Another way to analyze this graph visually is to divide it into smaller parts according to the temporality of the documents. A study of the evolution of the Committee's activity shows an almost exponential evolution during its first years. With the increase in exchanges, we observe a greater clustering of the graph: the more time advances, the less the structure is centralized around the same core of people. This is due to the multiplication of bodies, sub-committees, etc. but also to the emergence of the Paris Institute, which create a new pole of activity.

But for now, we're only scratching the surface of this data.



Verticality

A multilayer system to reveal an 'institutional topography'

As we saw in the introduction, the notions of centrality or periphery take on a different meaning depending on the scale at which a phenomenon is observed. This is why we will try to give verticality to this analysis.

The archival metadata network is only a "flat" representation of intellectual cooperation. It's one particular type of relationship among others, but it also does not take into account the fact that these more than 3 thousand individuals are also organized among themselves, form groups, belong to structures which are not related to this specific archival network. They are subject to professional or political hierarchies, and these groups are themselves affiliated to each other, or to institutions, etc.

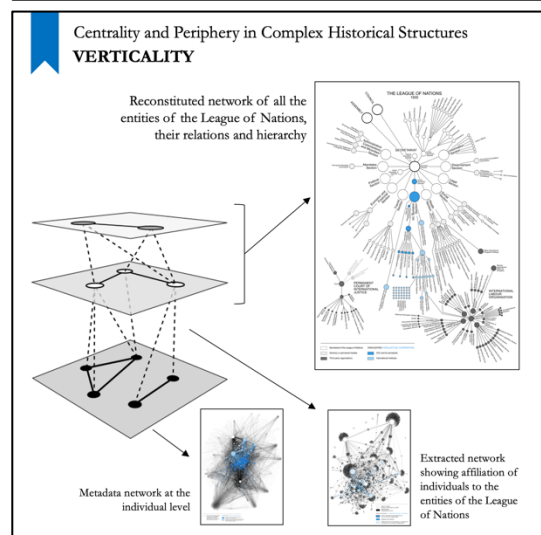
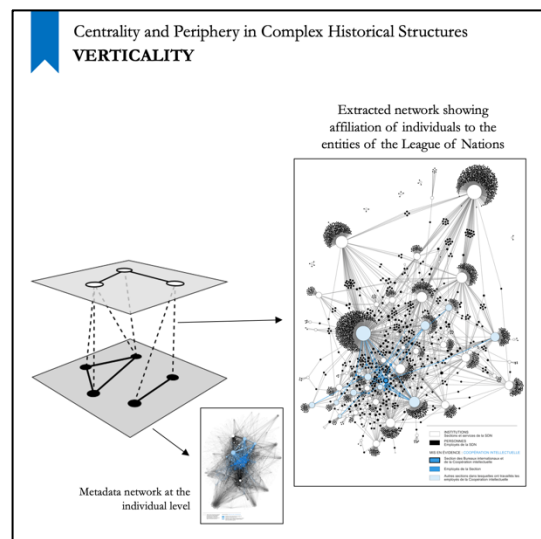
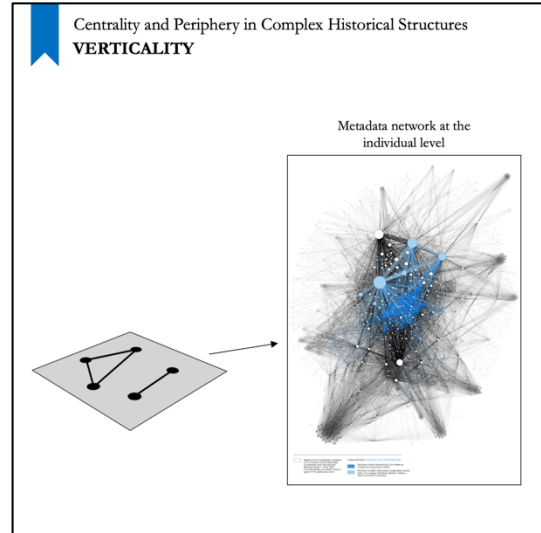
To connect this dataset to these other layers of information and organization, we need to clarify the modeling of the system we are building here.

To do this, I use this very simple model, here on the left. For now, this model is only composed of one layer, which contains relationships between individuals.

To this network of individuals, we can add a new layer. For this, we use this network of affiliation of these individuals to the various entities of the League of Nations. Here, we work on the data extracted from the personnel files. Each individual (the black dots) is connected to one or more groups (the white dots). To this, we will also add the affiliations of the experts to the different committees, the origin of the delegates, etc.

Of course, we have a lot of vertices which concern people who are not affiliated with the League, they will be grouped separately.

Then, we also want to know how these groups of people interact with each other. That is why we will seek a way to represent the official relations of these committees, secretariats, sections and institutes between themselves, as well as their relations at a higher level. This higher level, represented here by the



third layer in our model, is that of global organizations, the League of Nations, States, the academic world in general, civil society, etc.

To do this, we are going to reconstruct a precise organization chart of the various bodies of the League of Nations. As surprising as it may seem, there is no such complete representation of the institution's hierarchy. Historians often rely on very simplified charts produced by the League. The organization chart on the right was therefore produced by aggregating the information contained in the official documents. It looks like a tree, made up of more than 200 entities.

Based on this multi-layer model, we can create a three-dimensional representation. But more important than a 3D visualization, we can use this verticality to condition the spatialization of the vertices of the document metadata network.

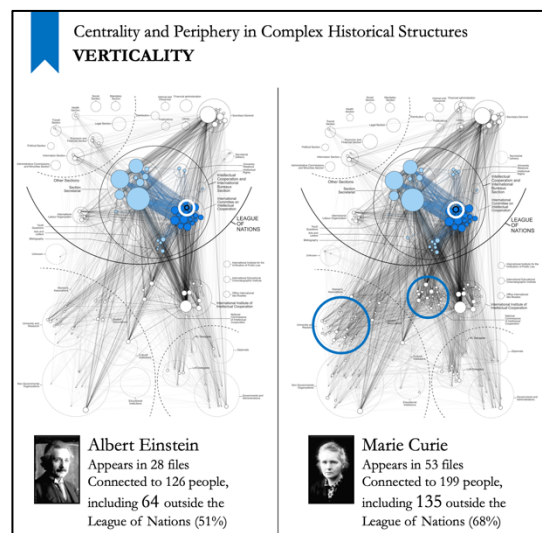
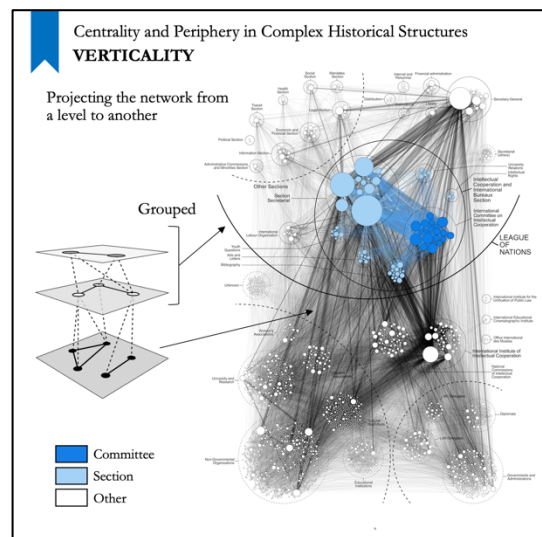
What we're doing here is to flatten the hierarchy by creating what I call an “institutional topography”: circles that group together the entities or individuals that belong to it. Within these circles, we reorganize our network of people exchanging documents.

Mathematically speaking, it is exactly the same object as before, but its new organization in space will allow us to see the official structure at the same time as we read the effective graph structure.

In the upper half of this graph we see everything inside the League of Nations. The general secretariat at the top right, but especially the Intellectual Cooperation Section (in light blue) and the Committee (in dark blue). In the lower half, we find everything that is outside the League of Nations: states and their representatives at the bottom right, civil society and academia at the bottom left. In the center, the small, very connected group is the International Institute for Intellectual Cooperation in Paris.

This institutional topography is a visual tool that will allow us to read certain structural or statistical characteristics that were previously difficult to distinguish in the “hairball”. Reading here is facilitated by the fact that the spatial organization of the elements makes sense and therefore can be interpreted effectively.

Now we just have to imagine analysis scenarios depending on what we want to study. To take the example previously used, if we're interested in the involvement of Albert Einstein and Marie Curie (highlighted with a white circle here, within the dark blue group), then we can now qualify the position of their correspondents in this topography. If we actually see that their network inside the core of intellectual cooperation is, as we had already detected, very similar, we can see very clearly that Marie Curie has twice as many connections outside the League of Nations.



And in addition to having more relationships in almost every group, there are two groups that are particularly interesting and that we highlight with a blue circle. These are academia and research, on the left, and representatives of national committees on intellectual cooperation, on the right. The number of Curie contacts in these groups leads us to think that she is a better connection than Albert Einstein to scientific circles and that she participates more in the "internal democracy" of the institution by maintaining contacts with local intellectual cooperation organizations.

Once again, the network is only a gateway to the archives, a means of exploration. These interpretations will have to be verified by a more qualitative approach of these documents. But now at least we know exactly which documents to look for.

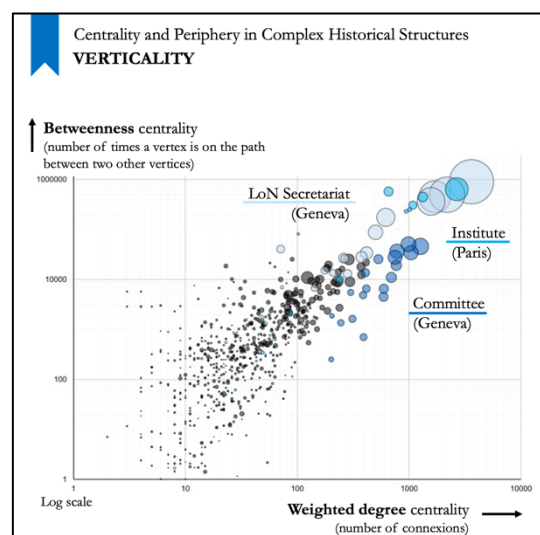
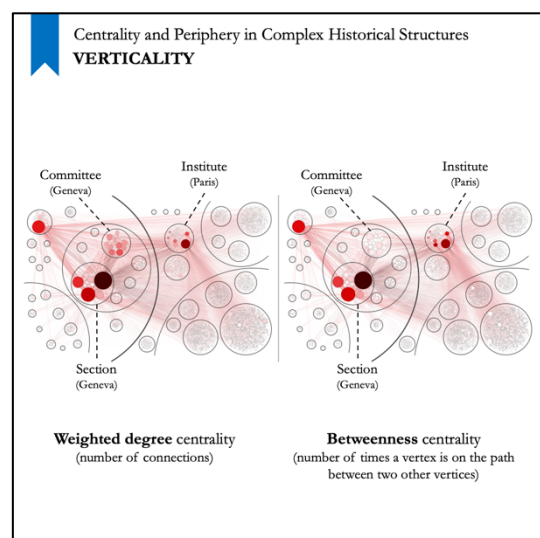
In a more global and data driven approach, graph metrics can now be compared to this institutional topography. Here, we compare side by side the result of the weighted degree centrality and the betweenness centrality. So, on the left, the red dots indicate people who have a large number of connections, which means that they send and receive a lot of documents. On the right, the red dots indicate people who are often on the path between others, so the people who have a "bridge" function in the network, who make the link between clusters.

And this visualization brings a surprising and immediate visual result. By comparing the three groups mentioned on these graphs, we realize that the Intellectual Cooperation Section and the Institute of Paris both have very high values in these two measures, but that is not at all the case for the Committee on Intellectual Cooperation. The latter is well connected in terms of quantity (on the left), but very little in terms of the ability to create links (on the right).

Does this mean that these leading scientists are relegated to a secondary role? To use the terminology we are discussing here, do they only have a peripheral responsibility in the organization? But then who is the center?

In fact, this result reminds us of a reality of international organizations that is often overshadowed by the studies that puts these well-known personalities at the center of attention: The people who are the backbone of such an infrastructure are neither the politicians nor the experts, but the administrators of this gigantic bureaucratic machine, the international civil servants, directors and general secretaries.

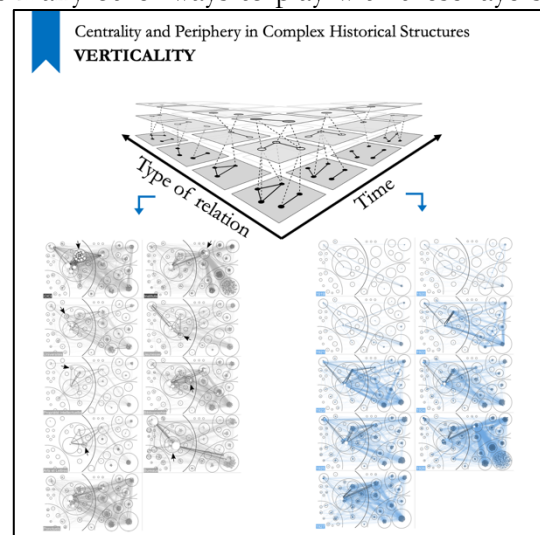
This scatter plot, which compares these two graph metrics for the 3 thousand people in our network, clearly shows a correlation between the number of documents exchanged and the ability to be a "bridge".



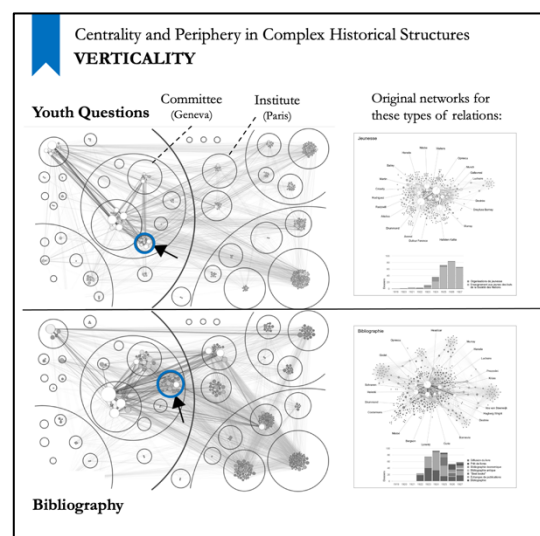
But above all, it shows that the experts of the Geneva Committee, here in dark blue, stands out from this correlation and appears well below the secretaries of Geneva or the administrators of Paris. In fact, when you think about it, it may seem quite logical for an administration to produce more documents and create more connections than the experts it solicits. But it is only very recently that historical studies rediscover the importance of these hundreds of shadow workers. Here is a very good opportunity to put them back at the center and to remind that intellectual cooperation is not only a meeting of great philosophers and scientists, but also an administrative machinery.

Let's finish this exploration by showing that there are many other ways to play with these layers and to develop research scenarios to understand the network of intellectual cooperation. In fact, our multi-layered system can very well be deployed to show new facets of our data.

For example, we can add a time axis, to analyze the evolution of the network in this institutional structure. We will therefore see precisely the moment when the Paris Institut begins to gain influence, or when a particular mission of the Committee creates new relationships with people with whom it was not previously connected, etc. Or we can develop a fine typology of the types of relations or of the types of documents to compare the structure of the exchanges around a certain theme. By multiplying these facets, and why not by combining them since we can now analyze a certain layer, for a certain theme and in a certain temporality, we create what we could call a form of structural "signature". By comparing these different signatures side by side, we can very quickly see which bodies of the League of Nations are concerned by which subject, and when.



As an example, we can focus on a comparison between "Youth Questions" and documents concerning Bibliography. Here a blue circle highlight the subcommittees responsible for these issues in the first place. The "Youth Questions" concern all the projects aimed at producing material to make young people understand the objectives of the League of Nations, its ideals of reconciliation and reconstruction. It is a very political project, which therefore primarily involves the organs of the League of Nations. On the contrary, questions linked to bibliographic coordination raises more technical issues: this therefore involves much more experts from the Committee on Intellectual Cooperation and officials from the Paris Institute. And we can obviously repeat this interpretation exercise whatever the research scenario.



Conclusion

Analyzing structures to redefine our global/local and central/peripheral approaches

To conclude, we must note that intellectual co-operation as set up by the League of Nations was never absolutely central in the field of science and culture in the interwar period. Basically, the Committee's lack of influence on international intellectual affairs can be explained by the completely peripheral position of intellectual cooperation within the League of Nations. These are not really failures on its part. If the creation of the Institute for Intellectual Co-operation in Paris in 1926 enabled the Committee to be much more than a simple meeting of experts, producing reports with little follow-up, it did not avoid this organization being an elitist body very poorly connected to scientific circles apart from its supporters. In addition, the creation of the Institute accelerates the bureaucratization of this project without giving the means to reach its "base" other than through government bodies. It is nonetheless a fascinating organization. And we have seen that its very complete archives allow network analyzes which enrich traditional approaches and show us this Committee in a very different light.

However, studying this organization in "network", in "layers", in "levels" or in its temporality, is a challenge which goes beyond the technical question of knowing how to represent them graphically. This is indeed a question which is fundamental for the field of global history, with its micro, meso and macro perspectives. We have had the opportunity here to put these questions into practice by creating an "institutional topography" which fits particularly well in a study of the bureaucratization of an international organization. Obviously, the network extracted from archives should not be confused with intellectual cooperation itself, which is a much more multifaceted and complex phenomenon, but it provides tools to concretely discuss these scales and contextualize these exchanges. In short, a new tool for source criticism.

References

The visualizations used in this presentation come from the following publications:

Grandjean, Martin, « A Conceptual Framework for Multilayer Historical Networks », *Workflows for the Digital Humanities, DARLAIH-CH Proceedings*, 2020.

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PDFs are available at: www.martingrandjean.ch/communications/

Data is accessible and reusable:

Grandjean, Martin, *The Network of Intellectual Cooperation*, Data set, 2018, github.com/grandjeanmartin/intellectual-cooperation (DOI 10.5281/zenodo.1257287).