

Research Article

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Network Effects on Rhythms of Scientific Publications

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Abstract: Studies based on bibliometric records have introduced the idea of ‘rhythmicity’ when it comes to the publication of research articles. However, the main approach of this particular topic was to analyze journal specific data on rates of manuscript and review submissions. This study takes another path, by analyzing aspects of publication rhythmicity based not on individual, attribute data, but taking into account the fact that publication of research results and the efforts leading to a certain manuscript are often collective endeavors. Thus, co-authorship ego networks are interpreted through the theoretical lenses of ‘social time’ (for temporality), and ‘homophily’ and ‘preferential attachment’ (for network characteristics). For this article, the same data analyzed by M.-G. Hâncean and M. Perc in their 2016 article, *Homophily in coauthorship networks of East European sociologists*, were used. The data was based on Web of Science bibliometric records for three populations of academic sociologists, from Poland, Romania and Slovenia, and their co-authors. The purpose was to see if the publishing rhythm of an author (i.e., ego) is influenced by the publishing rhythm of her co-authors (i.e., alters) and by the structural characteristics of her ego-network. Rhythmicity was measured as the sum of standard deviations from the mean for the number of articles published between 2006 and 2016, resulting in a score which characterizes egos and alters as constant or irregular in their publishing activity. Results suggest that the structural features of the co-authorship networks can give us certain insights for the rhythmicity of publications. Mainly, structural features of network size, density and node betweenness explain more the variation of egos’ constancy or irregularity in (non)publication than the rhythmicity of their co-authors.

Keywords: co-authorship networks; publication rhythms; homophily; preferential attachment; social time

Introduction

In the last years, some authors have opened a discussion about a subject which is not often addressed: the possibility for the existence of *rhythms* when we look at ‘how’ and ‘when’ research articles are published. After analyzing the patterns emerging from data which contained time information about the submission of manuscripts (of authors), and the submission of responses (of reviewers), James E. Cutting (2007) published an editorial with the title *Rhythms of Research*, in which he presented monthly and weekly patterns for the submission of manuscripts and reviews for the *Psychological Science* journal. For monthly patterns, he brought into attention that the summer months are the most active when it came for manuscript submissions. For weekly patterns, the main observation highlights the greater number of received manuscripts in the working days (from Monday to Friday), compared to the weekend, when reviewer activity is more intensive.

Starting from these observations, others have started to question whether there are some biases of editors and / or reviewers, being more inclined to accept more manuscripts depending on seasons or monthly and weekly cycles. S. Shalvi and his colleagues (2010) stated, in reference to the *Psychological Science* journal, that it is best to “write when hot – submit when not”. In another academic field – Physics –, M. Schreiber (2012), editor-in-chief of the journal *EPL* (Europhysics Letters), came with an opposite affirmation: “you should write when you like, but submit in July”. For Chemistry results vary. By analyzing acceptance and rejection rates of manuscripts, and controlling for citation impact, Lutz Bornmann and Hans-Dieter Daniel (2011) found no evidence of seasonal biases inside the *Angewandte Chemie International Edition* journal. Conversely, analyses made on data from *The Journal of the Serbian Chemical Society* showed weekly seasonalities – the authors who sent their manuscripts

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during the weekend have a higher chance of being rejected (Ausloos, Nedic & Dekanski, 2016).

Yet, these kind of results indicate specifics which reside at the level of each journal, taken separately. While the exemplified studies have the advantage of offering a bibliometric insight to possible abnormal editorial practices, I consider that the problem of rhythmicity should be discussed on a more general level, outside journal particularities, to see *how a certain type of rhythmicity of scientific publications can appear*. In this article, I propose another approach for the study of publication rhythms, namely, treating temporality as an endogenous variable – a phenomenon which must be explained, not only an explanation in itself. The purpose is to see how the rhythm of ISI publications of academic sociologists from three Eastern European countries – Poland, Romania and Slovenia – is influenced by the structural and compositional features of their co-authorship networks. The lens through which rhythmicity is discussed in this article brings forth the concept of *social time* and its theoretical implications. As analytical options, in this article were used analyses stemming from both a sociocentric and egocentric approach to co-authorship networks. The aim of this study is to test if the findings of Hâncean and Perc (2016) hold for another interest variable. The two authors found that citation homophily is a present characteristic in the personal network of Polish, Romanian and Slovenian academic sociologists. Furthermore, they brought empirical evidence for the positive relation between the number of publications and citations. Given that the two phenomena are related, the scope of this article is to see if the homophily effect holds for publication rhythms regressed on, mainly, the same factors.

Theory

Social time and social rhythms

While the field of Time Sociology does not have a clear delineation, and is viewed as either predominantly theoretical (Michelson, 2016), either predominantly empirical (Baert, 2000), the notion of social time has more conceptual accuracy. Even so, some beforehand clarifications should be made. It is tempting to think about *social time* as “time for social interactions”, or as “time spent in the ‘real’ world”, as opposed to the “‘virtual’ world”; and while in everyday conversations this sort of slippage can be acceptable, remaining at this level would make the notion to lose its sociological and anthropological subtleties.

The concept of *social time* originates from the Durkheimian school of thought, being first introduced in *The Elementary Forms of Religious Life*, where É. Durkheim (1915, p. 11, note 1) stated: “what the category of time expresses is a time common to the group, a social time, so to speak.”. P. Sorokin and R. K. Merton (1937) expanded on this concept, adding some important distinctions, by contraposing it with ‘astronomical time’ (time as measured by the clock). Thus, social time is *qualitative* (moments of time have social meaning, not only mathematical durations); *discontinuous* (the ‘normal’ flow of time suffers certain alterations); *uneven* and *heterogeneous* (even periods of time can have uneven degrees of importance). These insights influenced further researches in various fields. For example, the domain of what is known as “time use research” shares the same theoretical background, using special categories of time to divide the social meaning of human activity (Zuzanek & Smale, 2002). Other researchers continued the anthropological study of time reckoning, to see how (post) modern social temporality is different from non-western cultures (Pinxten, 1995), while others have as an interest the study of time markers – e.g., Sunday (see McCrossen, 2005), or the implications of technological acceleration (Wajcman, 2008).

In summary, *time* can be defined, from a sociological standpoint, as “a social category of thought shared by a collective in order to synchronize and coordinate social action” (Forrest, 1993, p. 617), or “a social practice that translates temporality into meaningful codes and organizes temporality’s material influence” (Moran, 2015, p. 283). Furthermore, it can be affirmed that social time represents the *diversity of socially significant temporal categories which are made, utilized and experienced by social agents*.

Last, but not least, I consider that a further nuance must be brought into discussion. With the significant impact which societal changes (driven by economical, technological and cultural dynamics) had on social time, discussions moved from aspects of rhythmicity to phenomena concerned with the abstracting and standardization of time (Thompson, 1967; Zerubavel, 1982), and, more recently, with its speed (Rosa & Scheuerman, 2009) or immediateness (Agger, 2011; Hassan, 2003). Yet, as D. J. Lewis and A. J. Weigert (1981) rightly pointed out, all the new forms of temporality which are based on linearity and homogeneity are embedded within certain rhythms. In other words, just because social events and human actions happen more linearly and faster, this doesn’t imply the disappearance of rhythms and cycles.

If the theorization of *social time* has been present in the literature of Sociology since its incipit, the same can be said about the concept of *social rhythms*. Even before É. Durkheim brought into attention the relation between time and social structure, his most prolific students already documented how the temporal expression of certain human groups reflected their social structure and other external constraints. M. Mauss (1979) gives an account of how the geographical elements structure the rhythms of activities for Eskimos, the result being a *social morphology*. Henri Hubert (1999), also, showed that religion played a big role in structuring the rhythms of collectivities, calendars (as a form of time reckoning) being derived from the social life of the groups.

Building on these observations, E. Zerubavel developed his studies around the idea of a “formal” *social pattern analysis* (Zerubavel, 2007) to reveal the *temporal order of social life* in various contexts – e.g., hospitals (Zerubavel, 1979). General features of any temporal order include: a) *standardization* (notions about time common to all the persons embedded in a group or societal context); b) *temporal parameters* concerned with *duration* (quantitatively and qualitatively), *sequence* (expected order in which events occur), *timing* (expected moments for the occurrence of events) and *tempo* (the pace of events); and c) *cyclicity*, because certain social events and actions move in time with a certain rate of recurrence (Zerubavel, 1976).

Today, the idea of social rhythms can be found in diverse aspects of research (not only sociological). An interesting fact is that the notion *social rhythm* has a far wider usage in scientific publications concerned with psychiatric and psychological issues. Whether the authors write about certain affections – e.g., bipolar disorders (Inder et al., 2014) – or methodological refinements of certain scales (da Fonsêca et al., 2018), it all resumes to the effects of disruptions in the cycle of usual, day to day life. While these approaches have different purposes, their conceptual understanding of social rhythm is similar to the sociological one. Namely, that people live their lives according to a certain order of actions, with a particular tempo and rates of recurrence. Economists, also, talk about what has come to be known as “the day of the week effect” which refers to higher or lower returns in stock exchanges depending on the day of the week (Dicle & Levendis, 2014). Similarly, in the medical field, researchers have noticed “day of the week effects” and “public holiday effects” on data used for syndromic surveillance. Namely, the data used for assessing the health status of the population can be artificially inflated by certain days or holidays when people seek more or less medical attention (Buckingham-Jeffery et al., 2017).

To resume, different areas of research have shown that rhythmicity is a general aspect of human life, having certain features of tempo and cyclicity which are (social) context dependent. For this reason, it can be presumed that scientific publications follow a certain rhythmic pattern. Academia is part of the social system, and for this reason the temporal dimensions which are embedded in it stems from the social action of researchers.

Co-authorship networks

Studies about co-authorship networks have become more and more common in bibliometric and scientometric studies, either with a whole of personal network approach; or, in another terminology, *sociocentric* versus *egocentric* approach (Hâncean, Molina, & Lubbers, 2016). The distinction is important, because it involves different methodological and analytical approaches to a research problem (for an example see Marsden, 2002).

A sociocentric design involves the study of a whole population of social actors (i.e., nodes) and the resulting overall structure which emerges from their relations (i.e., ties) (Pescosolido, Perry, & Borgatti, 2018). On the other hand, an egocentric design is revolving around singular nodes (i.e., ego), its relations with other entities (i.e., alters) and the relations between these alters (Halgin & Borgatti, 2012). One example of a sociocentric approach to co-authorship networks can be the widely known article of Newman (2004) where he compared the scientific collaboration in the fields of Biology, Physics and Mathematics, showing how they differ in terms of number of co-authors per author, the distances between the nodes in the network and ways of clustering. For an egocentric design, one good illustration is the study of McCarty and colleagues (2013) in which they used personal network analysis to show how the structural features of an author’s network can influence their *h*-index. Of course, the two approaches are not completely inseparable. For example, the study of *transnational social fields* involves a leap from the egocentric to the sociocentric level of analysis, as they are defined as “an unbounded terrain of interlocking egocentric networks” (Schiller & Fouron, 1999, p. 344).

The effects of co-authorship networks can be commonly analyzed through three different models: the *homophily*, *transitivity* and the *Matthew effect* (or *preferential attachment*) (Zhang, Bu, Ding, & Xu, 2017). Of the three, only homophily and preferential attachment will be taken into consideration here.

The *homophily effect* can be best expressed through the proverb “Birds of a feather flock together”, and it is no surprise that McPherson, Smith-Lovin and Cook (2001)

used its first part for the title of their article concerning network structures and tie formation. As the authors argue, a person's social status and social values, with all of their implications and sub-dimensions – e.g., social class, religion, education etc. – will be factors and consequences of homophilic tie selection. Simply put, individuals have a tendency to form relations and interact with those similar to them, as opposed to the phenomenon of *heterophily*, where the complementarity of attributes is the driving motive for tie formation (Fu, Nowak, Christakis, & Fowler, 2012). The existence of a homophily effect was documented in diverse real life networks concerned with evolution of friendship networks (Suitor & Keeton, 1997), health relating behaviors (Centola, 2011) or political actions (Gerber, Henry, & Lubell, 2013). Referring strictly to co-authorship networks, Kretschmer (1997) found that in some cases physicists co-author according to citation homophily – i.e., the highly cited co-author with the highly cited.

When it comes to the *Matthew effect*, the only similarity between it and the homophily effect is the fact that they both can be expressed through folk knowledge. In this case, the common phrase is: “the rich get richer and the poor get poorer”. In the sphere of science this phenomenon was brought into attention by Robert K. Merton (1968) and was named after a parable in the Gospel of Matthew. In short, the Matthew effect refers to the advantages obtained by well-established scholars in the social structure of science. For example, in situations of co-authorship the name of a known scientist might blur the contributions made for that paper by the others who are less established (Merton 1968).

Expanding on this concept, another similar phenomenon in the world of networks is *preferential attachment* (Perc, 2014). Barabási and Albert (1999) argue that in complex networks new nodes have a tendency to form ties with nodes which are already well-connected inside the structure of the network. The result of this behavior is a network where the *degree score* of the nodes follow a scale-free power law distribution, where a handful of nodes will concentrate the highest number of ties and will keep on growing. Evidence for the existence of a preferential attachment effect in the world of scientific collaboration can also be found in the literature. For example, Abbasi, Hossain, and Leydesdorff (2012) found that in social networks of scientific collaborations the centrality of a node can be a driving factor for preferential attachment – i.e., authors with higher centrality scores have a higher probability of creating ties with new authors.

Summarization

If social time can be thought of as the expression for the needs and activities of a certain social group, then it can be assumed that the social groups of academic sociologists have their own social time, a temporality with its own logic. Continuing on this idea, the social times of academic sociologists have their own rhythm. Academic life, in general, or certain aspects of it, in particular, can be analyzed through the lens of what Zerubavel (1976) identified as features of the temporal social order (standardization, duration, sequence, timing, tempo and cyclicity). Furthermore, academic life is organized through internal and external constraints. The interest of this study is to see how the publication rhythm of an author is influenced by the publication rhythms of her co-authors and by the co-authorship network in which the author is embedded.

Putting together the concepts of *social time* and *homophily* it can be deduced that an ego and its co-authors live in similar temporal structures, facilitating synchronization and coordination of scientific publishing. Thus, it can be hypothesized that:

H1: The publishing rhythm of an ego is positively correlated with the publishing rhythm of her alters.

In turn, the existence of preferential attachment might indicate that an ego does not share the same social time with their co-authors, having different social rhythms inside Academia, and, more explicitly, different rhythms of ISI publishing. Hence, the converse hypothesis is:

H2: The publishing rhythm of an ego with less indexed ISI entries is inversely proportional with the rhythm of its co-authors.

Methods

The data used for this article is the same utilized by Hâncean and Perc (2016) in their article, *Homophily in coauthorship networks of East European sociologists*. The data set contains first-order egocentric networks (i.e., $k = 1$) of co-authorship between *academic* sociologists from Poland, Romania and Slovenia, their co-authors and observed ties between them. Profiles for each author and co-author were constructed based on bibliometric records for each of them (authors and co-authors), extracted from Web of Science (WoS). This is an important aspect, which must be kept in mind: *the analyses are limited to publications indexed as ISI*. And it should be mentioned that the reference point for data collection is January 2016.

The ‘academic’ attribute is also significant with respect to this data. As Hâncean and Perc mention, certain properties, such as: “comparability of results”; “identical institutional pressures”; “the same configuration of professional relationships” and “roughly similar teaching and research activities” must be accounted for. Consequently, the data set has the advantage of circumscribing the analyses to well-defined, homogeneous populations.

Given that Hâncean and Perc employed an egocentric network analysis design for their research, is a fact which has implications not only at the analytical level, but also for gathering the data. Thus, each egocentric network contains an *ego* (full-time academic sociologist from, Poland, Romania or Slovenia), her *alters* (co-authors with whom she has written an article, or more, indexed in the WoS database), ties between the ego and her alters, ties between alters, and various attributes for the nodes in the network.

Regarding the attributes of the nodes – features which are attached to each individual (ego and alter), in each ego network –, I have selected the *number of publications in WoS between 2006 and 2016*. Based on this attribute and other structural and compositional variables, derived from relational data, the variables used in the current research are summarized in Table 1.

The dependent variable is the *publishing rhythm* measured as $\sigma \sum_{i=2006}^{2016} P$; where P = number of publications (articles, conference proceedings, book chapters) indexed in WoS between 2006 and 2010.

The main reason for selecting the standard deviation from the mean as a measure for publication rhythm is given by its property of measuring variability. Thus, small values indicate *constancy* in publication. Conversely, high values are a sign for temporal *irregularity* in publication rhythm. For example, if an ego has published one paper per year, between 2006 and 2016, that would result in

Table 1. Descriptive statistics for ego / network variables

Poland				
	Min	Max	Mean	SD
Dependent variable				
Ego's 10 years publishing rhythm	0.29	1	0.54	0.23
Independent variables				
Mean score of alters' 10 years publishing rhythm	0.29	1.24	0.64	0.29
Ego's n. of coauthors (network size)	1	28	4.42	6.04
Ego's normalized betweenness	0	0.98	0.12	0.26
Ego network density	0	100	52.63	39.92
Romania				
	Min	Max	Mean	SD
Dependent variable				
Ego's 10 years publishing rhythm	0.24	4.24	0.52	0.55
Independent variables				
Mean score of alters' 10 years publishing rhythm	0.24	4.83	0.85	0.68
Ego's n. of coauthors (network size)	1	20	3.81	3.60
Ego's normalized betweenness	0	0.87	0.07	0.20
Ego network density	0	100	67.05	35.84
Slovenia				
	Min	Max	Mean	SD
Dependent variable				
Ego's 10 years publishing rhythm	0	1.48	0.72	0.38
Independent variables				
Mean score of alters' 10 years publishing rhythm	0	4.58	0.94	0.61
Ego's n. of coauthors (network size)	1	29	5.50	4.63
Ego's normalized betweenness	0	25.83	4.50	6.49
Ego network density	0	100	45.69	30.38

a score of zero – the highest score of constancy. The same formula was applied for computing the rhythm of publishing for the alters in each ego network.

The independent variables used in this article are, mainly, the ones used by Hâncean and Perc (2016) in their regression models (excluding, of course, *ego's publications*). As the two authors report, *ego's publications* alone account for the biggest part in the variation of *citations count*: R^2 for Poland = 26%; R^2 for Romania = 32%; R^2 for Slovenia = 37%. Accordingly, if those phenomena are correlated, the purpose was to see if the independent variables follow the same explanatory paths when it comes to publication rhythm.

Results

The country context of ISI publications

Results for the variables describing the egos and their ego network are shown in Table 1. As a general description of the authors, it can be said that Polish and Slovenian academic sociologists have more constancy in their (non)publication rhythm, compared with Romanian sociologists, which exhibit higher scores on the maximum values and a higher standard deviation. Regarding the publication rhythm of co-authors, a higher constancy can be seen only for the alters of sociologists from Poland, as

a compositional measure of the ego network. The alters of Romanian and Slovenian authors, conversely, exhibit a higher degree of irregularity in (non)publication. Structural metrics of ego networks can also give important insights about the relation between the publication rhythms of the egos and alters. For network size, results reported in Table 1 indicate that: Slovenian sociologists have, on average, larger co-authorship networks; Romanian sociologists have smaller ego networks, with smaller variations across the population; the Polish context of academic sociologists can be described as one with high variability across co-authorship networks. Normalized betweenness scores, as a standardized measure of brokerage, imply that in Slovenia there are more egos who connect different groups of alters, whereas Polish and Romanian egos are embedded in more closed, disconnected networks. Results for network density (as ratio between observed ties and all possible ties) show that for Romanian sociologists collaboration between alters is higher, compared with the alters of Polish and Slovenian academic sociologists.

This general overview of the characteristics exhibited by the ego networks was brought into discussion for the reason that the difference in these structural features could be translated in their difference of importance for explaining the publication rhythm of the ego.

A summary of the total number of yearly publications by the egos from each country can be seen in Figure 1. For Polish sociologists, the general publication rate is

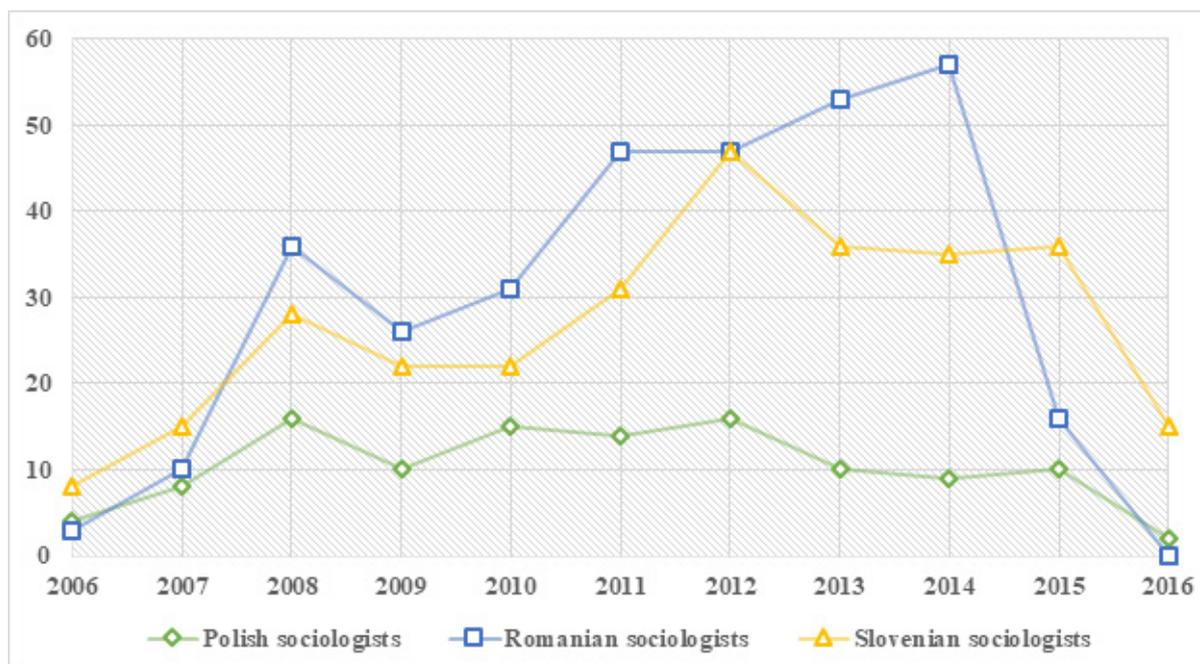


Figure 1. Yearly distributions of egos publications indexed in WoS, by country

quite stable starting from 2008, the fluctuations ranging between 10 and 20 publications, with an overall mean of 10.36 articles and a standard deviation of 4.43. Romanian sociologists, however, present more irregularities in their publications, having an overall mean of 29.63 and a standard deviation of 19.33. For Romania, it can be observed that two years have the most distinct aspects: 2008 and 2014. From 2009 and 2014 the publication trend is positive. What makes the years 2008 and 2014 stand out is the comparison with the years before and after. The years 2007 and 2009, for 2008, and 2013 and 2015, for 2014, present lower values in terms of publications. Similarly, for the Slovenian context ($\mu = 26.81$; $\sigma = 11.04$) two major points were observed: 2008 and 2012. Here, also, the comparison with the years before and after can raise questions about the causes of the observed fluctuations.

Results reported in Figure 1 indicate that general context of ISI publications in which Polish, Romanian, and Slovenian academic sociologists reside, can be interpreted along the features of social time introduced in the literature by P. Sorokin and R. K. Merton (1937). First of all, the observed fluctuations have qualitative features. In other words, sudden increases in publications do not appear purely by chance. Not only peaks can be of interest, but also points in which the steepness of the slope increases. They can be an indicator of an event which accelerated the publication rate until the year with the highest peak – e.g., legislative changes, winning a research grant, entering an inter-university twinning project etc. The observed fluctuations are, also, an indicator of unevenness between otherwise mathematically even points in time.

Usually, the sociological literature concerned with discontinuous aspects of social time bring into discussion circumstances such as: religious holidays, natural disasters or celebrations of certain events (Forrest, 1993). In other words, events with collective importance. *Mutatis mutandis*, sudden increases or decreases in the overall yearly distribution of publications is not the result of one author (i.e., personal time), but of a larger (social) context.

For example, in Romania, 2011 was the year when a new Education Act (1/2011) was put into place, its mission being, among others, a new ranking of universities. As Vlăsceanu and Hâncean (2012) state, universities would have a higher incentive to be classified as “research intensive” than “research and teaching” or “teaching-focused”. However, the classification of a university as “research intensive” is done by measuring the research output of its human resource. This could be possible explanation (and example of discontinuity inducing factor) for the sudden increase of Romanian academic sociologists’ publications between 2010 (as anticipatory action) and 2014.

Ego network measures and publication constancy

Poland

The results of regression analyses for the population of Polish authors (egos) are reported in Table 2. As it can be seen, the coefficient of determination from the first three models of the hierarchical regression indicate that alters’ publication rhythm, network size, and normalized betweenness do not account for any of the variation in the dependent variable (ego’s publication rhythm). What is important is the density of the ego network.

Alone, the density of the ego network accounts for approximately 45% of the variation in the dependent variable, the effect being attenuated (to 38%) when controlling for the other variables. The negative coefficient suggests that networks with higher densities have egos with a higher constancy in their publication rhythms. Also, according to model 4, egos are more constant when the alters have a more irregular publication rhythm. Integrating both results it can be affirmed that network density reinforces homophily effects. In its absence ties are characterized by preferential attachment.

The visualization of the co-authorship networks for Polish sociologists helps us better understand the results reported above. As seen in Figure 2, there are

Table 2. Hierarchical regression models for Poland

Variables	Model 1	Model 2	Model 3	Model 4
1. Mean score of alters’ st. dev. from 2006-2016 WoS publications mean	0.022	0.029	- 0.015	- 0.103
2. Network size		- 0.076	- 0.548	- 0.320
3. Ego’s normalized betweenness			0.572	0.264
4. Ego network density				- 0.599
R ²	0	0	0	0.38
ΔR^2		0	0	0.38

Dependent variable: Ego’s 10 years publishing rhythm

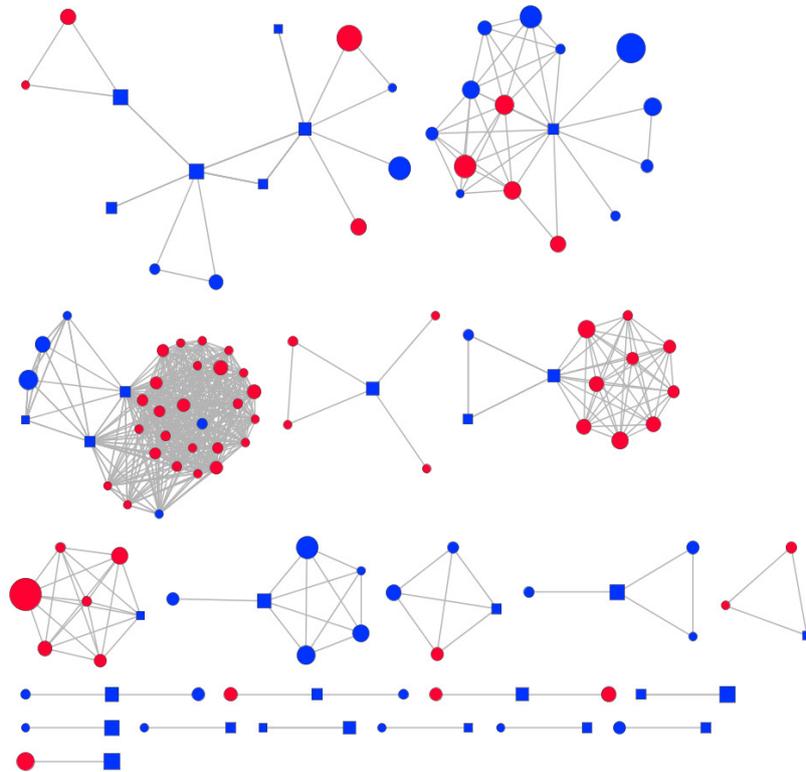


Figure 2. Whole network of Polish academic sociologists

Figure note: The visualization of the network was done with visone (Brandes & Wagner, 2004). The networks were grouped by the connected component, resulting 21 groups. The visual variables used for constructing the network were: *shape* (square = ego; circle = alter); *color* (blue = Poland; red = other countries); *size* (the standard deviation from the 2006-2016 publications mean).

many situations in which there are co-authorship ties not only between ego and alters, but also among most of the alters. In this specific case, of high density networks, we can assume not only that there is frequent alter-alter collaboration for papers, but also that all the alters are co-authors on the same publications, which is the clearest situation of homophily in terms of publication rhythm.

Romania

For Romanian academic sociologists the regression models tell a whole different story. First of all, results reported in Table 3 show that the relation between the publication rhythm of the ego and the mean publication rhythm of his / her alters is more direct, or at least more obvious, even in the absence of the structural variables. Thus, the positive beta coefficient indicates the probability of a homophily effect – i.e., authors with constant rhythm tend to have co-authors who, in turn, are more constant.

In the case of Romanian egos, the size of the ego network accounts for most of the variation in the dependent variable – publication constancy. When added in the regression equation, network size improves the

model with a 40% increase in the explained variation. Network density and the normalized betweenness scores of the authors do not improve the model by much, adding only 4% more variation.

As with the alters' mean publication rhythm, the relation between network size and ego's publication rhythm is positive, indicating that larger co-authorship networks are associated with a higher degree of publishing irregularity. Taking into consideration both variables, it can be said that, for the present regression model, structural properties of the network have more explanatory power than the compositional ones.

Figure 3 offers a visualisation of the co-authorship networks of Romanian sociologists. As suggested by the results from the regression models, there are many components in which the size of the nodes representing egos is similar with the size of the nodes representing alters. And the common denominator of those components is the size of the networks. Thus, it can be affirmed that, on average, for Romanian sociologists small network size is an indicator of rhythm homophily between an ego and her co-authors, while bigger co-authorship networks exhibit a higher chance for an effect of preferential attachment.

Table 3. Hierarchical regression models for Romania

Variables	Model 1	Model 2	Model 3	Model 4
1. Mean score of alters' st. dev. from 2006-2016 publications mean	0.380	0.233	0.228	0.245
2. Network size		0.647	0.467	0.514
3. Ego's normalized betweenness			0.290	0.306
4. Ego network density				0.084
R ²	.13	0.53	0.57	0.57
ΔR ²		0.4	0.04	0

Dependent variable: Ego's 10 years publishing rhythm

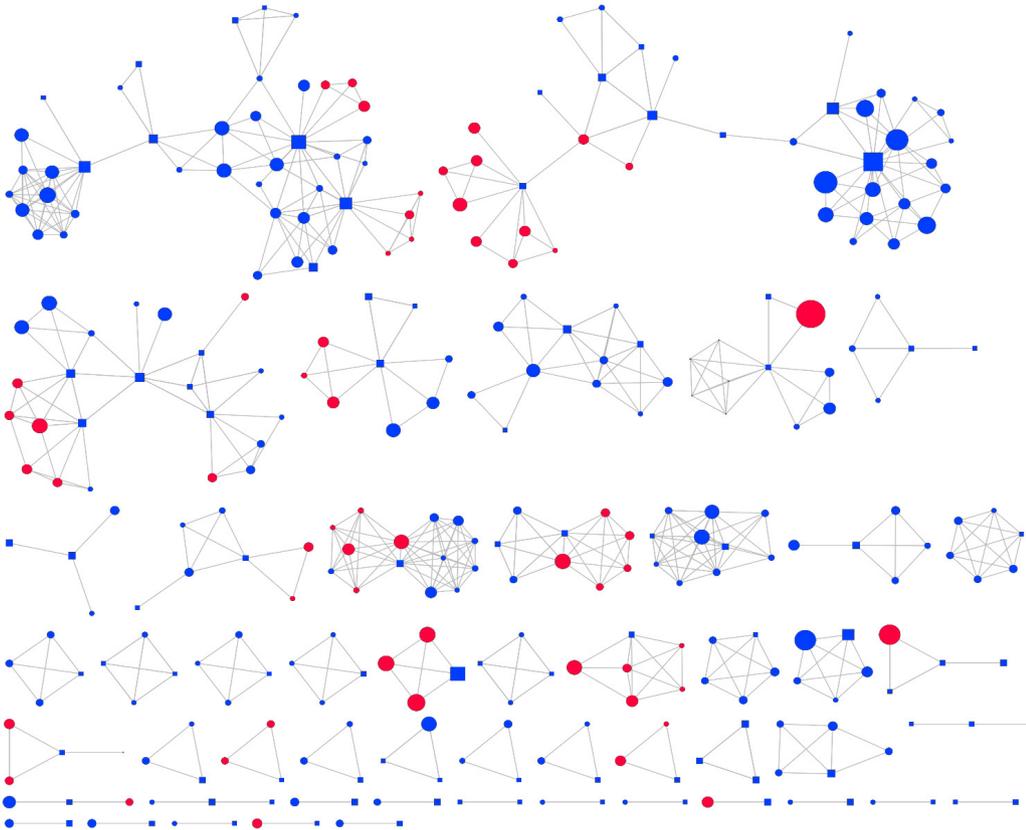


Figure 3. Whole network of Romanian academic sociologists

Figure note: The visualization of the network was done with visone (Brandes & Wagner, 2004). The networks were grouped by the connected component, resulting 51 groups. The visual variables used for constructing the network were: *shape* (square = ego; circle = alter); *color* (blue = Romania; red = other countries); *size* (the standard deviation from the 2006-2016 publications mean).

Slovenia

In their turn, Slovenian academic sociologists have particularities when it comes to publication constancy or irregularity. The compositional characteristic of the network, in terms of alters' mean publication rhythm, does not offer by itself any explanation with respect to the variation of the dependent variable. Simmilar with the Romanian case, what is important in the context of Slovenian sociologists' co-authorship networks is their size. Again, the relation between network size

and ego's publication rhythm is positive, thus having higher constancy of (non)publications in smaller ego networks. Also, results reported in Table 4, for regression models 3 and 4, show that the normalized betweenness scores are associated with higher publication irregularities.

As follows, egos who can be seen as brokers between unconnected alters are linked to multiple temporalities, specific to each group of alters. These results can be visualised in Figure 4, mainly in the principal component of the whole network, where the biggest square-shaped

nodes are at the ones interposed between the biggest number of alters.

Another aspect which must be taken into account, when interpreting results from Table 4, is that the normalized betweenness centrality of the egos is positively correlated with the size of the network. On the other hand, the density of the co-authorship network, which logically is negatively correlated with betweenness centrality, attenuates the impact of both network size

and normalized betweenness. Hence, ego networks with higher density are more probable to exhibit features of rhythm homophily between the nodes.

Conclusions and Discussion

If we look back at the hypotheses proposed at the beginning of this article and try to give a response in a classical manner, the overall conclusion would be

Table 4. Hierarchical regression models for Slovenia

Variables	Model 1	Model 2	Model 3	Model 4
1. Mean score of alters' st. dev. from 2006-2016 publications mean	0.029	0.025	0.430	-0.007
2. Network size		0.412	0.415	0.276
3. Ego's normalized betweenness			0.217	0.177
4. Ego network density				-0.072
R ²	0	0.13	0.15	0.09
ΔR ²	0	0.13	0.02	-0.06

Dependent variable: Ego's 10 years publishing rhythm

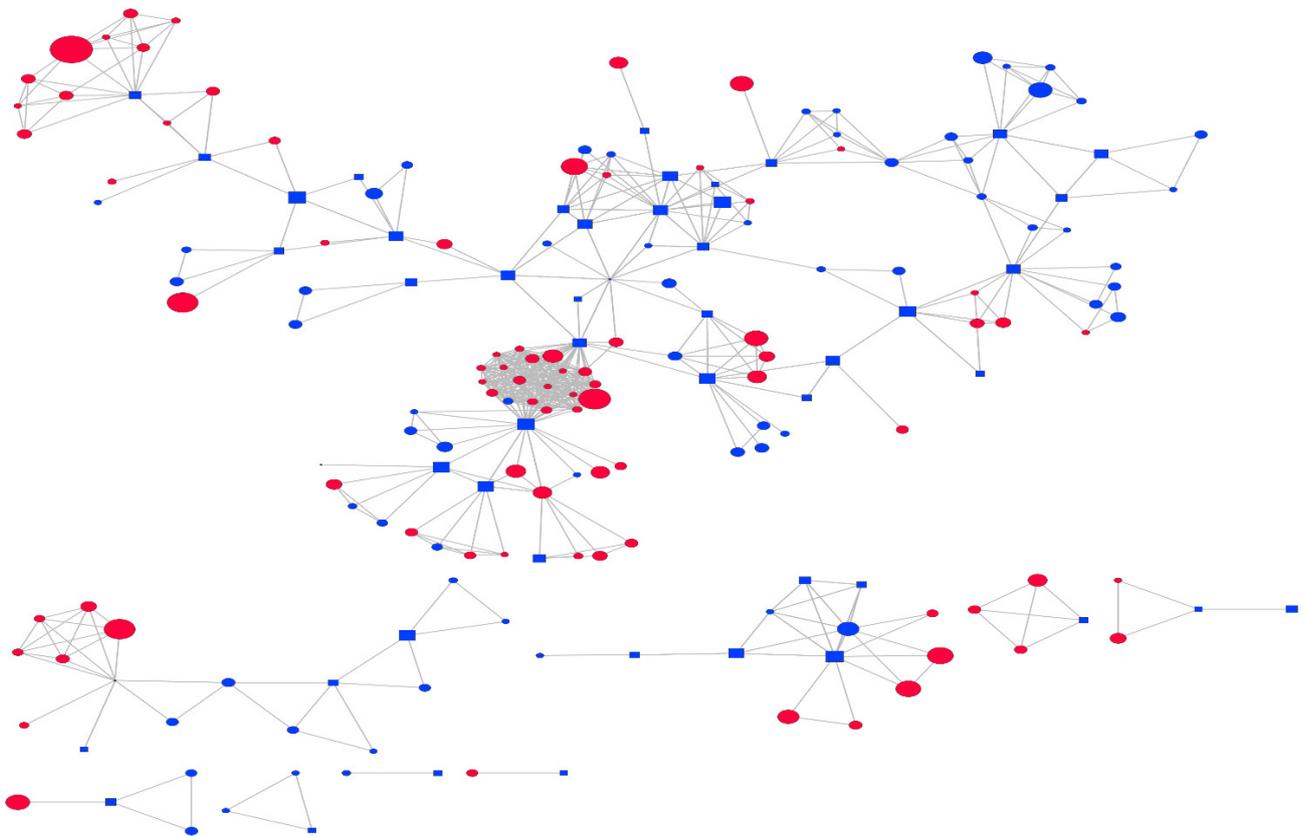


Figure 4. Whole network of Slovenian academic sociologists

Figure note: The visualization of the network was done with visone (Brandes & Wagner, 2004). The networks were grouped by the connected component, resulting 9 groups. The visual variables used for constructing the network were: *shape* (square = ego; circle = alter); *color* (blue = Slovenia; red = other countries); *size* (the standard deviation from the 2006-2016 publications mean).

to refute them, given the standardized beta and the associated determination coefficients (excepting the Romanian case). However, the results reported in Tables 2, 3, and 4 indicate that possible relations of homophily and preferential attachment can be seen through indirect effects. To resume the results, it can be said that: a) in the case of Polish sociologists, the effects of homophily and preferential attachment are obfuscated by the density of the ego networks. Denser networks are more homophilous in terms of publication rhythms, compared to ego networks with less density, in which there is a higher for preferential attachment; b) for Romanian sociologists, ego network size has the main explanatory power when it comes to similarities between egos and alters, smaller networks exhibiting more homophilic relations between ego and alters; c) regarding Slovenian sociologists, it was observed that an interplay of network size and betweenness centrality acts as an explanation for preferential attachment, being correlated with higher irregularities in the publication rhythm of the egos.

Hâncean and Perc (2016) noted a pervasive homophily effect between egos and alters when we compare their citation scores, while the impact of network characteristics is rather absent. However, in the analysis of publication rhythms – constancy or irregularity –, the reverse seems to be true. Network properties (i.e., structural features of size, density and betweenness) play a bigger role in explaining the variation of ego's publication constancy / irregularity than the compositional features (alters' characteristics).

Yet, there are present limits of the present study, that must be addressed. One limit of the research is given by the way in which rhythmicity was measured. The standard deviation can show if the publication rhythm of an author is characterized by constancy or irregularity. Using the general parameters of social time, described by Zerubavel (1976), it can be said that it measures the tempo – pace of events. But it does not show an important aspect for affirming that an ego and her alter(s) share the same social time, mainly, *simultaneity* – knowing that an ego and an alter publish at same time. If an author has published two articles in 2006 and one in 2015, and one of her alters has published one article in 2006 and two in 2015, their standard deviation will be the same.

On the other hand, as it was discussed in the Results section, metrics of network structure can add insights regarding this interpretation. The case of Poland is the most obvious. Here the social time of egos and alters exhibit the highest degree of simultaneity, because the high-density scores are an indicator of the fact that most

co-authors are present for the same paper(s). But the other structural variables can offer similar insights. Network size can also be an indicator for social time simultaneity, given that in small networks there is a bigger chance for egos and co-authors to appear on all the papers.

Another limit is using yearly distributions of data. An important aspect for the social time of publications could be given by what in time series analysis is called *seasonality*. Yet, seasonal decompositions require at least to yearly sub-divisions – e.g. quarters, months, weeks etc.

Finally, the results presented in this study must be interpreted in a descriptive manner. Just because the analyses started from egocentric data, I do not imply that homophily or preferential attachment are strategies employed only by the ego in tie selection. The purpose was to describe an overall image about types of nodes in co-authorship networks based on a number of structural and compositional features that can explain their similarities or differences in terms of publication rhythms. Also, results can only be interpreted with regards to publications indexed in Web of Science. Taking into account less restrictive bibliometric data – e.g., Scopus, Google Scholar – can give a more accurate image about the publication rhythm of the egos, as well about their co-authors and the structural and compositional characteristics of the ego networks. Additionally, further research, which would imply a decomposition of the data to level of dyadic tests, such as the E-I Index, which measures similarity between each pair of two nodes to give an overall image about an ego network's level of homophily / heterogeneity, can yield more accurate results. Returning to the main thesis of this study, namely, that publications rhythms can be seen as social rhythms inside a system with its own temporal logic – i.e., social time –, it can be said that the present results point towards a constructive direction for a reflexive approach to science. Both general (descriptive) results and analyses performed on ego network specific measures indicate an analytical coherence between network phenomena of homophily and preferential attachment, and features of social temporal order.

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