Kudos to you!
**Comparing co-authorships and acknowledgements in political science
journals from Germany**

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Abstract

Scientific research on academic collaboration focuses on co-authorships, citations and acknowledgements as ‘reward triangle’. However, acknowledgements have received comparatively little attention. In this paper, we compare co-authorship and acknowledgement networks and investigate conditions that influence their formation (gender, institutional affiliation and status of authors and acknowledged individuals). We select three sub-disciplinary political science journals from Germany between 2010 and 2017. We employ techniques from social network analysis to compare these conditions by using homophily measures. The results demonstrate that co-authorships have a rather sparse network while including acknowledgements reveals hidden collaboration structures. Moreover, scholars from the same institution are more likely to co-author and acknowledge each other while we show heterophily effects for acknowledging and co-authoring behavior of professors. We also identify an underrepresentation of female academics as authors and credit-givers alike. Thus, our exploratory study reveals similarities and differences patterns for co-authorships and acknowledgements providing new ground for future studies on all aspects of collaborative behavior in science.

Keywords: academic collaboration, co-authorship, acknowledgements, social network analysis, political science, Germany

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Introduction

Co-authorships, citations and acknowledgements may be considered the three currencies of scientific research and are theorized as 'reward triangle' (Costas & Leeuwen, 2012; Cronin & Weaver, 1995; Desrochers et al., 2018). While much research has focused on co-authorships and citations as well as its interrelation (A. Díaz-Faes & Bordons, 2017; Costas & Leeuwen, 2012; Cronin, 2001), acknowledgements have gathered relatively less attention. Yet, scholars have argued that acknowledgements can be understood as 'super-citation', 'courtesy', 'gift' or 'symbolic capital' in academia (Cronin & Overfelt, 1994; Desrochers et al., 2018; Edge, 1979; McCain, 1991). Acknowledgements reveal rather informal social interactions and represent parts of the personal context of scholars (Hyland, 2003).

Cronin and Weaver (1995, p. 175) claim that studies are necessary that analyze 'issues of equity in terms of how rewards are distributed, e.g. co-authorship versus acknowledgements'. Since then only few studies have investigated both co-authorship and acknowledgement (Costas & Leeuwen, 2012; Paul-Hus, Mongeon, Sainte-Marie, & Larivière, 2017). Previous work on acknowledgements gave a descriptive overview about the state of acknowledgments in different disciplines, demonstrating that almost all scientific disciplines share the act of credit giving and that this behavior increases since decades (Cronin, McKenzie, & Rubio, 1993; Giles & Councill, 2004; Salager-Meyer, Alcaraz-Ariza, Luzardo Briceño, & Jabbour, 2011).

In this paper, we are particularly interested in acknowledgements to single persons or what Cronin and colleagues call 'peer interaction communication' (PIC)

(Cronin et al., 1993), because these are crucial to identify scientific and intellectual ‘debt’ to others (Costas & Leeuwen, 2012; Giles & Councill, 2004; Paul-Hus, Díaz-Faes, et al., 2017). While quantitative information is available for various disciplines (Cronin, Shaw, & La Barre, 2003; Heffner, 1981; Hyland, 2003; McCain, 1991; Salager-Meyer et al., 2011), a comparative study of conditions that influence acknowledgements and co-authorship has not been taken up. Thus, we build upon previous work and investigate *under which conditions co-authorship and acknowledgement form similar or different patterns.*

Based on former contributions on co-authored collaboration we consider gender, institutional affiliation and academic status of scholars as relevant conditions. While homophily effects have been observed for co-authorship (Leifeld, Wankmüller, Berger, Ingold, & Steiner, 2017; Teele & Thelen, 2017; West, Jacquet, King, Correll, & Bergstrom, 2013), we do not know the mechanism at work when it comes to acknowledgements. Our basic assumption is that similar mechanisms evoke co-authorship and acknowledgements.

We apply techniques from social network analysis (Wasserman & Faust, 1994) to examine the conditions that affect collaboration and acknowledgment patterns in an explorative way. Constructing multiplex co-authorship and acknowledgement networks allows us to investigate homophily concerning gender, affiliation and status. While homophily is one of the most investigated features in social networks (McPherson, Smith-Lovin, & Cook, 2001), it is only rarely applied to co-authorships and even less to acknowledgements.

To investigate both co-authorship and acknowledgement relations, and, at the same time, account for disciplinary differences (Leahey, 2006; Leahey & Moody, 2014; Rawlings, McFarland, Dahlander, & Wang, 2015), three sub-disciplinary political science journals from Germany are selected, the *Zeitschrift für Internationale Beziehungen* (Journal of International Relations, ZIB), the *Zeitschrift für Vergleichende Politikwissenschaft* (Comparative Governance and Politics, ZfVP) and the *Zeitschrift für Politische Theorie* (Journal of Political Theory, ZPTH). The journals are relatively new, but have a good reputation in the related German political science profession. Moreover, comparative politics, international relations and political theory seem to be on opposite sides of collaboration patterns in political science. While comparative politics scholars show a stronger pattern of collaboration, political theorists seem to publish predominantly single authored articles; international relations scholars are in between this spectrum (Leifeld & Ingold, 2016; Metz & Jäckle, 2017). In order to study the formation and conditions of co-authorship and acknowledgements in the three journals, all issues are analyzed from 2010 to 2017 and the relevant information about authors and acknowledged persons had to be collected manually. We concentrate on sub-disciplinary differences within the field of political science rather than on further similarities to maximize information contained in the limited dataset.

The article is structured as follows: The next section discusses and situates our study in the literature on acknowledgements and co-authorship. Furthermore, we present our hypotheses on status, institutional affiliation and gender differences in academic collaborations. The research design then describes data collection and

material as well as the social network analysis techniques. The fourth section presents and interprets the findings. The final section concludes the study, discusses its limitations and gives an outlook on future studies.

Collaboration types in academia

Previous research suggests that collaboration leads to increased productivity and is understood as necessary for successful research and relevant for receiving funding (Heinze, Heidler, Heiberger, & Riebling, 2013; Iglič, Doreian, Kronegger, & Ferligoj, 2017; Katz & Martin, 1997; Melin & Persson, 1996; Tsai, Corley, & Bozeman, 2016; Wray, 2002). Researchers perceive publishing together easier, because they can exchange ideas and get feedback within teams more quickly than as single author (Gordon, 1980; Lewis, Ross, & Holden, 2012; Metz & Jäckle, 2017; Tsai et al., 2016).

Even though collaboration as concept is difficult to define and includes several layers (Katz & Martin, 1997), many studies investigate it as *visible cooperation* between at least two researchers who co-author a published text (report, article, book etc.). In this regard, scholars show the increase of research collaboration across academic disciplines and countries (Cronin et al., 2003; Leifeld & Ingold, 2016; Leifeld et al., 2017; Melin & Persson, 1996; O'Brien, 2012; Ossenblok, Verleysen, & Engels, 2014). Moreover, they demonstrate that empirical research is far more team-based than theoretical work (Fisher, Cobane, Ven, & Cullen, 1998; Leifeld & Ingold, 2016; Metz & Jäckle, 2017; Moody, 2004; Smith, 1958). Single-authored texts might matter in terms of merits and reputation in the respective field, because as single-author, you do not have to share the recognition for your work (Lewis et al., 2012, pp. 699–700; Metz &

Jäckle, 2017). Collaboration in the humanities and social science is perceived as extra-work and more difficult than working as sole investigator (Farber, 2005; Lewis et al., 2012). Accordingly, we differentiate political science into sub-disciplinary schools of thought to account for potential differences with regard to collaboration patterns.

Invisible collaboration plays also an important part in academia in the form of ideational exchange, informal talks and feedback (Heffner, 1981; Plummer, Newman, & Winter, 1993; Subramanyam, 1983). These forms of collaboration are often neglected in bibliometric studies. As Subramanyam (1983, p. 35) argues: 'a brilliant suggestion made by a scientist during casual conversation may be more valuable in shaping the course and outcome of a research project than weeks of labor-intensive activity of a collaborating scientist in the laboratory'. In a recent review article, Leahey (2016, p. 82) concludes that 'collaboration is more varied, and possibly more common, than the coauthor measures based on bibliometric data sources suggest'.

Accordingly, other scholars argued that acknowledgements are a crucial indicator to study indirect forms of collaboration, because they provide insights into information exchange and communication processes. As Paul-Hus et al. (2017, p. 11) point out: 'They shed light on otherwise invisible contributions that complement authorship and provide insight on researchers' collaboration patterns, division of labor, and credit attribution practices.' This intentional act to show gratitude to other scholars is also a voluntary act that cannot be enforced by journals or publishers, and provide no direct benefits. Cronin and colleagues argue that acknowledgements are 'sub-author collaboration' (Cronin et al., 2003; Cronin & Weaver, 1995).

While such a characteristic might be true in sciences in which many researchers respectively research teams are involved, social science does not experience such large publications teams as emerging norm that might qualify acknowledgments as 'sub-authors'. Therefore, understanding acknowledgements as courtesy seems more valid (Cronin & Overfelt, 1994; McCain, 1991). Most of the researchers know about this 'institutionalised practice' (Cronin et al., 1993, p. 37) of giving credit to others in a publication. As studies showed, scholars look specifically for such acknowledgements and have an expectation to get acknowledged if they know that they have exchanged ideas with the author(s) (Cronin & Overfelt, 1994). Understanding acknowledgements as collaborative actions of the peers also shows that the divide between team-based and single author publications might not be as pronounced as often claimed (Paul-Hus, Mongeon, et al., 2017). However, such a culture of acknowledgements is more established in U.S. academia than in other countries (Costas & Leeuwen, 2012; Salager-Meyer et al., 2011).

Scholars have suggested to look at different types of acknowledgements and studies have shown crucial differences between these types (Cronin et al., 1993; McCain, 1991). Moreover, funding acknowledgements and the number of citations of research articles are investigated, but do not show a clear correlation (Costas & Leeuwen, 2012; Giles & Council, 2004). We focus on peer interactive communication, understood as 'a record of, presumably significant, intellectual input and influence received from one's peers. The registering of this influence, or intellectual debt, via acknowledgement is comparable with the registering of influence via citations.'

(Cronin et al., 1993, p. 31). We do this for two reasons. *Firstly*, our aim is to compare co-authorship and acknowledgement relations and, hence, individual researchers as co-authors and acknowledged persons are of interest. Funding agencies or specific events are not considered in our study. *Secondly*, while differentiating acknowledgements into different sub-types such as moral, financial or technical support (Cronin et al., 1993, p. 31) would have added interesting information, it does not enrich our comparison with co-authorship patterns. Thus, we solely focus on the simple mentions of individuals in the dedicated section of the research article and consider them as *informal* tie in a network of scholars. By comparing individuals, we can also analyze who are the most central scholars in the respective network and whether this is based on their co-authorship, acknowledgements or both relations. The authors and acknowledged persons are then further characterized by their gender, institutional affiliation and status to investigate effects of homophily.

Gender, institutional affiliation and status in academic collaborations

Three aspects of academic collaboration have been predominantly investigated: gender, institutional affiliation and status. Studies on the gender dimension of academic collaboration show that women are not as well connected and collaborate less than their male peers in specific areas such as methodological issues (Barnes & Beaulieu, 2017; Dehdarirad, Villarroya, & Barrios, 2014; Hancock, Baum, & Breuning, 2013). 'Only-women'-contributors are especially rare in high-ranked journals compared to 'only-men'-authors and male academics tend to publish more single-authored articles than women (Fisher et al., 1998; Leahey, 2006; Teele & Thelen, 2017;

West et al., 2013). Moreover, the majority of female scholars is still working in disciplines in which they are the majority. However, more women are involved in interdisciplinary research collaboration as men (Teele & Thelen, 2017; van Rijnsoever & Hessels, 2011; West et al., 2013).

So far, gender differences have not been investigated in studies on acknowledgements. Nonetheless, considering the findings on the most acknowledged persons in various disciplines (Cronin, 2001; Cronin et al., 1993; Giles & Councill, 2004), most of the mentioned scholars are male. However, this finding is only based on the presented results in the respective studies and has to be qualified in regard to its dyadic consequences. Hence, we derive two hypotheses:

H1a: We expect that more male than female academics are named in the acknowledgements.

H1b: We expect strong effects of gender homophily, i.e., females acknowledge other females, males other males.

In addition to gender, institutional affiliation affects collaboration. Previous studies show two different trends. On the one hand, scholars argue that internationalization and digitalization of academic research offers the opportunity to cooperate and communicate with colleagues easier, faster and in a more productive way than in past decades (Hunter & Leahey, 2008). Moreover, rather small or specialized fields tend to collaborate across national boundaries, because the 'epistemic community' in the own national community is rather limited (Iglič et al., 2017).

On the other hand, scholars argue that researchers tend to cooperate mainly at the same institute. The initial contact and exchange of ideas is perceived as easier and applying for funding is more effective if the researchers are based at the same university (Correia, Paredes, & Fonseca, 2018; Ferligoj, Kronegger, Mali, Snijders, & Doreian, 2015; Iglič et al., 2017; Kronegger, Mali, Ferligoj, & Doreian, 2012). More specifically, recent studies demonstrate that geographical proximity increases the likelihood of collaboration research (Heiberger & Riebling, 2015; Leifeld & Ingold, 2016; Leifeld et al., 2017).¹ Therefore, our second hypothesis is as following:

H2. We expect that acknowledgments tend to occur more often between members of the same institution.

The third aspect refers to the status of an academic, whether the researcher is a PhD student or a professor. Either researchers on the same status cooperate or it is a hierarchical cooperation.² The first collaboration might occur among Post-Docs and professors who work on similar topics and put their strength and interests together. While Post-Docs try to improve their reputation, demonstrate that they can work with others and on different subjects, collaboration among professors might be differently motivated. Professors build on 'ties that last' (Rawlings et al., 2015) with regard to former collaboration projects, counting on their existing reputation and multifold connections within the research community.

¹ Giles and Councill (2004, p. 17603) point towards the relevance of institutional affiliations for acknowledgments, but they do not investigate this relation more closely.

² Calling it a hierarchical collaboration does not necessarily mean a negative power-exploiting cooperation. The term has no normative connotation in the present study.

We assume similar relations and homophily by status for acknowledgements. Scholars present their work to peers on conferences and workshops, but also discuss their research with colleagues in the institute or working group. Researchers on the same status level are mentioned because it is an equal exchange relation between peers. Yet, we assume the mechanism of homophily to prevail:

H3. We expect that researcher name other researchers with the same status in their acknowledgements, i.e., homophile relations with regard to status.

However, it is also feasible that collaborating as well as giving advice and providing help might be heterophile in status. The PhD student or Post-Doc wants to publish an article and either s/he asks the supervisor if they want to work together or the supervisor initiates it and argues for a co-authored article with his/her PhD student(s) or Post-Docs (Subramanyam, 1983). In particular, graduate students as well as Post-Docs have close relationships with their mentors in the German academic world, in which patronage is an important way to receive and grant promotions (Münch, 2001). This behavior could also be exhibited when it comes to acknowledgements. A professor might comment an earlier draft of the paper by his/her doctoral students or Post-Docs resulting in a mention in the acknowledgement section of the paper.

Summarizing our expectations, we investigate how gender, institutional affiliation and status influence acknowledgements and co-authorship. Based on previous work, we expect similar homophile effects for all three factors, namely that similarity in

gender, institutional affiliation and status positively affects the chance to be coauthor or being acknowledged.

Case selection and data material

We have selected three sub-disciplinary political science journals for the analysis of collaboration patterns. This has two advantages in comparison to studies on single countries or general-interest journals. *Firstly*, we expect a close linkage in the respective journal network. All texts are targeted for a specific audience and engage in topics which are relevant for the discussion in the field. Sub-disciplinary journals might show a stronger overlap of author and acknowledgement links than general-interest journals. In contrast, journals of general interests cover many different issues and encompass various sub-disciplines (Arzheimer & Schoen, 2009; Fisher et al., 1998). *Secondly*, the analysis of country collaborations bears the tendency of 'methodological nationalism' (Wimmer & Glick Schiller, 2002). This means that only publications were considered for the analysis that were (co-)authored within the national community (Cancela, Coelho, & Ruivo, 2014; Kronegger et al., 2012; Leifeld & Ingold, 2016; Leifeld et al., 2017). Our selection of three sub-disciplinary journals can transcend these methodological concerns.

Most often, top-ranked journals of academic fields are analyzed (Fisher et al., 1998; Metz & Jäckle, 2017; Teele & Thelen, 2017). However, the emphasis on high-ranked journals might show a biased representation of collaboration patterns. Many researchers try to publish in these journals, but might end up in lower ranked journal. Thus, looking at journals with lower impact factors and less perceived

prestige might demonstrate different collaboration patterns and the present study fills this gap.³ The *Zeitschrift für Internationale Beziehungen* (ZIB), the *Zeitschrift für Vergleichende Politikwissenschaft* (ZfVP) and the *Zeitschrift für Politische Theorie* (ZPTH) are based in Germany and publish mainly German texts, although the option to publish in English is available (and used by authors).

The journals ZfVP, ZIB and ZPTH are selected according to three aspects: *Firstly*, they are sub-disciplinary journals in German political science and their target group in terms of authors and audience is focused on comparative politics, international relations or political theory. The selected sub-disciplines seem to be on the opposite side of collaboration patterns in political science. Comparative politics shows a stronger pattern of collaboration and seems closer to natural science collaboration patterns than political theorists who tend more towards the arts and humanities discipline. International relations might be placed in the middle between these two poles (A. Díaz-Faes & Bordons, 2017; Leifeld & Ingold, 2016; Leifeld et al., 2017; Metz & Jäckle, 2017). *Secondly*, the analysis of collaboration patterns in political science has gained attention in the last decade and this is especially true for the German case (Arzheimer & Schoen, 2009; Cancela et al., 2014; Leifeld & Ingold, 2016; Leifeld et al., 2017; Metz & Jäckle, 2017; Pehl, 2012; Teele & Thelen, 2017). The study sheds light on the German political science community which is strongly influenced by the English-

³ The strong emphasis in the empirical research on co-authorship in high-ranked journals might hide other publication patterns and should be treated cautiously in terms of result generalizability. The suggested focus on lower-ranked journals does not argue that focusing on these is in any way 'better'.

speaking scholarly community and we can assess whether cultural differences are relevant for acknowledgment patterns as Salager-Meyer et al. (2011) demonstrate.

Thirdly, the journals are linked to the respective sections and working groups in the German Political Science Association (DVPW, 2019). Thus, they are the main communicators of such research in German political science and read by the peers. Publishing in one of these can be seen as an important step towards visibility within the sub-disciplinary (national) scientific community.

The ZIB is published since 1994 and is the leading academic journal on international relations in Germany. Furthermore, it was the first German political science journal with a double blind peer review process. The ZIB is published twice a year, includes thematic forums and does not publish single book reviews.

The ZfVP is edited since 2007 and with its explicit focus on comparative politics, it is the leading German journal in this field. It publishes research articles, book reviews, conference reports and interviews. From 2007 to 2012, it has published two issues per year and after that, it changed to four issues per year. Research articles go through a double blind peer review process.⁴

The ZPTH is edited since 2010 and even though it is a rather new journal, it is also unique for the sub-discipline political theory in Germany. It publishes two issues each year and contains research articles, book reviews, conference reports and other texts such as interviews. From time to time and within a regular journal issue, a

⁴ The ZfVP also publishes special issues, but these are excluded, because for those, specific call for papers are published and specific scholars are invited to publish.

thematic section with 4-5 related articles is published. All research articles are published after a double blind peer review process.

For our analysis, all texts are selected which have been published in the regular issues of the three journals between 2010 and 2017. Creating a rather similar dataset for the three journals increases the comparability of the collaboration patterns. The data collection was partially done manually and partially done by scrapping the respective information from the publisher websites with the R package *rvest* (Wickham, 2016).

While the author's information (gender based on first name, status, institutional affiliation) are provided by the journals, the acknowledgements from the respective section were retrieved manually. Other information on funding or conference participation have been deleted and only the names of the individual have been extracted. After that, the data was cleaned and, if necessary, corrected manually. In the next step, every characteristic of the acknowledged persons had to be identified manually by comparing the authors dataset with the acknowledgement dataset and when information on acknowledged persons were missing or non-existing, they had to be identified by individual web searches.⁵ An automatization of retrieving acknowledgements, as Giles and Council (2004) deployed or a large data extraction

⁵ In few cases, some of the characteristics of the author were not provided in the article and could not be identified later. The gender of the author was attributed by using the authors' first name as indicator. We are aware that this is problematic, because it might reify social and cultural understandings of female and male first names. If the institutional affiliation and the status of the authors were not reported in the text, the information was indicated as 'n/a' in the dataset due to the difficulty to clearly determine the status and affiliation of the author at the time of the published article. Moreover, some authors had no institutional affiliation and only named the city of living. Again, the information was coded as 'n/a' in the dataset. This challenge in the data collection and completeness is discussed in the conclusion.

from the web of science applied in other studies (A. Díaz-Faes & Bordons, 2017; Costas & Leeuwen, 2012; Paul-Hus, Díaz-Faes, et al., 2017) was not possible and would have not provided the relevant information for our study. The labor-intense information gathering creates a unique dataset of acknowledged persons, authors and their attributes which are, so far, not provided by Scopus or Web of Science.

Social network analysis

Social network analysis focuses on the relations of actors and investigates the structural components of social actions (Kadushin, 2012; Wasserman & Faust, 1994). To apply social network analysis to our study, author names, status and institutional affiliations have been collected manually from the journal articles as well as the information on the acknowledged individuals.⁶ In our case, social networks consist of two sorts of ties. The first is the widely investigated structure of co-authorships with which we will compare our main research aim, acknowledgements of scholars.

Co-authored collaboration is understood as undirected ties between at least two academics while acknowledgement links are conceptualized as directed ties. If researcher A and B have published a text together, a "1" is put into the respective column and row in the adjacency matrix; if there is no joint publication, "0" is put in. If A mentions B in the acknowledgement, the direction is conceptualized from A to B. If researcher A and B have published a text together and also mentioned each other in the acknowledgements, the two different ties are noted separately, i.e. they are reciprocal.

⁶ The personal attributes of the acknowledged individuals can only be assigned with high certainty because we look at rather small sub-disciplines.

Studies on scientific collaboration often investigate the centrality of academics in collaboration networks. Since we are interested whether acknowledgement ties resemble co-authorship ties and whether the dominant authors and acknowledged person have similar or different characteristics, we calculate each scholars' "degree centrality". (Freeman, 1978; Wasserman & Faust, 1994). *Weighted degree centrality* is the number of all relations between two authors. If two authors' collaboration resulted in 3 papers, they would have, for instance, a weighted degree of 3 (Opsahl, Agneessens, & Skvoretz, 2010). Because acknowledgements are directed relations and we are interested in scholar's influence, we only consider *being* acknowledged (i.e., weighted indegree). Having a high degree centrality indicates a crucial position of a researcher in the academic network, because the researcher publishes many co-authored papers in the selected journals, is acknowledged many times or both aspects match.

In addition to the (descriptive) investigation of centrality of scholars, we focus on the influence of personal attributes (gender, affiliation, status) on tie formations. In other words, we assume homophily of these attributes (McPherson et al., 2001).⁷ Mark Newman (2003) developed an indicator to reveal potential homophily in social networks. Assortativity is the correlation between certain properties of nodes, for instance, Merton's Matthew effect (Merton, 1968) might be framed as high degree assortativity in networks, i.e. that nodes with high degrees tend to have strong ties

⁷ To measure homophily, most often Exponential Random Graph Models are employed. However, the acknowledgement networks are too sparse for conversion of the ERGMs. We have been only able to obtain very specific ERGMs and refrained from using those. The results of the ERGMs may be requested from the authors.

with other nodes with many relations. In this paper, we investigate assortativity in respect to the personal attributes indicating whether the acknowledgement and co-authorship networks in the three journals are structured by homophily effects.⁸

Formal and informal networks in German Political science

Structure

The three journals have published 16 (2 issues per year in the ZIB and ZPTH) respectively 23 issues (ZfVP) between 2010 and 2017.⁹ 303 texts could be obtained from the ZfVP, 183 from the ZPTH and 127 from the ZIB. From this sample of texts, the ZIB has the highest share of research articles (87 per cent), followed by ZPTH (44 per cent) and the ZfVP (29 per cent). The ZfVP publishes many book reviews which lowers the percentage of research articles. Conference reports, Editorials and other texts account for a minority of published texts in the three journals. The vast majority of the acknowledgements appear in research articles which corroborates previous findings in other disciplines (Cronin et al., 1993; Salager-Meyer et al., 2011).

Our dataset is relatively small in comparison to other studies (Costas & Leeuwen, 2012; Cronin et al., 1993; Giles & Councill, 2004; Paul-Hus, Díaz-Faes, et al., 2017, 2017). This is due to the additional identification of personal information on the authors and acknowledged persons which we collected manually. Without those information, our central aim to reveal and compare conditions of collaboration, would not be achieved. However, given the limited sample size the following results give an explorative insight into co-authorship and acknowledgment patterns.

⁸ We use the R package “igraph” (Csárdi & Nepusz, 2006) to compute and visualize all collaboration patterns.

⁹ The ZfVP has published three double issues (3/4, 2014; 1/2, 2015 and 3/4, 2016), each counted as one.

The first step of our analysis comprises the visualization of the co-authorship and acknowledgement ties between authors, differentiated by journal.¹⁰ Differentiation and visualization give us a first glance on how the acknowledgements are distributed and spread across the scholars' network. In addition, the visualization reveals how similar or different both types of ties are among the journals in question. Therefore, we show a multiplex network for each journal, i.e., networks containing both relationships. While the red ties show the acknowledgements (from the author to the credited person), the black ties show the co-authorship links. The size of the nodes is based on weighted degree centrality, indicating how well a scholar is connected to other scholars in the field via co-authorship and acknowledgements.

Figure 1-3. Visualization of co-authorship and acknowledgement networks

Each of the three networks demonstrate that co-authorships and acknowledgements overlap for some authors. More interestingly, Figures 1 to 3 also reveal differing collaboration patterns. Acknowledgement connects bigger groups and links

¹⁰ We included an overview about the different descriptive network statistics of the three journal networks in table 1A in the online appendix.

otherwise isolated researchers with scholars who are more central in the field. Hence, we demonstrate that single-authored papers are also situated in research communities and support networks by visualizing the acknowledgement links.

The visualization of the multiplex networks also shows who the most central scholars in each journal are. Table 1 provides a numeric overview about the highest ranked scholars in the respective journal, based on weighted in-degree and degree centrality.

Table 1: Degree centrality of the highest ranked scholars in the ZIB, ZfVP and ZPTH journal

ZIB journal					ZfVP journal					ZPTH journal				
Acknowledgement					Acknowledgement					Acknowledgement				
Co-Authorship					Co-Authorship					Co-Authorship				
Names	In-Degree	In-Degree Rank	Degree	Degree Rank	Names	In-Degree	In-Degree Rank	Degree	Degree Rank	Names	In-Degree	In-Degree Rank	Degree	Degree Rank
<i>Nicole Deitelhoff</i>	9	1	2	42	Steffen Kailitz	3	3	8	3	Bernd Ladwig	2	2	0	28
Thomas Diez	7	2	4	23	Christoph Mohamad-Klotzbach	2	7	14	1	Christian Volk	2	2	2	6
Peter Niesen	6	3	0	86	Frieder Wolf	2	7	2	42	Gary S Schaal	1	11	2	6
Dirk Peters	4	12	2	42	Gert Pickel	2	7	6	14	Peter Niesen	1	11	4	1
Michael Zürn	4	12	4	23	<i>Marianne Kneuer</i>	2	7	0	87	Vincent Rzepka	1	11	2	6
Hannes Hansen-Magnusson	1	89	6	14	Stefan Wurster	2	7	8	3					
<i>Judith Renner</i>	1	89	8	3	Aurel Croissant	1	66	8	3					
<i>Lisbeth Zimmermann</i>	1	89	12	1										
<i>Maren Hofius</i>	1	89	6	14										
Sassan Gholiagha	1	89	6	14										

Note: The five scholars with the highest in-degree and the five scholars with the highest degree centrality are displayed here. The full name of female scholars is in italics.

Table 1 demonstrates that taking acknowledgements into account strongly affects the network structure in each journal. Many scholars have a central position in one of each network, so they are either a central collaboration partner *or* many times acknowledged. Rank-correlating the centrality in co-authorship and acknowledgement networks reveals values of -0.05 (ZIB), 0.11 (ZfVP), and -0.34 (ZPTh), all representing insignificant correlations. Thus, rank correlation resembles stark differences between both networks.

To be sure, the network structure of the three journals differs too, which leads to different interpretations why the specific scholars are the most central ones.¹¹ The ZIB network structure is rather dense, because there is an encompassing main component which connects most of the scholars in the journal. There are scholars such as *Deitelhoff*, *Diez* and *Niesen* who have a high in-degree, because they are often acknowledged while *Geis*' or *Zürns*' centrality is based on a mixture of co-authored articles and acknowledgment relations. Scholars such as *Renner* or *Zimmermann* co-author articles in the ZIB, but are rarely acknowledged in other journal articles. While the first mentioned scholars are professors, the last two scholars are post doctoral researcher. We further explore this status difference in the next section of the article.

The strong increase of the number of scholars from co-author links to including acknowledgement links (see Table 1A in the online appendix) indicates that the German international relations community is well connected, works on similar issues

¹¹ For a detailed overview about the centrality values of the scholars in the three journals, we included a table (Table 2A) in the online appendix.

and creates an epistemic community. German IR scholars seek feedback and comments within the German community. Moreover, since the ZIB is the oldest journal of these three sub-disciplinary journals and related to the thematic section in the German Political Science Association, publishing in the ZIB might be an important academic career step in the German IR community. The German IR community is highly internationalized and strongly linked to the English speaking community in Europe and the US (Wemheuer-Vogelaar & Risse, 2018) which might explain the co-authorship and acknowledgements behavior (see also next section).

In the ZfVP, *Mohamad-Klotzbach*, *Kailitz* and *Gert Pickel* have co-authored articles in the ZfVP and are acknowledged and thus, they become rather central. In contrast to the German IR field, comparative politics seems to rest on a few central academics who co-author articles and are acknowledged in ZfVP articles. Moreover, the total number of acknowledged persons as well as the concrete number of acknowledgements to individuals is smaller than in the ZIB. This might indicate a greater diversity in terms of research topics as well as collaboration strategies. Different research strands might be represented in the journal that are partially linked by these central figures, but not as densely as in the German IR journal. The difference in the number of acknowledgements might also indicate a different 'acknowledgement culture' than in the ZIB. Moreover, *Kneuer* and *Gert Pickel* are member of the editorial board of the ZfVP and *Mohamad-Klotzbach* is the respective editorial assistant and this might explain their central position in the journal

network. As in the ZIB network, the majority of the most often acknowledged scholars in the ZfVP are professors.

The last journal network (ZPTH) is rather sparse. There exists a main component but it is rather loosely connected and is predominately based on acknowledgment relations. While *Ladwigs* centrality is solely based on mentions in other scholars acknowledgments, the other scholars co-authored articles and are acknowledged by others. We can assess that acknowledgements emphasize otherwise hidden structures of the collaboration networks, but this is also related to the small network and different epistemological stances in the subfield.

Even though, peer-reviewed journal articles increased their relevance in German political theory, studies demonstrate that single authored papers and monographs are still the main drivers for reputational gains and career steps in German political theory (Diehl, 2015). Thus, collaboration might not only be seen as epistemologically difficult to realize, but also as less-rewarded and acknowledged than single authored publications. The rather weak 'acknowledgement culture' in the ZPTH in comparison to the English-speaking academic context might be another explanation for these findings. Additionally, the ZPTH is the youngest selected journal and therefore, might suffer from a weaker reputation and recognition in the field than the other two selected journals.

Despite these differences in the network structure, the three journals share the underrepresentation of female scholars among the highest rank researchers (only 23 % of all 48 scholars in Table 1 are female). Most visibly is this in the political theory

journal (ZPTH) with no women being present and in the comparative politics journal (ZfVP) in which one of 14 scholars is a woman. In contrast the international relations journal (ZIB) has a representation quota of 34 per cent of all high ranked scholars are being female. Thus, hypothesis H1a on the underrepresentation of female scholars can be confirmed.

Comparing homophily patterns

To investigate homophily we apply the idea of assortativity to 'gender' (H1a, 1b), 'institutional affiliation' (H2) and 'status' (H3). A high value of assortativity indicates homophily within the respective category (e.g. women tend to publish with women) while a higher negative value suggests that scholars do not work or acknowledge others with the same gender or status (e.g. PhD students tend to give credit to non-PhD students in their acknowledgements).

Figure 4. Assortativity by gender and institutional affiliation

With regard to gender (H1b), acknowledgements tend to be given to scholars with the same gender in each journal. While this likelihood is high in the comparative politics journal (ZfVP), the likelihood is moderate in the political theory journal (ZPTH) and slightly negative in the international relations journal (ZIB). While co-authorship shows a similar homophily pattern for the ZfVP and ZIB, the ZPTH shows a high tendency toward heterophily among co-authors. Hence, it is rather likely that the co-authors of political theory articles in the ZPTH have a different

gender. Hence, the homophily effect for co-authorship in the political theory journal is not supported.

The category 'institutional affiliation' of authors and credit-giving persons shows a strong tendency of homophile ties in all three journals (H2) and therefore, it is more likely that academics co-author or acknowledge scholars from the same institution. The assortativity value is very high in the ZfVP for both types of ties (acknowledgement and co-authorship) and rather high in the ZIB. For both journals, the value is higher for co-authorship ties than for acknowledgement links. The investigation of the acknowledgement network in ZPTH shows mixed findings. While acknowledgments seem to be given by colleagues in the same institution, the co-authorship relation is minor negative.

Figure 5. Assortativity by status

The last of our three categories is 'status' and refers to whether an author or credit-giver is professor, postdoc or doctoral student (H3).¹² We find a tendency towards homophile scholarly relations in the ZfVP with regard to acknowledgements and co-authorship in each status group. Despite of the status, academics tend to publish more with their status peers (Doc-Doc, PostDoc-PostDoc, Prof-Prof) and also

¹² We also coded the statuses 'student' and 'unclear' but due to the small number of cases, we omitted these for the analysis.

acknowledge those scholars who have the same status (H3). As Figure 5 demonstrates, this is especially the case for doctoral students who have a higher likelihood of acknowledging and publishing with other doctoral students.

The international relations journal (ZIB) has a similar pattern of homophile relations of credit-giving and co-authorship in the doctoral and post-doctoral status group. However, professors tend towards heterophilious relations. They seem to publish with other status groups and also tend to acknowledge scholars who have a different status more often than peers with the same professorial status.

The comparative politics journal (ZfVP) shows homophily effects on the doctoral and post-doctoral level in both modes of collaboration (acknowledgements and co-authorship). On the professor status, the homophily effect can be demonstrated with regard to acknowledgement, but shows a minimal heterphilious effect with regard to co-authorship.

The ZPTH shows more dissimilarity along the acknowledgement and co-authorship distinction. While authors in the political theory journal tend to co-author articles with peers in the same status groups (homophile relations), the negative assortativity values in the postdoc and professor status group indicate that acknowledgements are given to scholars with a different status than the author(s). Especially in the professor status, this heterophilious relation is rather strong. Hence, our expected homophily pattern for co-authorship and acknowledgements regarding researchers' status is mostly not corroborated.

Conclusion

The paper compares co-authorships and acknowledgements and investigate the conditions under which these are similar or different. While co-authorship patterns are widely recognized in research on science's inner-workings and also acknowledgements gain increasing attention in bibliometric studies (Cronin et al., 2003; Desrochers et al., 2018; Paul-Hus, Mongeon, et al., 2017), the conditions that explain similarities as well as differences between those have not been investigated before.

Co-authorship relations as well as acknowledgements are understood as parts of the 'reward triangle' (Costas & Leeuwen, 2012; Cronin & Weaver, 1995) and studied in a comparative manner with regard to scholars' attributes of gender, institutional affiliation and status. To investigate both ends of the reward triangle empirically, we analyzed co-authorship and acknowledgements in three sub-disciplinary journals in political science from Germany from 2010 to 2017. We collected original data on the authors, acknowledged persons in the respective section and their attributes (gender, institutional affiliation, professional status).

We can corroborate our initially formulated assumption that co-authorship and acknowledgement show homophily effects for most conditions.¹³ Considering acknowledgments shows that many actors become more important when it comes to credit-giving. This supports previous findings that few scholars are acknowledged extensively while the large majority of scholars gets only few acknowledgements,

¹³ In the online appendix, we included a table (Table 2A) that gives an overview about the homophily effects in our study.

resembling a power law curve (Cronin et al., 1993; Giles & Councill, 2004). We also show that more male than female academics are given credit in the acknowledgement section of articles (H1a). Authors tend to acknowledge other individuals with the same gender and also tend to co-author articles with scholars of the same gender (H1b). However, while the international relations journal (ZIB) shows a heterophily effect with regard to acknowledgments, the political theory journal (ZPTH) indicates heterophily relations regarding co-authors. The gender heterophily effect in the ZIB might be explained by the higher number of female scholars in the field and thus the sheer number of women who are able and willing to comment other peoples work. This heterophile acknowledgement pattern might indicate a greater gender balanced representation of female scholars and participation in epistemic communities such as the German IR field. The finding for the ZPTH might be explained by the publication of specific thematic sections in the journal or the limited data availability, but this has to be further investigated.

Regarding the institutional affiliation we observed rather homophile relations in co-authorship and acknowledgment links (H2). Researchers are more likely to cooperate with their peers in the same institution and also acknowledge their feedback and comments than co-authoring with or acknowledging scholars from other institutions. Again, the political theory journal (ZPTH) shows a heterophile effect, but this effect is rather small and might be a data artifact due to the small dataset and sparse collaboration network in the ZPTH.

Our last hypothesis was related to scholars' status (H3). The findings support our expectation that these are rather homophile relations, but with crucial exceptions for the professors status group and the political theory journal. In the ZPTH journal, the acknowledgment links are rather heterophile across the postdoctoral and professor status groups (H3) which might also be explained by the relative small size of the sub-disciplinary community in Germany and, hence, the number of individuals who can be asked to comment research articles (and are subsequently acknowledged for this). We also detect a heterophile effect for the professors' status group in the other two journals.

Therefore, we do not only corroborate the expected difference between collaboration patterns in theoretical work and in empirical-oriented research (A. Díaz-Faes & Bordons, 2017; Cronin et al., 1993), we also show that acknowledgements and co-authorships occur under different conditions in regard to status groups.

We can conclude that we identified several homophily effects, most notably for the institutional affiliation of scholars, but also report mixed homophile findings for gender and status with regard to acknowledgements and co-authorship. This may provide ground for further empirical investigation of the three conditions and comparative studies of acknowledgements and co-authorship.

Our study has several limitations. The empirical part of the paper draws on a rather small dataset. Therefore, our study has an explorative character highlighting what a first attempt to collect systematically data on peer interactive communication

as one type of acknowledgements can detect in scientific collaboration. Acknowledgements had to be extracted manually and further information on the acknowledged persons were collected individually. This allows us to extend the amount of information on authors' attributes other studies use, although they rely on a far higher number of publications. The study provides a first step for further research on different types and conditions of collaboration.

Future studies on acknowledgements could use extended data sources such as books and edited volumes. They could also examine the complete reward triangle (authorship, acknowledgement, citation, social media presence) (Cronin & Weaver, 1995; Desrochers et al., 2018) to provide a full picture of academic collaboration behavior. Additionally, tools for semi-automated extraction and recognition of different types of acknowledgement could help to investigate these informal cooperation actions on a larger scale. Yet, the larger the sample the more issues arise concerning name disambiguation providing severe challenges to data validity.

Another limitation is that we cannot shed light on the black box of the concrete act of acknowledgement. Mentioning colleagues in the respective section is an intentional act on the author's side with no restrictions from the journal side who and how many are named (or not). While the intentional act to acknowledge others might lead to a 'reputational show off' that names researchers who have not provided any comment, but are given credit to mark off their academic reputation on the author. On the other hand, 'acknowledgement amnesia' (Costas & Leeuwen, 2012, p. 1650) should also be considered. While preparing the manuscript scholars might just forget

some people who have actually provided valuable comments or they do not feel obliged to acknowledge others. What authors motivates to acknowledge others and how they consider whom to acknowledge was not possible to study with our data. Hence, it might be worth investigating such acknowledgement behavior in a qualitative way by conducting interviews with authors and acknowledged individuals.

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