

Exploring international collaboration and language dynamics in Digital Humanities: insights from co-authorship networks in canonical journals

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Abstract

Purpose – This paper presents a follow-on study that quantifies geolinguistic markers and their apparent connection with authorship collaboration patterns in canonical Digital Humanities (DH) journals. In particular, it seeks to detect patterns in authors' countries of work and languages in co-authorship networks.

Design/methodology/approach – Through an in-depth co-authorship network analysis, this study analysed bibliometric data from three canonical DH journals over a range of 52 years (1966–2017). The results are presented as visualised networks with centrality calculations.

Findings – The results suggest that while DH scholars may not collaborate as frequently as those in other disciplines, when they do so their collaborations tend to be more international than in many Science and Engineering, and Social Sciences disciplines. DH authors in some countries (e.g. Spain, Finland, Australia, Canada, and the UK) have the highest international co-author rates, while others have high national co-author rates but low international rates (e.g. Japan, the USA, and France).

Originality/value – This study is the first DH co-authorship network study that explores the apparent connection between language and collaboration patterns in DH. It contributes to ongoing debates about diversity, representation, and multilingualism in DH and academic publishing more widely.

Keywords Digital Humanities, Network analysis, Co-authorship, Geolinguistic effects

Paper type Article



1. Introduction

The “role of difference” in Digital Humanities (DH) (e.g. gender, race, geolinguistic diversity, and intersectionality) has been much discussed. DH scholars and organisations have started to make efforts to address the need for inclusive representation and community diversity, especially in the past few years (O’Donnell *et al.*, 2015; ADHO, 2022). The voices of diverse DH researchers and practitioners, historical and contemporary, have started to be heard through diverse publication channels, both formal (Galina, 2013; Nyhan, 2023; Weingart, 2018) and informal (Ross *et al.*, 2011; Bailey *et al.*, 2016; Liu, 2018) communication channels. These connections and collaborations form different networks that have been studied and visualised from various perspectives (Grandjean, 2016; Gao *et al.*, 2017, 2018; Kemman, 2018).

Previous work has sought to statistically investigate the co-authorship patterns that manifest in three canonical DH journals (*Computers and the Humanities (Chum)*, *Literary and Linguistic Computing (LLC)*, and *Digital Humanities Quarterly (DHQ)*) over a range of 52 years (1966–2017) (Gao *et al.*, 2022). This research found that although single-authored papers were predominant in this period, numbers of co-authored papers were increasing (Nyhan and Duke-Williams, 2014). Further research showed the apparent connection between gender and collaboration in the DH community, and found that women play more central roles and act as main bridges in the collaborative publication networks of the aforementioned journals (Gao *et al.*, 2022).

Researchers are known to benefit from diverse interpersonal and institutional connections and networks, which have distinctive advantages for creating and sharing knowledge (Gao *et al.*, 2022, p. 327). As DH scholarly activities become more global, it is necessary to further research co-authorship patterns across different regions and languages, to gain more knowledge about how and why DH authors from different geolinguistic backgrounds collaborate. This follow-on study, therefore, extends previous DH co-authorship network studies by adding authors’ country of work as a new dimension of analysis.

As has been emphasised in previous publications, the journals that are focalised in this present study are understood to be authoritative ones that can help us to build an empirical picture of the publication activities of a substantial cohort of DH researchers. We do not, however, suggest that the work we present here is a comprehensive picture of DH co-authorship in its totality. Nor do we suggest or imply that DH publications and scholars not included in our sample are in any way marginal to the global and diverse DH communities.

2. Research context

Within the domain of academic collaborations, the connections amongst authors originating from distinct institutions and geographical locations, while engaging in communication through diverse languages, manifest varying degrees of cohesiveness. Authors from different institutions and locations who speak different languages tend to have weak collaboration ties. Collaboration ties between those in the same location who speak the same languages are generally stronger (Tuire and Erno, 2001, p. 494). Factors such as language and geographical location (and sometimes culture) are believed to be deeply intertwined with each other, and it is not pragmatic to distinctly separate them when analysing the formation of a community (Goodman, 2011, p. 235). This study, therefore, focuses on both the author’s country of work and their publication language and positions these as important geolinguistic factors in collaboration patterns.

As a particularly language-oriented field (or at least for some DH topics), geolinguistic factors are believed to be critical determinants of DH community formation (Flanders, 2016; Pitman and Taylor, 2017; Tello, 2017). Despite advances in the provision of, and access to, digital communication technologies, country of work remains a key determinant that influences scholarly collaboration practices and outcomes. Pan *et al.* conducted a large-scale study that investigated the relationship between academic collaboration and scholars’ country of work (Pan *et al.*, 2012). They not only found a strong correlation between authors’

affiliation and their collaboration strengths (i.e. the closer the proximity of the affiliated locations, the more the collaboration between scholars), but they also discovered a linear growth between national funding and the scholarly productivity of a country (i.e. the more research funding a country invests, the greater its scholarly output).

Nevertheless, many factors may combine to explain why some scholars or groups of scholars rise to prominence. The Matilda Effect, which refers to the systematic bias and under-recognition of the contributions made by women scientists throughout history (Rossiter, 1993), is an example of the “cumulative advantages of academic capital” (Merton, 1968, p. 62) that bolster some members of the academic community and not others. Such cumulative advantages are likely to be intersectional, and to comprise geolinguistic factors, from which we can conclude that country of work may well play an important part in academic communication and collaboration. Thus, by looking into the country of work in DH, as this research does, new perspectives on the local and global dimensions of DH as a field can be opened up.

Up to now, existing scholarship has presented a somewhat unidimensional analysis of the geolinguistic dimensions of DH co-authorship patterns. Using data collected from ADHO (Alliance of Digital Humanities Organizations) conferences, Terras showed that Anglophone countries accounted for the majority of presenters at DH conferences from 1996 to 2005 (Terras, 2006). The Anglophone-country-dominant distribution can be found in other DH geographic studies, e.g. Clavert (2012), De la Cruz *et al.* (2015), Weingart and Eichmann-Kalwara (2017).

Terras sought to visualise in an infographic (Terras, 2012), the geographical proliferation of DH activities and institutions that could be noticed from about 2010 onwards. This infographic was critiqued in the context of wider debates about DH as a site of neo-colonialist knowledge production and gatekeeping (O'Donnell *et al.*, 2015). As Risam wrote of the map:

This map is often used as evidence of the global scope of digital humanities, touting the existence of 114 centers in 24 countries. The heavily circulated image is taken as the mappa mundi of digital humanities [...] A critical reading of the map, however, reveals its implication in colonial world making in digital humanities, positioning the United States—and to a lesser extent the United Kingdom, Canada, and Australia—as the global center of digital humanities, and relegating the rest of the world to its peripheries. [...] The message seems clear: digital humanities is the domain of the Global North (Risam, 2018, pp. 72-73).

More recent scholarship has often sought to contest the hegemony of Anglo-American DH. O'Donnell *et al.* have drawn attention to the unsteady basis of DH's rhetorical claims about collaboration and internationalism, arguing:

[...] while practitioners of the digital humanities tend to define their disciplines as being both highly collaborative and highly international [...] it is for the most part the case that our international and collaborative activity is conducted along a primarily east-west axis among a relatively small number of mostly contiguous high-income economies in the northern hemisphere: Japan, Taiwan, South Korea, Canada, the United States, the countries of western and central Europe, and, in the South, Australia and New Zealand. (O'Donnell *et al.*, 2015, pp. 493)

Galina, for example, pointed to the significant contributions of the Spanish-speaking community to DH scholarship, and she emphasised the importance of diversity, geography, and languages other than English within the DH context (Galina, 2014, pp. 312–313).

Revealing how DH may be considered as a microcosm for questions of diversity and representation right across academia, the Anglophone-dominated geolinguistic distribution in DH is consistent with other academic fields. An increasingly high flow of submissions to English-language journals can be detected, and many of these submissions have greater influence compared to those in other languages in the same disciplines (Bocanegra-Valle, 2014, p. 67). English is the dominant global medium of scholarly publication (Li, 2019). Studies

have shown that in non-Anglophone countries, e.g. Poland (Duszak and Lewkowicz, 2008), Portugal (Bennett, 2011), Iceland (Ingvarsdóttir and Arnbjörnsdóttir, 2013), Spain (Moreno *et al.*, 2012), and others (Flowerdew, 1999), there is increasing pressure to publish academic works in English, particularly with regards to academic advancement (Mahony, 2018). Problematic is also that English publications are often assumed to be of inherently higher status than those in other languages.

Many scholars claim that this English premium influences opportunities for promotion and research grant capture (Flowerdew, 2000, p. 127; Mahony and Gao, 2018). Speaking to the plausibility of such claims, some argue that whether scholars' first-language is English or not, the majority would probably benefit from publishing in English to gain visibility both in the international academic community and recognition in their own local community (Bocanegra-Valle, 2014, pp. 65–66). Some scholars are concerned that writing in English for non-Anglophone scholars not only creates barriers for them to disseminate their work, it also poses challenges and limits participation when they communicate with other scholars (Uzuner, 2008, p. 250). Some even consider that non-Anglophone speakers are “linguistically disadvantaged” compared to Anglophone scholars when it comes to publishing in international journals (Ferguson *et al.*, 2011, p. 45). Many studies criticise this viewpoint and argue that it can lead to discrimination and isolation in the global academic environment (Ammon, 2012, p. 333). More and more studies have raised the question of extending the meaning of “international” beyond just the Anglo-American countries (Paasi, 2005; Earhart, 2018). This movement indicates the growing momentum towards change, and the support that exists for the development of a more diverse and representative global academic environment. DH also aims to contribute to such a movement (Estill *et al.*, 2022; ADHO, 2022).

Weingart and Eichmann-Kalwara (2017) have argued that conference location might be a key factor to attract more diversified authors in DH. For example, when DH2015 was held in Australia, it attracted the most geographically diverse distribution of scholars compared to previous years; the number of scholars from Asia almost doubled in proportion while delegates from Oceania were seven times greater than the overall average (Weingart, 2014a).

Such geographic influence is more obvious in regional conferences. Most participants at the Taiwan DH conferences (DADH2009–2012) were Chinese and Japanese (Chen and Hsueh, 2013), while 80% of presenters at the German DH conference (DHd2016) were affiliated with German institutions (Tello, 2016). At the DHBenelux conferences (2016–2018), more than 90% of authors were from the Benelux region (the Netherlands, Belgium, and Luxembourg) (Kemman, 2016), while at the Digital Humanities in the Nordic Countries (DHN) conferences (2016–2018), almost all scholars were based in Nordic countries (Mäkelä and Tolonen, 2018).

However, although these dispersions are anticipated in geolinguistic specific activities and demonstrate that non-Anglophone DH communities flourish, to contribute to the global development towards a more diverse environment for DH, we need to look back and focus on the international events and publications that involve different linguistic-cultural contexts, which also echo the recent discussion by Estill *et al.*:

As more digital humanities conferences emerge with various national, regional, linguistic, thematic, disciplinary, methodological, and other foci, we believe that our international organization should rethink the point of the conference through the perspective of diversity, equity, inclusion and decolonization. (Estill *et al.*, 2022, para.5)

In this article, we contend that it is necessary to explore how and why DH scholars engage with different linguistic-cultural contexts in international events and publications. By expanding the bibliometric dataset beyond existing efforts, this study, therefore, revisits this question from a multidimensional perspective that pushes beyond simple measures of geolinguistic distribution.

3. Methodology

Following previously published work (Gao *et al.*, 2022), this study applies co-authorship network analysis but here to explore the geolinguistic structure of the DH community. The applications used are VOSviewer 1.6 to visualise the networks and Gephi 0.9.2 to calculate the betweenness centrality.

3.1 Data collection

We selected all the authors that have published research articles in three well-known Digital Humanities journals – *Computers and the Humanities (Chum)* 1966–2004, *Digital Scholarship in the Humanities (DSH)* 1986–2017 and *Digital Humanities Quarterly (DHQ)* 2007–2017 – as the study subject.

This selection of Anglophone journals is narrow and not representative of the field as a whole. Nevertheless, Anglophone journals reflect one important aspect of DH global development, as many international publications in DH are in English, which involve different linguistic-cultural contexts to be studied. To clarify, we are analysing geolinguistic co-authorship patterns in Anglophone journals and do not here address co-authorship patterns in multilingual journals or journals written in languages other than English. Further studies might address other international geolinguistic journals, such as *Umanistica Digitale*, or *Humanités Numeriques*. We recognise this limitation of our study and proceed to carefully contextualise our findings within this scope.

As this is a follow-on study, we have used a previously published dataset (Gao *et al.*, 2022), and the publication period covers 52 years ranging from 1966 to 2017. Our aim is to study the foundational developments in the field as far as they were captured, albeit incompletely, in selected Anglophone journals. The selection of this period was made with careful consideration, allowing the findings presented here to be brought into conversation with earlier studies that have been conducted on this same dataset. In total, 2,527 articles were collected (1,035 articles from *Chum*, 1,195 from *LLC/DSH*, and 297 from *DHQ*).

3.2 Data cleaning

After applying Author Name Disambiguation method (Strotmann *et al.*, 2009; Zhao and Strotmann, 2011, p. 120) to efficiently deal with homonymy and synonymy issues, we carefully associated the country of work to author names. More specifically, a list of countries and regions is used based on the information from the United Nations Member States webpages [1]. If the author has affiliations in more than one country, the most frequently used country is selected. For example, if a researcher lists affiliations in both the UK and Australia, this study selects the UK as their affiliated country if they have published most frequently with the UK affiliation. If two or more countries are used with equal frequency in the affiliations, the selection is then made based on personal knowledge and a web search (e.g. the most recent affiliation is selected). Where a country no longer exists (or is now identified by a different name), such as the Soviet Union, as noted for example in an LLC article (Tambovtsev, 1987), then the name of the current country of the institution is used (in this case, the Russian Federation). If no country information could be found, then the author is assigned to the “unknown” group. In our analysis, we have treated the “unknown” category as a separate group when conducting general statistical analysis but this group are not compared when we analyse the co-authorship patterns in the later sections.

3.3 Data analysis

From previous studies of the same data, we know that 38% (960 out of 2,527 articles) are multi-authored and that there has been a steady growth in co-author rate over the 52-year period (Gao *et al.*, 2022, p. 329). Overall, 3,382 unique authors have been weighted by counting the total number of articles each author published in the dataset (i.e. full publication count).

Table 1 shows the top 30 authors in our dataset ranked by the number of publications with “Country of Work” information added; the complete table can be found in Appendix. The author names have been used as node labels, and the size of the node has been weighted by its number of articles.

3.4 Network visualisation

An edge of a co-authorship network is formed by two scholars who co-authored an article, and for every article co-authored by those authors, the value of their co-authorship edge increases by 1. The undirected edges of each pair of co-authors were calculated and the matrix structure constructed. The complete network data can be found in Appendix.

Amongst the 3,382 identified authors, 661 (19.5%) were connected to the main network of co-authors. Most of the authors who published more than one article in our dataset are connected to the main co-authorship network, although some are part of smaller networks that are disconnected from the main one, e.g. John Burrows, Gordon Dixon, Robert J. Valenza, Roberto Busa. Figure 1 shows the main co-authorship network with country of work information.

As shown in Figure 1, some nodes are important bridges of the network, such as Susan Hockey, Julianne Nyhan, Melissa Terras, Edward Vanhoutte, and John Nerbonne. To better investigate the roles that scholars play in research collaboration, it is beneficial to apply centrality measures. Studies have shown promising advantages when using centrality indices to analyse and interpret co-authorship networks (De Stefano *et al.*, 2011; Abbasi *et al.*, 2012), and we shall discuss this in the following section.

4. Results and discussion

The country of work distribution will assist in determining the international collaboration patterns in DH among those who published in the journals under examination. There are

	Author name	Country of work	No. articles		Author's name	Country of work	No. articles
1	Melissa Terras	UK	27	16	John Bradley	UK	11
2	Susan Hockey	UK	22	17	Paul Fortier	Canada	11
3	M.W.A. Smith	Unknown	20	18	Lou Burnard	UK	11
4	Mark Olsen	USA	17	19	Christopher Howe	UK	10
5	John Nerbonne	USA	16	20	Lisa Lena Opas-Hänninen	Finland	10
6	David Holmes	USA	16	21	Stan Ruecker	USA	9
7	Thomas N. Corns	UK	16	22	Julia Flanders	USA	9
8	Edward Vanhoutte	Belgium	15	23	Whitney Bolton	unknown	9
9	Willard McCarty	UK	14	24	Barron Brainerd	USA	9
10	Peter Robinson	Canada	14	25	Raymond Siemens	Canada	8
11	Julianne Nyhan	UK	13	26	Geoffrey Rockwell	Canada	8
12	Estelle Irizarry	Costa Rica	13	27	Michael Sperberg-McQueen	USA	8
13	Susan Brown	Canada	12	28	Tony McEnery	UK	8
14	Fiona Tweedie	UK	12	29	Gregory Crane	USA	8
15	Claire Warwick	UK	11	30	R.L. Widmann	USA	8

Table 1.
The top 30 authors by the number of publications in journals *Chum*, *LLC/DSH* and *DHQ*, 1966–2017

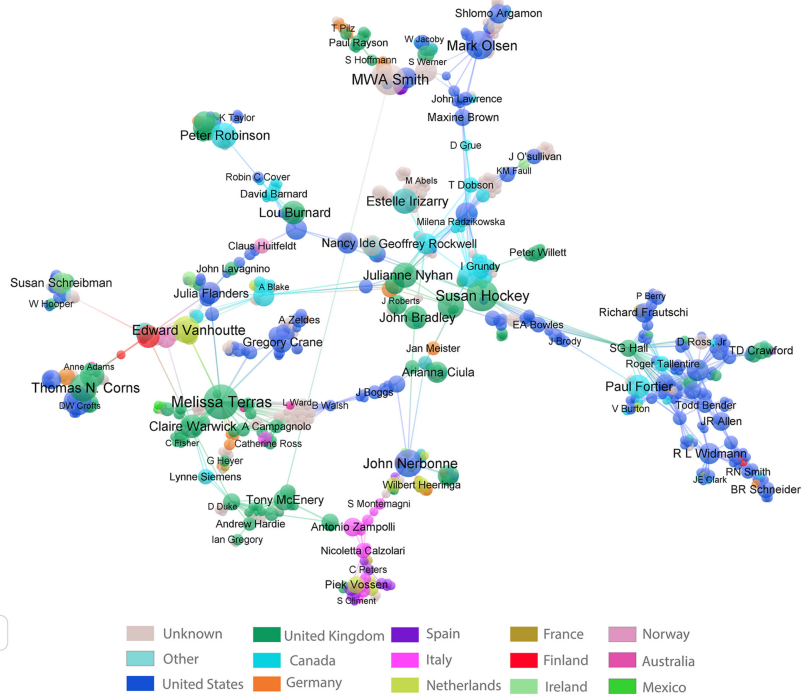


Figure 1. DH co-authorship network with country of work information, data from journals *Chum*, *DSH/LLC* and *DHQ* (1966–2017), graph created by VOSviewer 1.6

3,382 unique authors in our dataset, and more than half of those have been affiliated with countries where English is a dominant language. There are 1,044 USA authors (30.9%), 461 UK authors (13.6%), 199 Canadian authors (5.9%), and 64 Australian authors (1.9%). There are also many authors who have affiliation in Germany (5.5%), France (4.5%), the Netherlands (3.5%), Italy (3.1%), Spain (2.2%), and Japan (2.1%). [Figure 2](#) below shows the

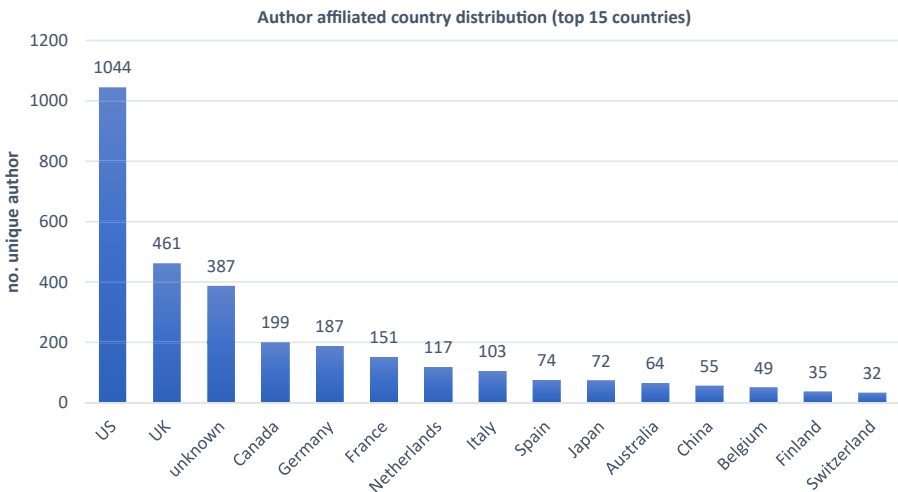


Figure 2. The number of unique authors in each affiliated country (top 15), data from journals *Chum*, *DSH/LLC* and *DHQ* (1966–2017)

number of unique authors in each affiliated country (top 15), and the complete table of all the 62 countries is included in [Appendix](#).

[Figure 2](#) provides a general country of work distribution based on publications in *Chum*, *DSH/LLC*, and *DHQ*, and its robustness is emphasised by how it agrees with the country distribution detected by previous studies, e.g. ADHO annual attendance ([Weingart, 2012, 2013, 2014b, 2015, 2016](#)), as well as DH journal publications ([De la Cruz et al., 2015; Tang et al., 2017](#)).

From the perspective of the number of articles, amongst the 2,527 articles in the current dataset, 960 of them are co-authored (38%) and 244 articles have been co-authored internationally (i.e. articles published with scholars from more than one country, 9.7% of the total articles); this figure does not include the cases when an individual scholar affiliates with multiple countries, as explained in the methodology section above. [Figure 3](#) shows the annual total number of the internationally co-authored articles in a line graph (see [Appendix](#) for more details).

As shown in [Figure 3](#), although fluctuating, the proportion of internationally co-authored articles has been growing generally during the 52-year period, with a clear rising trend. From 0% in 1966–1972, gradually increasing to 8.7% in 1985, 12.2% (1996), 23.1% (2000), 25% (2008), it peaked at 34.6% (2012) and finally reached 23.7% (2017). The apparent variations are largely due to year-to-year fluctuations, but it suggests a sustained increase in international collaboration in DH based on the calculated linear regression. Although the average mean is 9.7%, the numbers in the later period (especially after 2000) are higher than numbers in other disciplines during the same time. For example, based on a comprehensive range of globally published Science and Engineering journals indexed by Scopus in 2000, international co-authored papers accounted for 15% ([US National Science Board, 2000](#)), while in DH, it was 23.1%. That figure rose to 19% in 2012 and 22% in 2017, while the numbers in our DH dataset were consistently higher with 35 and 24% in the respective years ([US National Science Board, 2020](#), p. 15). Considering that co-authorship in Science and Engineering fields should normally be more frequent and international than the norm ([Glänzel and Schubert, 2005a](#)), the consistently higher proportion of internationally co-authored articles in DH presents a surprisingly worldwide and diverse collaboration pattern, though we acknowledge that this pattern is one that reflects a primarily Anglo-American geolinguistic lens and context.

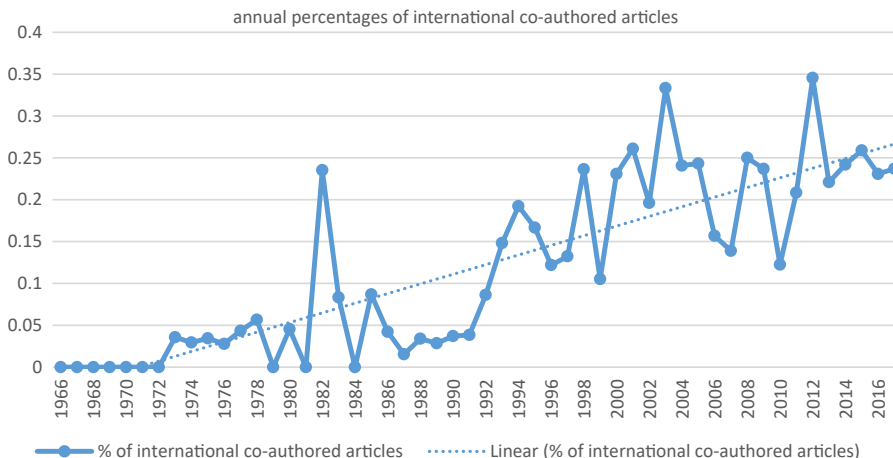


Figure 3.
The annual percentages of the international co-authored articles, data from journals *Chum*, *DSH/LLC* and *DHQ* (1966–2017)

Moreover, the DH international co-authored share is notably higher than many fields in Social Sciences. Henriksen has analysed the international share of co-authorship in 4.5 million articles published from 1980 to 2013 indexed in the Social Science Citation Index (SSCI), Clarivate, Web of Science (Henriksen, 2016). Figure 4 is a comparative line graph that combines the results of this study with the percentages published in Henriksen's research.

As shown in Figure 4, although the DH percentages fluctuate significantly over the period due to the different scales of the two studies, DH percentage values are generally higher than most of the disciplines in Henriksen's study (1980–2013), such as Transportation, Geography, Urban Studies, Law, Political Science, International Relations, Criminology and Penology. Fields like History, Cultural Studies and Nursing are amongst the lowest (Henriksen, 2016). The figure suggests a much greater expansion of DH research collaboration than seen in other fields around the world. Although the overall international share of co-authorship has been shown to be rising in all disciplines (Glanzel, 2001; Chen *et al.*, 2019), DH is one of the fields with considerably more global collaboration. While DH scholars may not collaborate as frequently as those in other disciplines, when they do collaborate, those collaborations tend to be more international.

Some have claimed that international co-authorship produces papers with higher citation rates and possibly higher impact too (Glanzel, 2001; Glanzel and Schubert, 2001; Sugimoto *et al.*, 2017), even though national collaborations across industries (i.e. academic, government and industry collaboration) also have higher citation and impact (Perkmann and Walsh, 2009; Frenken *et al.*, 2010). To investigate how to further improve the level of international co-authorship in DH, it is important to analyse which groups of DH authors have contributed most. Figure 5 demonstrates the different groups of authorship in each affiliated country. In particular, the green areas indicate the number of scholars who have internationally co-authored (number label as shown in chart).

As shown in Figure 5, countries, such as the UK, the USA (despite being low in overall proportion), Canada, Germany, and Spain (significantly high in proportion) contribute the most internationally co-authored articles. The USA, despite having the highest number of scholars and co-authored scholars in this dataset, ranks second only, 164 (after the UK, 168),

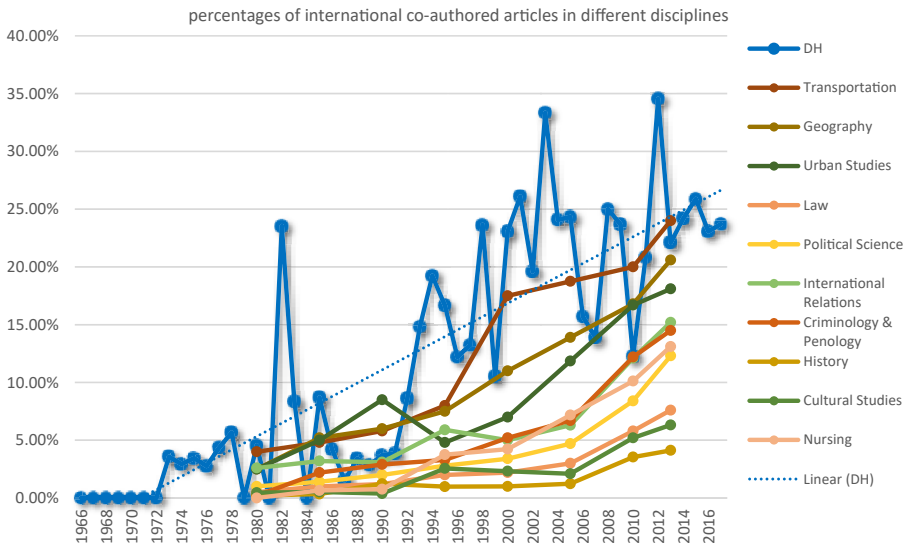


Figure 4. The annual percentages of the international co-authored articles in DH combined with the percentages of other disciplines 1980–2013 in Henriksen's study (Henriksen, 2016)

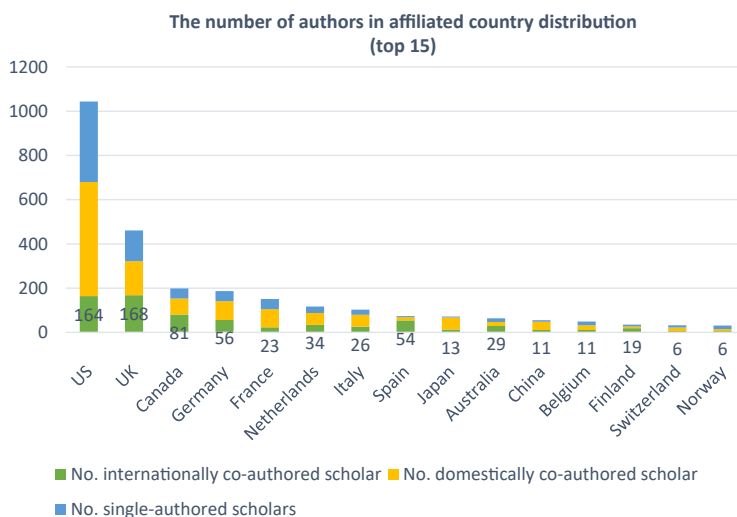


Figure 5. The different author distributions in each affiliated country (top 15), data from journals *Chum*, *DSH/LLC* and *DHQ* (1966–2017)

when it comes to the number of international co-authoring scholars. The difference between the UK and the USA shows that whilst language has its influence in publications, the geographic location is also a major consideration, and we unpack this in more depth in the later sections.

Table 2 shows the top 15 countries with the most scholars in the dataset, and they are ranked by their international co-authorship rate. Columns from left to right present the number of unique scholars; the number of co-authored scholars (i.e. scholars who co-authored articles); the number of international co-authored scholars (i.e. scholars who have co-authored an article with collaborators affiliated in a different country excluding individuals who have multiple affiliations); the percentage of co-authored scholars (i.e. number of unique scholars divided by the number of co-author scholars); and the percentage of international co-authored

	No. unique scholars	No. co-authored scholars	No. international co-authored scholars	Co-authored %	International co-authored %	
1	Spain	74	69	54	93.2%	73.0%
2	Finland	35	27	19	77.1%	54.3%
3	Australia	64	47	29	73.4%	45.3%
4	Canada	199	153	81	76.9%	40.7%
5	UK	461	322	168	69.9%	36.4%
6	Germany	187	141	56	75.4%	30.0%
7	Netherlands	117	88	34	75.2%	29.1%
8	Italy	103	80	26	77.7%	25.2%
9	Belgium	49	32	11	65.3%	22.5%
10	China	55	48	11	87.3%	20.0%
11	Norway	31	15	6	48.4%	19.4%
12	Switzerland	32	22	6	68.8%	18.8%
13	Japan	72	68	13	94.4%	18.1%
14	USA	1,044	680	164	65.1%	15.7%
15	France	151	105	23	69.5%	15.2%

Table 2. The top 15 countries with the most scholars ranked by the international co-authored rate, data extracted from journals *Chum*, *LLC/DSH*, and *DHQ*, 1966–2017

scholars (i.e. the number of unique scholars divided by number of international co-authored scholars) in the current dataset. For the complete table, see [Appendix](#).

From [Table 2](#), although the sample size of each country varies, we can see that 73% of scholars affiliated in Spain have co-authored articles with scholars from other countries, making Spain the most internationally collaborative country in the current dataset. Finland, Australia, Canada, and UK are ranked the second to the fifth, respectively (54.3%, 45.3%, 40.7%, 36.4%). However, there are some interesting cases with high co-author rate but low international co-author rate, i.e. frequent co-author activities that tend to be limited to national spheres. For example, Japan has the highest co-author rate (94.4% of Japanese scholars have co-authored articles), but its international co-author rate is the third last among the 15 countries (suggesting that only 18.1% of Japanese scholars in our dataset have published with scholars affiliated outside Japan). Although the USA has the highest overall number of scholars in our dataset (30.9%), only 15.7% of them have ever co-authored articles with scholars outside of the USA. Thus, the USA ranks second to last. Similarly, scholars affiliated in France, Switzerland, and China have relatively high co-author rates but low international co-author rates. Suggesting that this finding is not an anomaly of our dataset, this country ranking is similar to that provided by the US National Science Board in 2020 ([US National Science Board, 2020](#)). This ranking is based on a wide range of Science and Engineering journals in Scopus and shows that the most internationally collaborative countries are the UK (62%), Australia (60%), Canada (56%), Germany (53%) and Spain (53%), and similarly, the USA has an international co-authorship percentage of 39% which is below the average ([US National Science Board, 2020](#), p. 15).

Why do the majority of American or Japanese (or French, Chinese, etc.) scholars choose to actively collaborate in their national or regional sphere? Why do people affiliated in, e.g. Spain, Canada, the UK, Germany, and the Netherlands, choose to collaborate more frequently with scholars in other countries? Answering this complex question would require further primary research into dynamics like funding bodies, international relations, languages, policies, personal connections, etc. We suggest that these questions are important and may be addressed by future studies. The current study focuses on finding which country DH authors prefer to collaborate with based on co-authorship, and it seems that language and country of work are key determinants in this.

[Table 3](#) shows the most frequent co-authorship country pairings. It is not surprising to find that predominately English-speaking countries, especially the USA and the UK, form most of the co-authorship country pairs. That this is indeed an artefact of our dataset is this

Rank	Country pair	No. co-authored articles	Rank	Country pair	No. co-authored articles
1	UK – USA	36	11	Netherlands –Germany	7
2	USA – Canada	29	12	UK –China	6
3	UK –Canada	19	13	Netherlands –Belgium	5
4	UK –Germany	19	14	Netherlands –Italy	5
5	USA – Australia	12	15	Germany –Canada	4
6	USA – Germany	10	16	UK –Finland	4
7	USA – Ireland	10	17	UK –Ireland	4
8	UK –Australia	8	18	Spain –Italy	4
9	UK –Netherlands	8	19	UK –Japan	4
10	USA – Netherlands	8	20	Spain –Netherlands	4

Table 3. The top 20 most frequently co-authored international country pairs, data extracted from journals *Chum*, *LLC/DSH*, and *DHQ*, 1966–2017

case because it was collected from English-language journals. However, our dataset does suggest that different Anglophone countries do seem to collaborate differently. For example, scholars in the USA often form DH authorship partnerships in English-speaking countries (e.g. the UK, Canada, Australia), while those in the UK collaborate both with scholars in predominately English-speaking countries as well as with scholars in non-Anglophone countries (e.g. Germany, the Netherlands, China, Finland, Japan), and they do this more often than those in the USA. Over the longer term, the impact that Brexit may have on this pattern, for example as a result of changes to research funding participation and eligibility, remains to be seen.

Moreover, in terms of national co-authorship patterns, scholars who are affiliated with a UK institution tend to collaborate more often than scholars affiliated with other countries. Table 4 shows the top 20 countries with nationally co-authored publications in this dataset and shows that the UK has more nationally co-authored articles than the USA. One also needs to bear in mind that the number of USA authors in this dataset (1,044 individuals) is more than double that of UK authors (461).

If we see the collaboration from the perspective of network analysis, the measure of *betweenness centrality* offers a clearer interpretation. Figure 1 (in section 3.4 above) shows the co-authorship network colour-coded with affiliated country information, and Table 5 provides the top 15 countries with the most scholars ranked by *betweenness centrality*.

The affiliated country distribution on the co-authorship network is somewhat similar to that of the total number of authors in the dataset, but we can see the clear increase in the proportion of UK authors. USA authors account for 31.2% of the nodes on the network and this figure is similar to the proportion of USA authors in the total number of collected authors (30.9%), while there are 18.9% of UK authors on the network, and this number is higher than its percentage in the general author collection (13.6%). This difference indicates that there is a higher proportion of UK authors connected to the co-authorship network.

As mentioned, *betweenness centrality* is a network metric that quantifies the extent to which a scholar acts as a bridge connecting other scholars within the network. A higher *betweenness centrality* suggests that a scholar plays a more critical role in connecting others. Conversely, a *betweenness centrality* of 0 indicates that a scholar does not serve as a bridge between others in the network. For instance, Belgium’s high *betweenness centrality* suggests that within this scholar network, the two scholars from Belgium often act as intermediaries connecting scholars from other countries.

Rank	Country pair	No. co-authored articles	Rank	Country pair	No. co-authored articles
1	UK–UK	107	11	Italy–Italy	12
2	USA–USA	106	12	China – China	10
3	Canada –Canada	57	13	South Korea–South Korea	8
4	Germany–Germany	47	14	Finland–Finland	6
5	Netherlands –Netherlands	32	15	Norway–Norway	6
6	Australia–Australia	21	16	Japan–Japan	5
7	Spain –Spain	18	17	Singapore–Singapore	5
8	Belgium–Belgium	13	18	Switzerland–Switzerland	5
9	France–France	12	19	Israel–Israel	4
10	Ireland–Ireland	12	20	Sweden–Sweden	4

Table 4. The top 20 nationally co-authored countries, data extracted from journals *Chum, LLC/DSH*, and *DHQ*, 1966–2017

Table 5.

The top 15 countries ranked by the betweenness centrality, data extracted from journals *Chum*, *LLC/DSH* and *DHQ*, 1966–2017

		Total scholar	Co-authored %	International co-authored %	No. scholar on the network	Betweenness centrality (average no. of pairs)
1	Belgium	49	65.3%	22.5%	2	7521.57
2	Canada	199	76.9%	40.7%	54	4233.65
3	UK	461	69.9%	36.4%	126	3713.76
4	Italy	103	77.7%	25.2%	14	2715.79
5	USA	1,044	65.2%	15.7%	206	2088.80
6	Norway	31	48.4%	19.4%	4	1884.98
7	Germany	187	75.4%	30.0%	24	1036.80
8	Spain	74	93.2%	73.0%	16	926.55
9	Netherlands	117	75.2%	29.1%	15	733.74
10	France	151	69.5%	15.2%	8	0
11	Japan	72	94.4%	18.1%	1	0
12	Australia	64	73.4%	45.3%	4	0
13	China	55	87.3%	20.0%	1	0
14	Finland	35	77.1%	54.3%	7	0
15	Switzerland	32	68.8%	18.8%	0	0

Although the choice to publish in one or more of the three DH journals under examination here is each scholar's individual choice, these choices can be greatly influenced by various factors, and national wealth is believed to be a significant one (Ammon, 2006, p. 7). Although this association is not uncontroversial (Trajtenberg, 1990; Harvey and Green, 1993), many find De Solla Price's argument about the relationship between the number of academic publications and national wealth persuasive (Stephan, 1996; Nickerson, 1998; Börner *et al.*, 2005). De Solla Price's argument is that:

[...] the share each country has of the world's scientific literature by this reckoning turns out to be very close—almost always within a factor of 2—to that country's share of the world's wealth (measured most conveniently in terms of GNP). The share is very different from the share of the world's population and is related significantly more closely to the share of wealth than to the nation's expenditure on higher education. (De Solla Price, 1986, p. 142)

Although, with the data to hand, at this stage it is difficult to justify this claim in the DH environment, we can see that countries with the most DH publications are amongst the “wealthiest” (Ammon, 2006, p. 7), e.g. the USA, UK, Canada, Germany, France, the Netherlands, Italy, Spain, and Japan (see Figure 2 and Table 2). In particular, as arguably the economically strongest language community in the world, Anglophone countries combined have the most DH publications, as well as co-authored and internationally co-authored publications, which might be simply because the selected journals are published in English. However, when compared to the UK (36.4%) and Canada (40.7%), why does the USA have the second lowest internationally collaborative rate (15.7%)?

Some argue that this is a problem of scientific size and suggest that the more scholars a country has, the less need there is for international collaboration, as Melin suggested:

It is generally assumed that there is a negative correlation between national scientific size and amount of international research collaboration: The larger the size is of the national scientific arena, the lesser the amount of international research collaboration. (Melin, 1999, p. 161)

In 2019, the UK had a population of 66.44 million, while Canada had 37.59 million. The USA, however, had almost ten times the population of Canada (327.2 million in 2018) (Roser *et al.*, 2020). In the UK, 42% of the population have higher education qualifications (UK Gov, 2017), in the USA 45.2% (US Census Bureau, 2018, p. 2018). Thus, scholars in the UK have fewer

opportunities than USA scholars to select a national collaborator and this may lead to a lower rate of national collaboration in the UK (Glänzel and Schubert, 2005b). This seems to be the same with Canada (US National Science Board, 2010). Thus, it seems explainable that more than half of UK research is produced through international collaborations (Universities UK, 2018), while the USA is often amongst the countries with the lowest international collaboration rate (US National Science Board, 2000, 2010, 2020).

Nevertheless, population differences are not enough to explain different patterns of the DH international collaboration. The case of high national and low international collaboration rates is not only associated with the USA; Japan has the largest gap (94.5% co-author rate but only 18.1% international rate), followed by China (87.3% co-author, 20% international) and France (69.5% co-author, 15.3% international) (as shown in Table 5). Is it also because these countries have a large population size? Although China and Japan are known for their high population density, their low international co-authorship rates might depend more on their languages and geographic locations than population size. Because of the difficulties of learning a foreign language, Chinese scholars may be more comfortable working with Chinese-speaking scholars, and many international collaborations in China are found to be with Chinese emigrant scholars who have moved to other countries and publish in English (Wang *et al.*, 2013). International collaboration in Japan, too, seems to be influenced by geographic location and language and Japanese scholars are noticed to collaborate more often with East Asian scholars (whose language and location is closer) than with Western scholars (Miquel and Okubo, 1994, p. 286; Zitt *et al.*, 2000, p. 639).

As for France's DH collaboration, it appears not to be possible to use population size to explain their low international co-authorship rate for they have neither a relatively large population nor a high population density. While the combination of geographic and (partial) linguistic proximity can help to interpret existing collaborations between French-speaking (and partly French-speaking) countries (e.g. France, Switzerland, Belgium, and Canada), it is unclear as to why France in particular has the lowest international co-authorship rate among the top 15 productive countries in DH in our dataset. Despite the French stereotype of not speaking English (Eurobarometer, 2012, p. 37), many scholars have discussed France's low collaboration rate with other countries such as the UK, USA, Germany, Japan, and China (Okubo *et al.*, 1992; Zitt *et al.*, 2000, p. 636; He, 2009). As Ammon showed, French is a type of international language that has been negatively impacted by Anglophone globalisation, as seen by comparing their present with their previous situation (Ammon, 2006, p. 16). Unlike speakers of languages that have never become international, Francophone scholars have arguably not yet fully adjusted to the new Anglophone dominance, especially the older generation "who have suffered a dramatic social decline" (Ammon, 2006, p. 16).

In contrast to French, the German language had been "boycotted" long before English became the internationally dominant language that it is now (Bailey *et al.*, 1986; Ammon, 2006, p. 7; Ferguson *et al.*, 2011). The "systematic exclusion of the German language from international conferences and publications" began in the wake of First World War (Schroeder-Gudehus, 1990; Ammon, 2006, p. 7). German scholars had to publish in other languages, especially English (Reinbothe, 2013). Therefore, it is not surprising to find that Germany is among the countries with high international collaboration rates (23%). This is similar to the situation where countries with non-international languages try to reach an international audience (e.g. Finland, the Netherlands, Italy, Belgium). As Ammon explained:

They have always had to communicate internationally in a foreign language. For them the present situation even has the advantage that they are no longer forced to acquire skills in several languages of science as was the case formerly, but can, with perhaps slight restrictions here and there, limit their endeavours to a single language. They therefore are not deeply worried about the hegemony of English as the international language of science but even consider it an advantage. (Ammon, 2012, p. 16)

Therefore, it is not difficult to see why Finland (54.3%), the Netherlands (29.2%), Italy (25.2%), and Belgium (22.5%) have relatively higher international collaboration rates in DH, too.

However, international collaboration is a complicated phenomenon that depends on a variety of complex factors, such as the direct benefits (e.g. language convenience, equipment and material advantages) and indirect benefits (e.g. strategic, economic, political, or other formal policies) (Georghiou, 1998). Moreover, population, language, and country are only three indicators and cannot explain fully the DH international collaboration pattern. This study is an initial investigation into *DH* international collaboration, as attested in and by our datasets, which should be further expanded in the future.

It should also be stated that the international co-author rate is influenced by various factors that cannot be adjusted by individual scholars, and there is inherently no right or wrong to having a high or low international co-author rate (Glänzel and Schubert, 2005b, p. 336). Although there is an apparent (but limited) correlation between citations and international collaboration, it is not a direct measure of research quality (Schmoch and Schubert, 2008). Moreover, many DH subjects and topics are language-specific, and so the suitability and desirability of pursuing collaborations between international scholars who speak many different languages is unclear.

So too, the samples of each country represented by this study varies. For example, in Table 5, Belgium has the highest *betweenness centrality* because it has two scholars only in the current sample. Countries such as the UK and the USA have 126 and 206 scholars on the network respectively, and the number of USA scholars is more than 100 times the number of Belgian scholars. Despite the fact that many USA and UK scholars have higher *betweenness centrality* than the Belgium-affiliated scholars included in our dataset, the average values for their country are lower than Belgium. Future studies could work on expanding the dataset and exploring a wider range of scholars from different countries to obtain a more comprehensive understanding of the global scholarly network in DH.

5. Limitations and future study

This study visualised the co-authorship network based on the data drawn from three canonical DH journals, analysed co-author clusters and studied the interconnectedness of country and language using the *betweenness centrality* method. It provides a new perspective on collaboration patterns and geolinguistic distribution in DH, and it raises new questions to be examined in future studies. For example, how do DH scholars working in different countries collaborate and co-author? How do we encourage collaboration in DH? How can we assist in policymaking that supports the formation of collaboration not only at a larger scale but also at the scale that is most suitable for different national and international subject areas? What other factors play out in co-authorship relationships (e.g. funding bodies, international relations, policies, personal connections)?

DH scholars as well as policy makers could take this study as a reference when planning future collaborations and collaboration-enhancing programmes. Universities, centres, journals as well as research organisations might take the geolinguistic differences discussed here into account when encouraging authors to collaborate and publish. Future network studies may furthermore take and use the data set (Appendix) to replicate this study and/or apply it in other fields and with different topics, also making effective comparisons between different disciplines.

As mentioned in the data collection section, if the dataset could expand its current scope and include a more diverse and linguistically representative range of publications in other languages, such as *Umanistica Digitale*, or *Humanités Numeriques*, it would offer further opportunities to delve deeper into the dynamics of international collaborations in DH. Our analysis is based on accepted papers, not submitted papers, and we acknowledge the possible

biases in the dataset, such as the higher chance of being rejected for non-native speakers of English (Amano, 2023). Future studies can also investigate the backgrounds of journal editors, editorial boards and other members with editorial input to understand their important role in contesting linguistic bias. Additionally, incorporating qualitative data and conducting interviews or surveys with scholars could provide insights into the underlying mechanisms driving collaboration and knowledge dissemination within the field, further enhancing our understanding of the dynamics at play.

Note

1. United Nations Member States: <https://www.un.org/about-us/member-states> [retrieved on 2023-03-23].

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Appendix

Appendix: More detailed tables and calculations of authors who published in journals *Chum*, *DSH/LLC* and *DHQ* (1966–2017).

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