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Assessment of global law and psychiatry research in the period of 1993-2012

A bibliometric analysis (Part-I)

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Global law and
psychiatry
research

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Abstract

Purpose – The purpose of this paper (bibliometric analysis) is to analyse the global scientific outputs, research patterns, research emphases and trends of law and psychiatry (L&P) research during 1993-2012 from the Web of Science (WOS) database. Besides, the paper also offers an overview to deepen intercultural understanding and cooperation in the field among professionals concerned with the interface of this research field and related disciplines.

Design/methodology/approach – This paper conducted a bibliometric study of the characteristics and patterns of publication outputs, major journals, network of co-occurrence of authors, international productivity and collaboration.

Findings – *International Journal of Law and Psychiatry*, *Journal of the American Academy of Psychiatry and the Law and Psychiatry*, *Psychology and Law* were the representative journals in the field of L&P research. The results from the analysis of co-occurrence of authors suggest that the L&P co-authorship network analysis is relatively fragmented. In addition, the most productive institution was the University of California System, which published the most inter-institutional collaborative publications and was the top institution by centrality measures. The Harvard University published the most single-institute publications. The most productive country was the USA, which was the top country by centrality measures. The USA was the most collaborative country and took the central position in the collaborative network.

Originality/value – This is the first study to quantify and evaluate global research productivity in L&P viewed through the WOS during 1993-2012, which might provide a potential guide for future research among professionals concerned with the interface of L&P, as it is a very constructive contribution to the area.

Keywords Data analysis, Collaboration, Bibliometrics, Information resources management

Paper type Research paper

Introduction

The field of law and psychiatry (L&P) explores the intersection between the mind and personal mental states and their connection with L&P. There is a growing need for exploring the interaction between these areas. Assessing an individual's history of aggression is a common task in clinical and forensic mental health practice (Gilbert *et al.*, 2013). Psychiatry plays a role in crimes, torts, contracts, property and domestic relations and it aids in resolving legal matters and exploring social policy that affects mental health and legal concerns. The intermix of psychiatry in law is becoming more common. Law has always



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played a role in the practice of psychiatry. Current law maintains the significant rift between emerging psychiatric advancements and legal acceptance of exculpatory mental illness (Toole, 2012). The mentally ill in the criminal justice system are an extremely marginalised group (Brett, 2003). Forensic service systems for the mentally ill are being reconsidered in relation to the criminal justice system and civil law (Nakatani, 2000). The intersection of L&P tasks are multifaceted (Ermer and Rosler, 2008). *Forensic psychiatry* is the psychiatric subspecialty that focuses on the interrelationship between psychiatry and the law (Sadoff and Dattilio, 2012). There is a growing awareness of the need for exploring the multidisciplinary area of L&P and common features of both the legal and psychiatric systems, as well as the social implications of their interaction. Despite the importance and high growth rate of L&P research, there have been few bibliometric studies conducted to gather data about the scientific production and international collaboration of L&P research. Therefore, it is necessary to carry out a comprehensive research with an overview of L&P research over the past 20 years using Web of Science (WOS).

The purpose of this study is to provide a bibliometric analysis of L&P research from 1993 to 2012 using the WOS database. Specifically, this article aims to identify general patterns for publication outputs and journals, identify academic groups of authors who work closely together based on a network of co-occurrence of authors and evaluate national and institutional research performance by analysis of international productivity and collaboration.

Literature review

There is a great diversity of methods and techniques that may be used for identifying general patterns of publication outputs and academic groups, evaluating national and institutional research performance and summarizing research hotspots and trends. Nieminen and Isohanni (1997) analysed a total of 223 published research studies pertaining to the therapeutic community in a variety of treatment settings from 1987 to 1992 and pointed out that collaborative authorship was scanty for addictions and psychiatry. A bibliometric analysis of the *Biological Psychiatry* journal from 1991 to 1996 revealed, among the 22 categories considered, a marked pre-dominance of papers related to schizophrenic (26.4 per cent) and depressive (20.9 per cent) disorders, making these two areas almost half of the 1,640 articles examined (47.3 per cent) (Navarro *et al.*, 1998). Pantel and Mundt (1999) discussed the possibilities and limitations of bibliometric analysis in the evaluation of psychiatric research. Jacob *et al.* (2007) utilised accessible bibliometric indicators to recognise highly successful authors researching German psychiatry. Garcia-Garcia *et al.* (2008) performed a bibliometric study on scientific publications related to phytotherapy in psychiatry during the period 1986-2006 using Embase.com and pointed out that the countries with the highest percentage of documents were the USA (29.4 per cent), Germany (9.4 per cent) and Japan (8.8 per cent), and those with the highest proportional national participation index were India and China. Diaz-Moran and Tobena (2011) analysed the scientific production of the Department of Psychiatry and Forensic Medicine at the Autonomous University of Barcelona, which published 11.8 per cent of the most cited papers in Spanish psychiatry, 20 per cent in the field of drug addiction and 20.8 per cent in the field of behavioural science. A comparison of psychiatry and internal medicine based on a bibliometric study (Stone *et al.*, 2012) demonstrated that biological and non-biological studies were similarly frequent in psychiatric journals (48.2 and 51.8 per cent, respectively), and that psychiatric journals published more biological studies than internal-medicine journals. The authors suggested that this tendency may influence psychiatric education and practice in a biological direction, with less attention to psychosocial or clinical approaches to psychiatry. Appelbaum (2006)

provided the most related research to this study as the author qualitatively reviewed the past 25 years of the L&P column of the journal *Psychiatric Services* and noted that the evolution of legal concerns in psychiatry, as well as the presence of core issues, have remained unchanged. Wu and Duan (2015) carried out social network analysis of international scientific collaboration on psychiatry research. Bibliometric methods were used to describe the publication patterns on hierarchical linear models in psychiatry by Cervantes *et al.* (2009). It has been demonstrated that bibliometric analysis could help evaluate scientific progress and research performance based on publication records. Publication records were assessed from the following aspects: characteristics of publication outputs, subject categories, major journals, international productivity and collaboration (Cao *et al.*, 2013; Qiu and Lv, 2014; Zhu and Willett, 2011). This method has been applied to evaluate research trends and progress in a variety of fields (Ahlgren *et al.*, 2015; Anwar and Al-Daihani, 2011; Bakri and Willett, 2011; Cantos-Mateos *et al.*, 2012; Chiu and Ho, 2007; Niu *et al.*, 2014; Senel and Demir, 2015; Tsay and Shu, 2011; Walton and Morris, 2013).

Data sources and methodology

The data were based on the WOS database from Thomson Reuters which includes the Science Citation Index Expanded, Social Sciences Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index-Science and and Conference Proceedings Citation Index-Social Science and Humanities. WOS indexes using WC = tags to assign articles to a field of study and an advanced search with this tag can be used to narrow a search to specific fields of study. The advanced search strategy of searching the topic field on L&P is as follows: WC = Psychiatry and WC = Law and Timespan = 1993-2012. The category of psychiatry covers resources that focus on the origins, diagnosis and treatment of mental, emotional or behavioural disorders, and the category of law includes resources from both general and specialised areas of national and international law. Information was gathered on 18 December 2013. Articles originating from England, Scotland, North Ireland and Wales were grouped under the UK heading (Yang *et al.*, 2013). All results were analysed using Microsoft Excel, and Ucient and Netdraw were used for visual representation of the collaboration networks. Bibliometric mapping, or science mapping, attempts to find representations of intellectual associations within the dynamically changing system of scientific knowledge (Small and Koenig, 1977). The VOSviewer (version 1.5.5) was used for constructing and viewing bibliometric maps (Van Eck and Waltman, 2010, 2011; Waltman *et al.*, 2010).

Results and discussion

Document types

The distribution of documents types was analysed and resulted in 12 document types, within a total of 2,852 publications. The most frequently used document type was journal article with 1,864 articles (65.4 per cent of the total publications), followed by editorial material (481, 16.9 per cent), book review (244, 8.6 per cent), proceeding (149, 5.2 per cent) and letter (134, 4.7 per cent). The other document types were less significant, such as review (61, 2.1 per cent), biographical item (25, 0.9 per cent), correction (9, 0.3 per cent), reprint (2, 0.0 per cent), bibliography (1, 0.0 per cent), item about an individual (1, 0.0 per cent) and note (1, 0.0 per cent). It should be noted that in these publications, there were 120 publications that were listed as both journal article and proceeding, accounting for 4.2 per cent of the total publications. Most of the publications were of the type journal article, indicating that research on L&P has been an attractive research theme since 1993. In addition, further analysis revealed that English was the dominant language for these journal articles. As journal articles represented the majority of document types that were also peer-reviewed

within this field, 1,864 original articles were identified and further analysed in the following study, while all others were discarded.

Publication year

The publication output is shown in Figure 1. During the past two decades, articles on L&P research in WOS increased from 21 in 1993 to 155 in 2012. The research seemed to be in three stages. The first stage was a developing period from 1993 to 1995, and the second one was a gentle developing period from 1996 to 2005, with 82.6 as an average annual number of research articles. The final was a fast-growth period starting in 2006, and the annual publication outputs sharply increased from 104 in 2006 to 155 in 2012. These data demonstrated that research on L&P has been attracting attention in scientific communities and is now an important field of cross-disciplinary research.

Journal outputs

As shown in Table I, there are four journals publishing L&P-related research in WOS during the time period under study (1993-2012). It should be noted that *Journal of the American Academy of Psychiatry and the Law* was entitled *Bulletin of the American Academy of Psychiatry and the Law* prior to 1997.

Bulletin of the American Academy of Psychiatry and the Law had the highest average citations (TC/TP) in L&P research, meaning that articles in this journal are an important

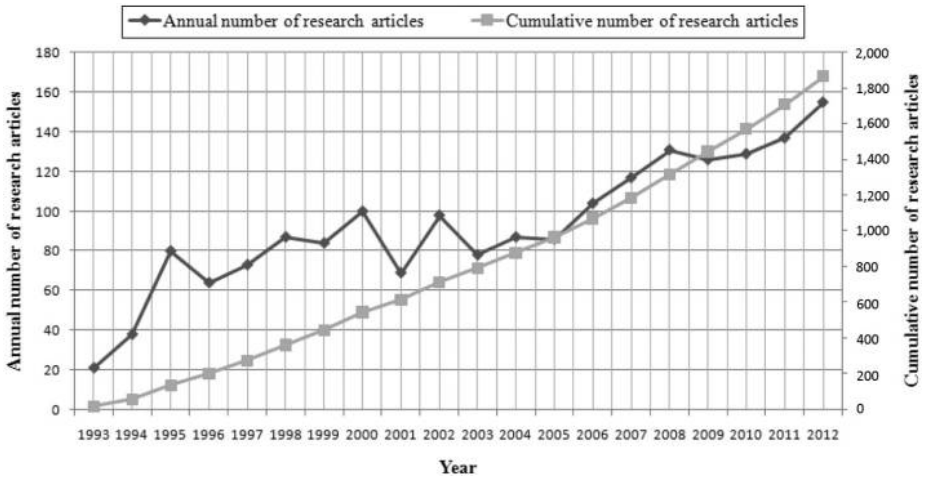


Figure 1. Publication outputs of L&P research in the WOS 1993-2012

Full journal title	TP	NR	TC	TC/TP	JCR data		EM	
					IF	5-IF	ES	AIS
<i>International Journal of Law and Psychiatry</i>	816	32,723	7,112	8.7	0.7	1.4	0.00199	0.4
<i>Journal of the American Academy of Psychiatry and the Law</i>	717	16,319	4,943	6.9	1.3	1.3	0.00136	0.4
<i>Psychiatry, Psychology and Law</i>	224	7,844	311	1.4	0.4	0.5	0.00047	0.2
<i>Bulletin of the American Academy of Psychiatry and the Law</i>	107	2,803	1,163	10.9	N/A	N/A	N/A	N/A

Table I. Journal distribution for L&P research

Notes: TP = total publications; NR = cited reference count; TC = WOS times cited count; JCR Data = 2012 JCR Social Science Edition Data; IF = impact factor; 5-IF = five-year impact factor; EM = eigenfactor® metrics; ES = eigenfactor® score; AIS = article influence® score; N/A = not available in the period

source of guidance for this research field. *Journal of the American Academy of Psychiatry and the Law* (prior to 1997, *Bulletin of the American Academy of Psychiatry and the Law*) was the top journal by publication count with 824, followed by *International Journal of Law and Psychiatry* (816, 43.8 per cent) and *Psychiatry and Psychology and Law* (224, 12.0 per cent). *International Journal of Law and Psychiatry* had the highest cited reference count (32,723) and the second highest average citations (8.7).

Impact factor is an indicator for the evaluation of journals and has become a useful tool for the inter-comparison of scientific journals (Garfield, 2006). *Journal of the American Academy of Psychiatry and the Law* was the top journal by impact factor and ranked second by five-year impact factor. By contrast, *International Journal of Law and Psychiatry* was the top journal by five-year impact factor and ranked second by impact factor.

The Eigenfactor® metric is also a major measure of journal influence using citation data to assess and track the influence of a journal in relation to other journals, and it includes the two indicators of Eigenfactor® Score and Article Influence® Score. Unlike traditional metrics, such as the popular impact factor, the Eigenfactor® method weights journal citations by the influence of the citing journals (Franceschet, 2010). The Eigenfactor® metric applies an iterative ranking scheme similar to Google's PageRank algorithm, meaning that citations from top journals are weighted more heavily than citations from lower-tier publications by this approach (Bergstrom *et al.*, 2008; West *et al.*, 2010). *International Journal of Law and Psychiatry* was the first journal by Eigenfactor® Score and Article Influence® Score, followed by *Journal of the American Academy of Psychiatry and the Law* and *Psychiatry, Psychology and Law*.

Co-occurrence of authors

There were 3,144 authors appearing in the 1,864 articles, which can be interpreted as 0.6 articles per author. Nearly 78.9 per cent of the authors had only one publication and 365 (11.6 per cent) of the authors had two publications. Only one author produced the maximum number of publications (35 articles). A total of 607 (32.6 per cent) articles were solo authored; thus, it is clear that single authorship is common in this field. The co-occurrence of the author network revealed cooperation across authors. Analysing the co-occurrence of author networks will help to recognise groups of authors who carry out scientific research together. VOSviewer can be used to construct maps of co-occurrence of authors based on a co-occurrence matrix of authors (Van Eck *et al.*, 2010). Although there are 3,144 authors in L&P from 1993 to 2012, only the top 78 authors who published at least six papers were clustered with VOSviewer and displayed. Figure 2 shows a co-occurrence network map generated from publications of the top 78 authors. The "no overlap" in VOSviewer was unchecked, and lines can be displayed between any pair of authors with non-zero link strength. In Figure 2, authors are indicated by their label and, by default, also by a circle, and the font size of the node's label and the size of the node's circle depend on the co-occurrence weight of authors (Van Eck and Waltman, 2011; Zheng and Liu, 2015). There are four components (names of authors, author nodes, co-occurrence weight and networked relationship clustering) included in Figure 2. Each author corresponds to an author node, the co-authorship relation among papers corresponds to a link and the higher the co-occurrence of an author, the more prominent the author is presented in the map. The value of co-occurrence weight is the number of co-authored publications for each author out of the top 78 authors. The authors, Gutheil TG, Commons ML, Sreenivasan S, Miller PM and Bradford JM with 62, 46, 36, 30 and 28 co-occurrence weights, respectively, have the most collaboration with the other top 78 authors. Among the top 78 authors, Gutheil TG with 62 co-occurrence weights published 35 (1.9 per cent) papers; thus, this author can be considered to be the most

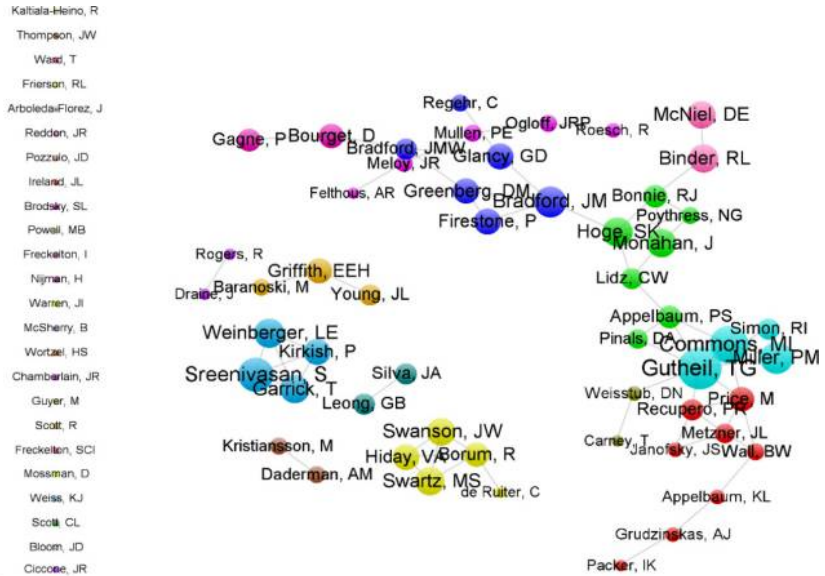


Figure 2.
Bibliometric mapping
of co-occurrence of the
top 78 authors

influential author in the L&P field. This means that not only did Gutheil TG produce the greatest number of papers but also had the most collaboration with the other top 78 authors. Ciccone JR ranks second with 18 papers, but had no collaboration with the other top 78 authors. The top 78 authors with at least five co-authorship publications are shown in Table II. The maximum number of co-authorship publications per each pair of authors was 13 articles. Also, 22 authors of the top 78 authors are involved in the production of 5.3 per cent of total publications in Table II. The pair of authors, Gutheil TG and Commons ML, were involved in the production of 13 papers (0.7 per cent). The pair of Binder RL and McNiel DE was involved in the production of ten articles (0.5 per cent).

Author 1	Author 2	TP (%)	Rank
Gutheil TG	Commons ML	13 (0.7)	1
Binder RL	McNiel DE	10 (0.5)	2
Commons ML	Miller PM	8 (0.4)	3
Gutheil TG	Miller PM	7 (0.4)	4
Sreenivasan S	Weinberger LE	7 (0.4)	4
Hoge SK	Monahan J	6 (0.3)	6
Sreenivasan S	Kirkish P	6 (0.3)	6
Bradford JM	Firestone P	6 (0.3)	6
Bourget D	Gagne P	6 (0.3)	6
Swanson JW	Swartz MS	5 (0.3)	10
Leong GB	Silva JA	5 (0.3)	10
Sreenivasan S	Garrick T	5 (0.3)	10
Griffith EEH	Young JL	5 (0.3)	10
Gutheil TG	Simon RI	5 (0.3)	10

Table II.
Top 78 authors with at
least five co-authored
publications

International productivity and collaboration

With the rapid development of cross-discipline research, scientific cooperation between research institutions has become common and necessary. At the same time, scientific collaboration has almost become an inevitable procedure in completing complex tasks and solving global problems (Han *et al.*, 2014). Collaboration plays an ever-growing role in research, which can be reflected by the cooperation between institutions or countries (Zhu *et al.*, 2015). Contributions of different institutions and countries/territories were estimated by focusing on the location of the affiliation of at least one author to the publications (Khan and Ho, 2012). Collaboration type was determined by the addresses of the authors, where the term “single institute or country/territory publication” was assigned if addresses of authors were from the same institute or country/territory and the term “inter-institutional or international collaborative publication” was designated for those articles that were co-authored by authors from multiple institutes or different countries (Zhang *et al.*, 2010; Zhuang *et al.*, 2013). As shown in Table III, the top 20 institutions were ranked by total publications. The most productive institution was the University of California system with 102 articles, followed by the University of Massachusetts system with 83, Harvard University with 81, University of Massachusetts Worcester with 63, Monash University with 61 and Yale University with 57. Harvard University published the most single-institute publications, followed by Yale University, Monash University, University of Sydney, Deakin University and University of British Columbia. The University of California system published the most inter-institutional collaborative publications, followed by the University of Massachusetts system, Harvard University, University of Massachusetts Worcester and Monash University. Though the University of California system, University of Massachusetts Worcester and the Florida State University system were in the top ten most productive institutes, these institutes had no single-institute publications. Among the top 20

Institutions	TP	TPR (%)	SP	SP/TP (%)	CP	CP/TP (%)
University of California system, USA	102	1 (5.5)	0	0	102	100.0
University of Massachusetts system, USA	83	2 (4.5)	4	4.8	79	95.2
Harvard University, USA	81	3 (4.4)	28	34.6	53	65.4
University of Massachusetts Worcester, USA	63	4 (3.4)	0	0	63	100.0
Monash University, Australia	61	5 (3.3)	17	27.9	44	72.1
Yale University, USA	57	6 (3.1)	22	38.6	35	61.4
Florida State University system, USA	38	7 (2.0)	0	0	38	100.0
University of Toronto, Canada	37	7 (2.0)	7	18.9	30	81.1
University of Sydney, Australia	32	9 (1.7)	16	50.0	16	50.0
University of Ottawa, Canada	31	9 (1.7)	10	32.3	21	67.7
University of Virginia, USA	31	9 (1.7)	10	32.3	21	67.7
University of California San Francisco, USA	29	12 (1.6)	0	0	29	100.0
Oregon University system, USA	27	13 (1.5)	0	0	27	100.0
University of California Los Angeles, USA	27	13 (1.5)	0	0	27	100.0
Deakin University, Australia	25	15 (1.3)	16	64.0	9	36.0
Simon Fraser University, Canada	25	15 (1.3)	10	40.0	15	60.0
University of British Columbia, Canada	25	15 (1.3)	15	60.0	10	40.0
University of Colorado system, USA	25	15 (1.3)	0	0	25	100.0
Oregon Health Science University, USA	24	15 (1.3)	0	0	24	100.0
University of Rochester, USA	24	15 (1.3)	0	0	24	100.0

Table III.

Top 20 most

productive institutions
during 1993-2012

Notes: TP = total publications; SP = single-institute publications; CP = inter-institutional collaborative publications; R = rank; % = share in publications

most productive institutions, 13 were from the USA, four were from the Canada and three were from Australia.

Freeman (1979) proposed four concepts of centrality in a social network, which have been developed into degree centrality, closeness centrality, betweenness centrality and eigenvector centrality. These four centrality measures can be useful indicators for impact analysis (Yan and Ding, 2009). *Degree centrality* equals the number of ties that a vertex has with other vertices, *closeness centrality* emphasises on the distance of a vertex to all others in the network by focusing on the geodesic distance from each vertex to all others, *betweenness centrality* is a measure of how often a vertex is located on the shortest path between other vertexes in the network, and the *eigenvector centrality* is based on the principle that the importance of a node depends on the importance of its neighbours (Ding, 2011; Everett and Borgatti, 1999; Leydesdorff, 2007). Ucinet, a social network analysis tool, was used to calculate the four centrality indicators by multiple centrality measures. As shown in Table IV, the University of California system was the top institution by centrality measures, with a degree centrality of 63.2, closeness centrality of 43.2, betweenness centrality of 40.4 and eigenvector centrality of 53.4. Harvard University had a degree centrality of 52.6, closeness centrality of 39.6, betweenness centrality of 13.6 and eigenvector centrality of 52.4, which ranked it second, second, second and third, respectively. The University of Massachusetts system had a degree centrality of 47.4, closeness centrality of 38.8, betweenness centrality of 5.8 and eigenvector centrality of 52.7 and was ranked third, third, seventh and second, respectively. University of Massachusetts Worcester had a degree centrality of 42.1, closeness centrality of 38.0, betweenness centrality of 3.8 and eigenvector centrality of 49.8, which ranked it fourth, fourth, eighth and fourth, respectively.

As shown in Table V, the top 20 countries were ranked by total publications. The most productive country was the USA with 1,010 publications, of which 935 were single-country

Institutions	DC	CC	BC	EC
University of California system	63.2	43.2	40.4	53.4
Harvard University	52.6	39.6	13.6	52.4
University of Massachusetts system	47.4	38.8	5.8	52.7
University of Massachusetts Worcester	42.1	38.0	3.8	49.8
University of Toronto	36.8	36.5	10.6	42.9
Florida State University system	31.6	35.2	2.5	37.2
University of Virginia	31.6	34.6	0.4	40.0
University of Colorado system	31.6	34.6	0.4	40.0
Oregon University system	21.1	34.0	0.2	21.3
University of California Los Angeles	21.1	34.0	0.6	19.4
Simon Fraser University	21.1	34.6	9.9	23.2
Oregon Health Science University	21.1	34.0	0.2	21.3
Yale University	15.8	34.0	9.9	15.7
University of California San Francisco	15.8	33.3	0	23.1
Monash University	10.5	32.2	9.9	7.9
University of Ottawa	5.3	27.5	0	6.2
Deakin University	5.3	25.0	0	1.2
University of British Columbia	5.3	26.4	0	3.4
University of Rochester	5.3	26.0	0	2.3
University of Sydney	0	N/A	0	0

Table IV.
Normalized centrality
measures for the top
20 most productive
institutions

Notes: DC = degree centrality; CC = closeness centrality; BC = betweenness centrality; EC = eigenvector centrality; N/A = not available

Country/territory	TP	TPR (%)	SP	SP/TP (%)	CP	CP/TP (%)
USA	1,010	1 (54.2)	935	92.6	75	7.4
Australia	236	2 (12.7)	209	88.6	27	11.4
Canada	198	3 (10.6)	171	86.4	27	13.6
UK	127	4 (6.8)	97	76.4	30	23.6
The Netherlands	56	5 (3.0)	42	75.0	14	25.0
Sweden	54	6 (2.9)	41	75.9	13	24.1
Germany	53	7 (2.8)	43	81.1	10	18.9
New Zealand	35	8 (1.9)	30	85.7	5	14.3
Israel	29	9 (1.6)	22	75.9	7	24.1
Finland	19	10 (1.0)	16	84.2	3	15.8
Italy	17	11 (0.9)	13	76.5	4	23.5
Norway	17	11 (0.9)	12	70.6	5	29.4
Japan	15	13 (0.8)	13	86.7	2	13.3
Denmark	13	14 (0.7)	12	92.3	1	7.7
Switzerland	12	15 (0.6)	8	66.7	4	33.3
Ireland	11	15 (0.6)	9	81.8	2	18.2
Belgium	8	17 (0.4)	6	75.0	2	25.0
Brazil	8	17 (0.4)	4	50.0	4	50.0
South Africa	8	17 (0.4)	6	75.0	2	25.0
France	7	17 (0.4)	4	57.1	3	42.9

Notes: TP = total publications; SP = single-country/territory publications; CP = international collaborative publications; R = rank; % = share in publications

Table V.
Top 20 most
productive countries/
territories during
1993-2012

publications and 75 were international collaborations. Australia published the second highest number of total publications, followed by Canada, the UK, The Netherlands, Sweden and Germany. From the perspective of share in publications of single-country publications, the USA was the first, followed by Denmark, Australia, Japan, Canada and New Zealand. In contrast, from the perspective of percentage of international collaborative publications, Brazil was the first, followed by France, Switzerland, Norway, The Netherlands, Belgium and South Africa.

As shown in Table VI, the USA was the top country by centrality measures and had a degree centrality of 84.2, closeness centrality of 86.4, betweenness centrality of 56.4 and eigenvector centrality of 67.4. The UK had a degree centrality of 47.4, closeness centrality of 65.5, betweenness centrality of 6.3 and eigenvector centrality of 52.7, ranking second, second, fourth and second, respectively. Canada had a degree centrality of 42.1, closeness centrality of 61.3, betweenness centrality of 4.3 and eigenvector centrality of 47.5, ranking third, third, fifth, and third, respectively. The Netherlands had a degree centrality of 36.8, closeness centrality of 61.3, betweenness centrality of 16.3 and eigenvector centrality of 39.7, ranking fourth, fourth, second and fourth, respectively.

Netdraw was used to depict the collaboration network of the top 20 most productive institutions (Figure 3) and the collaboration network of the top 20 most productive countries/territories (Figure 4). Each vertex represents one institution, the size of the vertex is based on degree centrality and the thickness of interconnecting lines represents the strength of collaboration (Kumar and Jan, 2013). As shown in Figure 3, the University of California system, Harvard University, the University of Massachusetts system, University of Massachusetts Worcester, University of Toronto, the Florida State University system, University of Virginia and the University of Colorado system were the most collaborative institutions. Institutions in the same territory tended to have a higher rate of collaboration;

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Country/territory	DC	CC	BC	EC
USA	84.2	86.4	56.4	67.4
UK	47.4	65.5	6.3	52.7
Canada	42.1	61.3	4.3	47.5
The Netherlands	36.8	61.3	16.3	39.7
Sweden	36.8	61.3	8.3	38.8
Germany	31.6	59.4	2.1	39.6
Australia	26.3	54.3	3.8	32.2
New Zealand	26.3	54.3	0.2	34.8
Finland	26.3	54.3	2.8	23.3
Israel	21.1	51.4	0	30.6
Norway	21.1	52.8	1.6	21.5
Denmark	15.8	41.3	0	12.6
Italy	10.5	50.0	0	13.7
Switzerland	10.5	48.7	0	16.2
Ireland	10.5	48.7	0	18.1
Brazil	10.5	48.7	0	17.4
South Africa	10.5	41.3	0.3	10.9
Japan	5.3	47.5	0	10.2
Belgium	5.3	38.8	0	6.0
France	5.3	47.5	0	10.2

Table VI.
Normalized centrality
measures to top 20
most productive
countries/territories

Notes: DC = degree centrality; CC = closeness centrality; BC = betweenness centrality; EC = eigenvector centrality

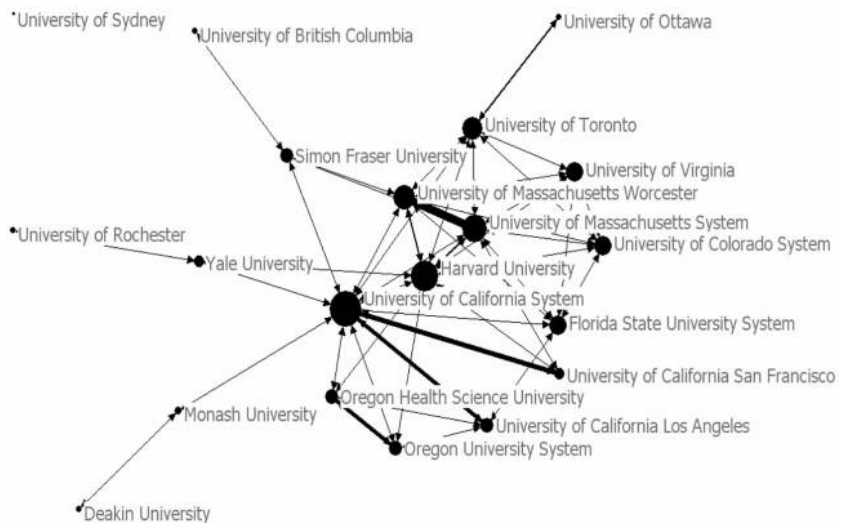


Figure 3.
Collaboration network
of the top 20 most
productive institutions

for example, the University of Massachusetts system and University of Massachusetts Worcester; the University of California system and University of California San Francisco; and the Oregon University system and Oregon Health Science University.

Collaboration among the top 20 most productive countries was infrequent as shown in Figure 4. The USA was the most collaborative country and took central position in the

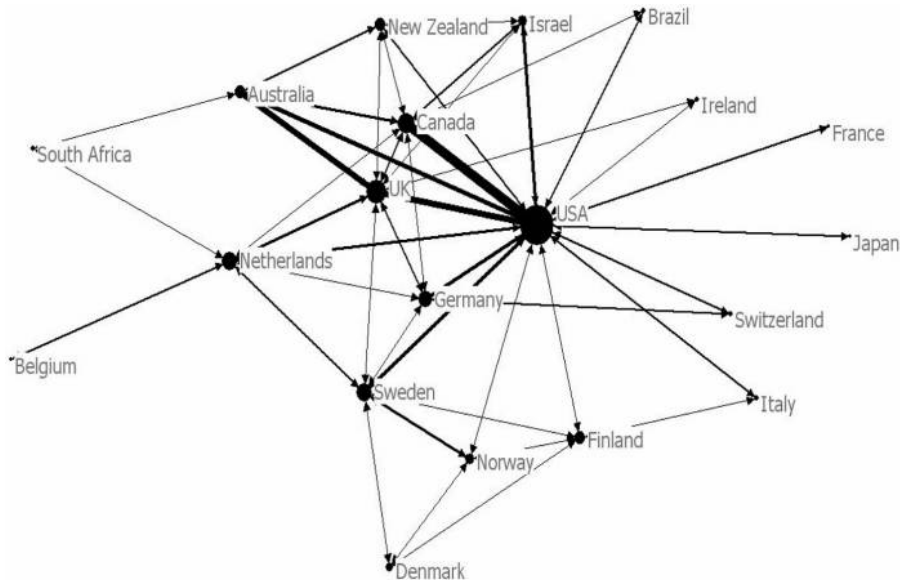


Figure 4.
Collaboration network
of the top 20 most
productive
countries/territories

collaborative network because it was the major collaborator with the most productive countries, including Canada, the UK and Australia. According to the collaboration network of the top 20 most productive countries/territories, there are many productive countries/territories that did not cooperate with other productive countries/territories. For example, Japan and France only collaborate with the USA and Belgium only collaborates with The Netherlands. Increasing research cooperation between different countries will facilitate the formation of greater globalization and structuring of the research, with more complex and articulated research networks. Therefore, it is necessary to increase research collaboration between different countries.

Conclusion

To deepen the intercultural understanding and cooperation in the field among professionals concerned with the interface of L&P and related disciplines, the paper firstly conducted a bibliometric study of the patterns of publication outputs, journals, co-occurrence of authors, international productivity and collaboration on L&P articles based on WOS database during 1993-2012. This study showed some significant points on the worldwide research performance and international collaboration. In conclusion, by bibliometric methodology, the findings and results of this study can help scientific researchers understand the performance of L&P globally. For example, based on these findings, scientific research policy makers and project managers can understand the status and positions of their institutions or countries/territories and the trends of L&P research all over the world, and thus, they can give out suggestions for directing L&P research and policy reform. In addition, with the help of these findings, researchers can make informed decisions of how to choose partners and academic exchange institutions or platforms. Overall, this bibliometric study calls for more research aimed specifically at strengthening coverage of L&P research topics and improving cooperation between L&P authors, institutions and countries. Finally, it was expected that the findings of this study could be a useful basis for a better understanding of the international development and collaboration of researches related to L&P.

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