Shifting sands: A bibliometric analysis of L2 vocabulary research in 1991

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Abstract

This paper uses a co-citation analysis to examine the research on L2 vocabulary acquisition that was published in 1991. Two analyses based on co-citations in this research are presented. The first analysis provides a context for the 1991 data. It looks at work that was being cited in a five-year window covering 1987-1991. The second analysis is a more detailed account of the 1991 research on its own terms.

Keywords: L2 vocabulary acquisition, vocabulary research, bibliometric, author co-citation

1. Introduction

This paper is the eleventh in a series of studies in which I have been mapping out the way L2 vocabulary research has developed over the last 50 years. Beginning with 1983, LingBaW has published a set of papers in which I have presented bibliometric mappings of the research that appeared in each year up until 1990 (Meara: 2014–2022). This paper takes this historical overview another step forwards. It presents a bibliometric analysis of the L2 vocabulary research published in 1991, places this work in a larger historical perspective, and discusses some changes in the structure of the field, as shown by a detailed co-citation analysis.

This report adopts a rather different structure from that which is used to organise the earlier papers in this series. In those papers, I reported the work published in a single year, and then provided a five year context in which this work could be evaluated. A number of readers have commented that they find the five-year data more useful than the data for a single year, mainly because the five-year windows seem to be better at capturing the main trends in the research, and they are less affected by local variations in the outputs of individual researchers. For that reason, in this report, I will first present an analysis of the five-year period 1987-91, and then follow this up with a more detailed and more exploratory account of the research published in 1991.

The analyses that follow use the Author Co-citation method developed by Small (1973). Small's methodology is described in detail in Appendix 1 for the benefit of readers who are not yet familiar with the approach used in these papers.

I have also made some changes to the way I have mapped out the co-citation data in this report. The details of these changes are described as they arise in the sections that follow, but more detail is supplied in Appendix 1.

2. Part 1: The 1987-1991 data set

Table 1 lists the main characteristics of the 1987-1991 data set. The table also includes the main features of the outputs that appeared in the previous five-year window covering 1986-1990, described in more detail in last year's report (Meara: 2022). This table is not a complete record of all the research published in the five year window. Conventional practice for co-citation analysis is to work only with papers published as journal articles or chapters in books. Monographs, unpublished reports, theses, and so on are not normally included in co-citation analyses, as they use citations in a way that is quite distinct from what we find in shorter, more conventional research reports. Working only with papers published as journal articles or book chapters ensures a certain level of consistency on what would otherwise be a very unmanageable amount of material.

Table 1 shows that the basic data for the two five-year windows are broadly similar. The main point of difference is that the number of papers in the 1987-91 data set fell slightly compared with the earlier window, and the number of authors contributing to the data set fell quite markedly. In contrast, the number of sources cited in the 1987-91 window increased. This probably reflects the fact that by 1991 there is simply more literature available to be cited, and citations generally increase with time.

Table 1: *The main characteristics of the 1986-1990 and the 1987-91 data sets*

	1986-90	1987-91
Number of papers in the data set	477	455
Number of authors contributing to the data set	475	406
Number of sources cited in the data set	4616	4738

Table 2 shows the number of authors contributing N papers to the 1987-91 data set.

Table 2: *Authors contributing N papers to the data set*

N papers	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Authors		1				1		1	2		1	3	8	17	39	331
Lotka		1	2	2	2	3	3	4	5	7	9	13	21	37	84	331

As usual, the vast majority of authors contribute only a single paper to the data set. The bottom line of Table 2 provides a context for this: it shows the number of authors we would expect to contribute N papers to the data set, given that we have 331 authors who contribute only one paper. This expectation is based on work by Lotka (1926). As in previous years, Lotka's

projection suggests that the data set in this five year window has a relatively small number of authors who contribute to multiple outputs. (Lotka's method is outlined and discussed further in Appendix 2.)

The most prolific authors in this five year period are Meara (15 papers), Laufer (11 papers), Zimmerman (9 papers), Carter and Palmberg (8 papers each), Scholfield (6 papers), Bogaards, Nation and Vermeer (5 papers each). This list is basically a consolidation of the previous five-year window. Scholfield and Bogaards are new entries to the list, while a number of authors – Broeder, Beheydt, AD Cohen, Extra, Robinson and van Hout – have dropped out of the list of prolific contributors.

We now turn to the citations within the 1987-91 data set. A detailed analysis of who is cited in these papers identifies a total of 4738 sources. Most of these sources (3003 cases) are cited only once, but a considerable number of sources are cited more frequently than this. The complete distribution is shown in Table 3.

The most cited sources in the data set are listed in Table 4. This list is essentially the same as the equivalent list for the 1986-90 data set. Meara and Nation continue to be the most cited authors, cited in 16.5% and 15.2% of the papers in the data set, respectively. Laufer, AD Cohen and McCarthy are significant new entries to the list, while Kasper, Kellerman, Lockhart and Schouten-van Parreren have all fallen out of the 1986-1990 most cited authors list, though they still maintain a presence in the complete data set.

Table 3: *The number of cases cited N times in the 1986-91 data set*

FREQ	75+	74	73	72	71	70	69	68	67	66	65	64	63	62	61
Cases	1						1								
FREQ	60	59	58	57	56	55	54	53	53	51	50	49	48	47	46
Cases												2		1	
FREQ	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
Cases	1	1			1	1			2	1	2	1	1	1	5
FREQ	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Cases			3	4	2	3	5	2	3	8	11	5	5	4	11
FREQ	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Cases	10	6	19	17	29	22	40	48	63	68	127	171	332	700	3003

Table 4: *The most frequently cited authors in the 1986-1990 and 1987-91 windows.*

1986-90	1987-91
Meara (72)	Meara (77)
Nation (60)	Nation (69)
Krashen (51)	Carter Richards (49)
Levenston (50)	Levenston (47)
Faerch Richards (46)	Faerch (45)
Carter Sinclair (37)	Krashen (44)
Kasper (36)	Laufer (41)
Schouten-van Parreren Kellerman Lockart (35)	Sinclair (40)
	AD Cohen McCarthy (37)

The analysis that follows is based on the co-citations among the most frequently cited sources in the data set. Clearly, it would be a massively complex task to analyse all the co-citations between all the sources cited in the data set, and in order to keep things simple, it is normal practice in analyses of this sort to work with the 100 or so most frequently cited sources. The data in Table 3 suggests that we can get close to this conventional figure if we adopt an inclusion threshold of 15 or more citations. This threshold for inclusion is slightly higher than the figure of 14 citations that we used in our analysis of the 1986-90 data set, which gave us a set of 99 sources. The 1991 threshold gives us a set of 98 sources to work with. The main underlying characteristics of the analysis are reported in Table 5, which also includes the equivalent features of the 1986-1990 analysis. The analysis itself is reported in Figure 1 in the form of a spanning tree, based on the strongest links between the nodes.

Table 5: *The main characteristics of the 1986-90 and 1987-91 data sets*

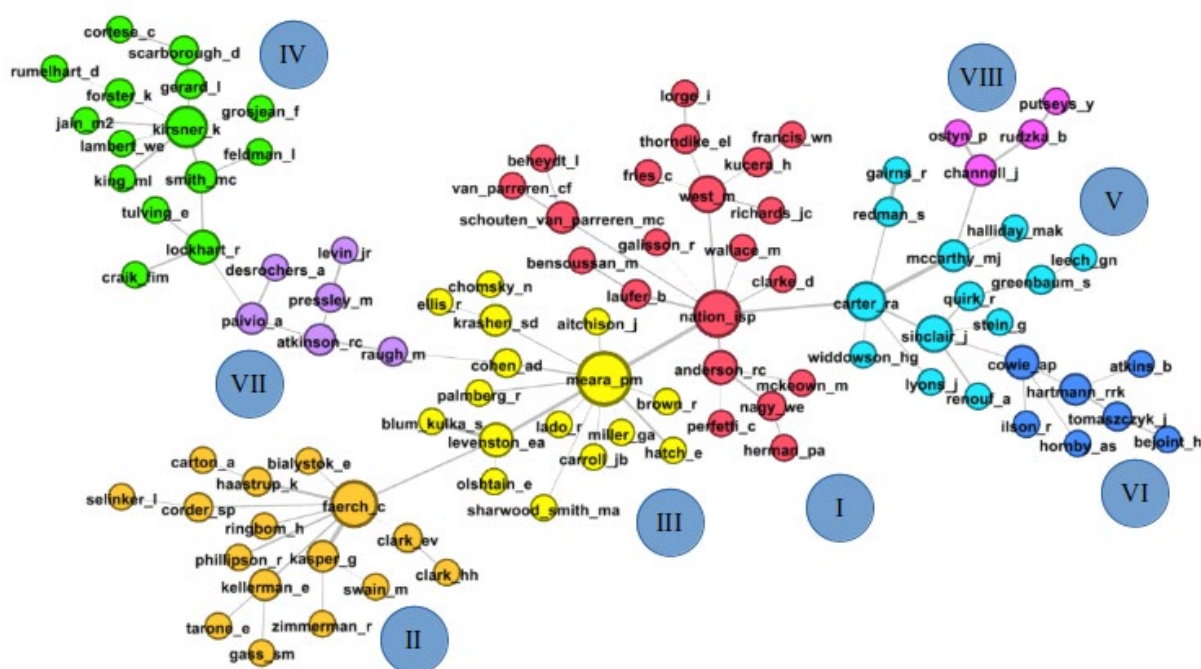|	**1986-90**	**1987-91**
Inclusion Threshold	14	15
Sources included	99	98
Clusters	8	8
New sources		10
Lost sources	11	

Figure 1: *Co-citations in the 1987-91 data set, graphed as a Spanning Tree. 98 nodes with at least 15 citations in the data set. Colours indicate the eight different clusters identified by Gephi using a cluster analysis. Nodes are sized according to how many connections they have with other nodes.*

This report is rather different from the ones we used in our earlier analyses, where we mapped all the co-citations with an arbitrarily decided minimum strength (e.g. all co-citation links that appear at least 10 times in the complete data set). In contrast, the mapping that appears in Figure 1 is a **spanning tree** that shows only the strongest connection between the most frequently cited

sources in the complete data set. (See Appendix 1 for further discussion of spanning trees.) The mapping is the result of an analysis by Gephi, a standard bibliometric mapping program (Bastian, Heyman and Jacomy: 2009). This figure is fairly easy to interpret. Gephi finds eight clusters in this data set, numbered in Figure 1 by their size. Table 6 provides a summary of the clusters identified in Figure 1 (right hand column). A summary of the 1986-1990 cluster data is provided in the left hand column for comparison.

Table 6: The clusters identified by Gephi in the 1986-90 and the 1987-91 data sets. Clusters are ordered by size.

cluster	1986-90	1987-91
I	Vocabulary teaching and reading (19)	Vocabulary teaching and reading (21)
II	Lexical error and transfer (19)	Lexical error and transfer (16)
III	Vocabulary learning theory (16)	Vocabulary learning theory (16)
IV	Performance of bilinguals (11)	Performance of bilinguals (14)
V	Dictionaries and their use (11)	Corpora and Discourse (13)
VI	Corpora and discourse and textbooks (11)	Dictionaries and their use (7)
VII	Imagery and Mnemonics (9)	Imagery and Mnemonics (6)
VIII	L1 acquisition (3)	Semantics and Collocation (4)

Cluster I, with 21 members, and centred on Nation and West, represents the main thrust of L2 vocabulary research at this time. It contains a number of identifiable sub-clusters: a set of sources who work on L1 reading (Nagy, Herman, Anderson), and a group of word counts (Thorndike and Lorge, Kucera and Francis, West, Fries and Richards). The main focus of this cluster seems to be L2 reading, guessing behaviour, and how this is affected by the frequency of words in the texts being read.

Cluster II, with 16 members, and centred on Faerch and Kasper, is mainly concerned with lexical inferencing and error. Again, we can identify some sub-clusters among these sources: the cluster is mainly composed of Scandinavian researchers (Faerch, Kasper, Ringbom, Phillipson, and Haastrup); it also includes two historically important sources (Corder and Selinker); the previously detached L1 development cluster (EVClark and HH Clark) has now become incorporated into this cluster; Gass, Tarone, Kellerman, Bialystok and Swain all point to the growing influence of North American research on L2 vocabulary studies.

Cluster III, also with 16 members, and centred on Meara and Levenston, mainly consists of sources who are less concerned with vocabulary teaching than the sources in Cluster I. There is strong emphasis here on experimental studies of language learners, and the sources provide a theoretical framework within which this research takes place.

Cluster IV, with 14 members centred on Kirsner, is the psycholinguistics cluster familiar from our earlier studies. The members of this cluster focus mainly on the performance of bilingual subjects in word recognition tasks.

Cluster V and Cluster VI are perhaps best treated as a single group of sources. Cluster V, with 13 members, centred on Carter and Sinclair, is mainly composed of UK linguists interested in Corpora and descriptions of English. Cluster VI, with seven members centred on Cowie, is a dictionary research cluster, with a particular interest in the way L2 learners use dictionaries. Taken together, these two clusters make up the second largest group of sources in Figure 1.

Cluster VII, with 6 members, is a group of sources who work on imagery and mnemonics.

Cluster VIII, with 4 members, consists of a predominantly Belgian group of researchers who published an influential set of textbooks based around emerging ideas in structural semantics.

A number of features in this map are worth highlighting.

1: The clusters identified in this analysis are essentially the same as the clusters we identified in our analysis of the 1986-1990 data set. Again, the equivalent list of clusters identified in 1986-90 is included in the table for the purpose of comparison, and this comparison shows that there is some movement among the clusters. Cluster I and Cluster IV appear to have increased in size. Clusters V and VI seem to be shifting their focus away from dictionaries, and shrinking slightly in the process, with Cluster VII forming a new cluster focussed on a single text book. Cluster VII has shrunk a little, as some of its members have become more closely aligned with Cluster IV. L1 acquisition has lost its status as a separate cluster and become absorbed into Cluster II in the 1987-91 map.

2: These changes come about as a result of changes in the underlying data. As usual, not all of the sources listed in the earlier map (1986-90) continue into the later (1987-91) map. Clusters V, VI and VII suffer no losses, but Cluster I loses Bogaards and Hosenfield; Cluster II loses Ard and Burt; Cluster III loses Howatt, Rivers and Rosch; Cluster IV loses Kolers and Meyer; Extra disappears from Cluster VIII. These losses are balanced by the appearance of nine new sources in the 1987-91 map. Perfetti and McKeown join Cluster I, strengthening the L2 reading focus in this cluster. Carton appears as a new source in Cluster II; he is mostly cited as a methodological influence because of his advocacy of introspective methods. Aitchison and Olshtain both appear in Cluster III; Aitchison strengthens the theoretical focus of this cluster, while Olshtain is mostly cited for her empirical work on vocabulary learning. Forster and Rumelhart are new sources in Cluster IV; they represent a new strand of research in this cluster that deals with formal modelling of bilingual lexicons. Greenbaum appears as a new source in cluster V; he is closely co-cited with Quirk and Leech, mainly in the context of an important corpus-based grammar of English (Quirk, Greenbaum, Leech and Svartvik) first published in 1985. Raugh, new in cluster VII, co-authored a number of papers in the 1970s with RC Atkinson; these are early papers on the use of mnemonic methods to acquire a large Russian vocabulary.

3: Cluster VI is the only cluster in the 1987-91 map that does not include any new sources. This may indicate that research on dictionary use by L2 speakers has peaked.

4: Table 7 lists the strongest links in the minimum spanning trees for 1986-90 and 1987-91. This is a new feature that we have not looked at in our previous analyses. There are a number of striking points in this data. In broad terms, the two lists are very similar, but the co-citation links for 1987-91 are generally stronger than the equivalent links in the 1986-90 map. Most of the very strong links come about because the two connected nodes are co-authors: Carter and McCarthy, Faerch and Kasper, Levenston and Blum-Kulka, Channell and Ostyn and Gairns and Redman all fall into this category. Only two of the strongest links are genuine co-citations in the sense that they do not involve co-authors being cited together: the Faerch ~ Haastrup co-citation – a new appearance in the 1987-91 list – is a sign of the increasing importance of the Scandinavian vocabulary research and underscores the central role of Faerch in the 1987-91 data set, while the Nation ~ Meara co-citation link – already strong in the 1986-90 map, but

here significantly stronger – demonstrates the increasing dominance of these two sources, and hints at the emergence of a first paradigm in the L2 vocabulary research. (cf. Meara: 2020b). The Carter ~ McCarthy co-citation is the one that shows the largest increase here (24 co-citations in 1986-90 but 32 in 1987-91). This shift highlights the growing importance of corpora for vocabulary research. Gairns and Redman is a striking new link in the 1987-91 data set, and will be discussed in more detail in Part 4 of this paper.

Table 7: The strongest co-citation links in the network

1986-90	1987-91
Faerch ~ Kasper 34	Faerch ~ Kasper 34
Levenston ~ Blum-Kulka 28	Carter ~ McCarthy 32
Levenston ~ Meara 26	Gairns ~ Redman 32
Nation ~ Meara 25	Nation ~ Meara 30
Carter ~ McCarthy 24	Levenston ~ Blum-Kulka 28
Channell ~ Putseys 22	Levenston ~ Meara 27
Ostyn ~ Rudzka 21	Faerch ~ Haastrup 24
	Channell ~ Ostyn 23

There seem to be two main fault lines in the 1987-91 map. These splits are mainly methodological in nature. Clusters II, IV and VII are made up of sources with a strongly empirical bias, and their work relies heavily on experimental studies of L2 learners. At the other edge of the map, we have clusters V, VI and VIII which consist of sources who are more concerned with what descriptive linguistics can tell us about what learners acquiring a vocabulary have to learn. These clusters are largely populated by British researchers.

The main trunk of the 1987-91 spanning tree is the set of edges that join Faerch, Levenston, Meara, Nation and Carter. These links are all strong, though surprisingly not as strong as some of the subsidiary branches (see Table 7). However, the really interesting feature here is the co-citation link between Faerch and Levenston that joins Cluster II and Cluster III. Faerch passed away in 1987, when he was only 39. Levenston is mainly cited for his important 1979 paper (Levenston 1979), and as far as I can see he did not produce any significant L2 vocabulary research after 1987. This means that 1987 marks the end of the active output of both these sources. Their influence will continue into future maps for a while, of course, but in the longer term we can expect the importance of this link to decline or even disappear. Given that this edge is the principal link between two of the largest clusters in the 1987-91 map, we might ask what effect this loss will have on the overall structure of the map, and which of the many sources in cluster II will emerge as its new focus.

3. Part 2: The 1991 data in more detail.

We now turn to a more detailed analysis of the research outputs published in 1991.

Figure 2 shows the distribution of the output types in this year. The figure shows that output of journal articles in the two data sets is very stable, but the number of book chapters has fallen in 1991, while the number of book-length studies has risen by about 40%. The books are listed in Table 8.

Battenberg is a wide-ranging review of opinions on dictionaries aimed at second language learners, with chapters providing a historical review of the development of learner dictionaries, the format of dictionary entries, reports on some studies of the ways users employ dictionaries, and a brief discussion of some likely developments in dictionary design. **Beheydt and Wieers** is a 1000 word dictionary aimed at L2 learners of Dutch. **Broeder** is a report arising from the European Science Foundation project (cf. Purdue: 1993). It details a set of four parallel case studies of Turkish and Moroccan learners of Dutch. Its main chapters cover the development of pronominal reference, the development of reference to movement, and the development of possessive forms. **Burgmeier et al.** is a practical work book aimed at learners of English. **Eggert** develops a systematic approach to vocabulary teaching based on semantic fields and valency. **Encinar** is a practical work book aimed at learners of Spanish. **Galisson** outlines an approach to vocabulary teaching which Galisson calls *lexicométhodolgie.* The approach stresses that L2 word meanings are not a given, but rather something which needs to be negotiated by learners. The three main chapters of this book deal with vocabulary as a component of communicative competence, the use of personalised dictionaries as a tool in vocabulary learning, and vocabulary as figurative language. (cf. also Galisson 1979). **Haastrup** is a version of a thesis which appeared in 1989. It makes extensive use of introspective reports from learners and analyses the inferencing strategies that they use when faced with unfamiliar words. **Johns and King** is a special issue of the *English Language Research Journal* published by Birmingham University. This collection is the only example of a special issue dedicated to vocabulary research in this year's outputs. **Pittelman et al.** develop an approach to vocabulary teaching based on semantic features, and has much in common with the text books developed by Rudzka at al. (1981). **Sokmen** is a text book aimed at learners of English. **Verhallen** reports a series of experimental studies which investigate depth of vocabulary knowledge in Dutch among L1 Turkish children. The data shows that these children have a smaller vocabulary than L1 Dutch children of an equivalent age and examines the size of this deficit. These children perform worse than L1 Dutch children on depth of vocabulary knowledge tests, even when these tests involve relatively "easy" vocabulary.
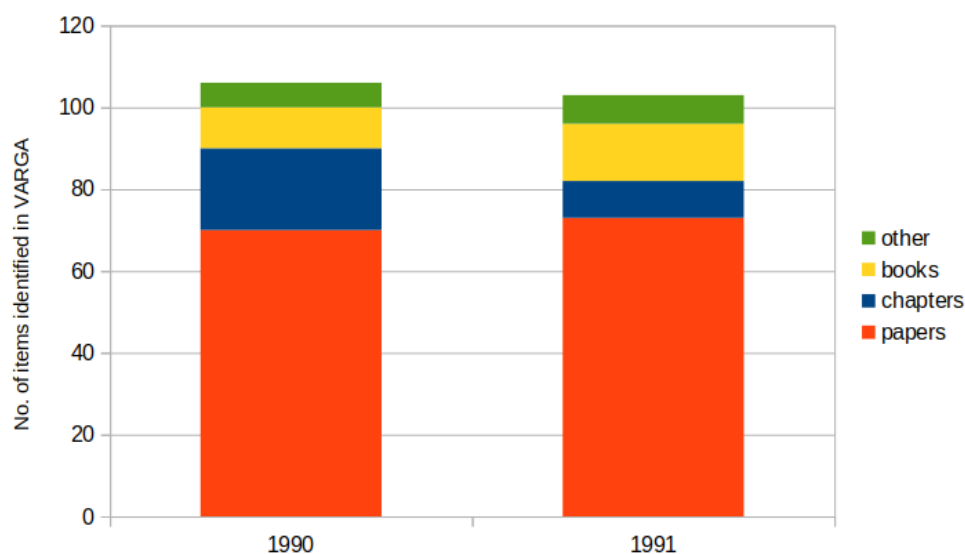

Figure 2: The 1991 research output by type

Table 8: *Book-length studies published in 1991*

Battenburg, J. D. (1991) English monolingual learners' dictionaries: a user oriented study. Tubingen: Niemeyer.

Beheydt, L. and T. Wieers. (1991) Elementair woordenboek Nederlands. Van In: Lier.

Broeder, P. (1991) Talking about people: A multiple case-study on adult language acquisition. Amsterdam: Swets and Zeitlinger.

Burgmeier, A, G. Eldred and C. B. Zimmerman. (1991) Lexis: Academic vocabulary study. Englewood Cliffs, NJ.: Prentice Hall.

Eggert, S. (1991) Wortschatz ordnen – aber wie? Überlegungen zu Lexiksystematisierung und -diffenzierung im Fremdsprachenunterricht Deutsch. Frankfurt: Lang.

Encinar, Á. (1991) Palabras, palabras: Vocabulario temático. Madrid: Edelsa

Galisson, R. (1991) De la langue à la culture par les mots. Paris: CLE international.

Haastrup, K. (1991) Lexical inferencing procedures. Tubingen: Gunter Narr Verlag.

Johns, T. and P. King (eds.) (1991) English Language Research Journal, volume 4.

Pittelman, S., J. Heimlich, R., Berglund and M French. (1991). Trabajos con el vocabulario. Análisis de los rasgos semánticos. Buenos Aires: Aique.

Sokmen, A. J. (1991). Common threads: an interactive vocabulary builder. Englewood Cliffs, NJ.: Prentice Hall.

Verhallen, M. (1991). Woordenschatuitbreiding bij anderstalige kinderen. [Second language vocabulary development in children.] Amsterdam, UvA Vakgroep Taalwetenschap.

The "other" items shown in Figure 2 include four doctoral theses. The VARGA database does not routinely monitor theses, as they tend not to be cited systematically in research papers. (In pre-internet days, it was practically impossible to get hold of theses unless they were published as books.)

As explained earlier, books, theses and unpublished reports are conventionally excluded from the author co-citation analysis that follows. This leaves us with a total of 75 outputs. For space reasons, I have not listed these items here, but interested readers can find a full list of these outputs in the VARGA database (https://www.lognostics.co.uk/varga) by entering **1991 ##** into the search box.

A total of 98 authors contribute to this data set. As usual, most authors (91) contribute just a single item to the data set with only a handful of authors contributing multiple outputs, see Table 9. The table also shows for comparison, the equivalent figures for 1990.

Table 9: *The number of authors contributing to N outputs in the 1991 data set*

No of outputs	5	4	3	2	1
1991 data		1	2	5	91
1990 data		2	0	6	87

The outstanding author here is Laufer, who contributes four papers to the data set. Laufer also contributed four papers to the 1990 data set, making her the most prolific author for two years in succession. The only other prolific author to appear in both the 1990 and the 1991 lists is Meara (two papers in the 1991 data set). Broeder (two papers in 1990) has fallen back to join the ranks of those who contribute only a single paper. The remaining prolific authors from the 1990 data set (Appel, Colpaert, Decoo, Schouten-van Parreren and Swartz) no longer appear in the prolific author list for 1991. There are, however, a number of new appearances in 1991. Bogaards and Scholfield contribute three papers each. Gruneberg, Kelly, Mondria and Stevens each contribute two papers. Bogaards is best known for his work on L2 dictionaries and their

users. Scholfield's papers, which were published in in-house journals deal with models of vocabulary uptake, and are far less well-known than they deserve to be. Gruneberg is a psychologist working on the potential of mnemonic systems for L2 vocabulary. Kelly, who had also published on L2 mnemonics in previous years, is working on listening errors in 1991. Mondria's two papers deal with lexical inferencing and rehearsal of new vocabulary. Stevens' two papers advocate for the greater use of concordances in teaching vocabulary. Overall, the new contributors seem to be strengthening existing themes that we noted in the 1990 data set. However, the overall rate of churn in the prolific authors list remains unusually high.

3.1. The data sources

The VARGA database (Meara n.d.) identified 82 outputs published in 1991 that were eligible for inclusion in the analysis that follows. A small number of these outputs were unobtainable, and these items are listed in Table 10.

Table 10: Outputs published in 1991 that proved to be untraceable

Anthony, E. and L. Menasche. 1991. Teaching Vocabulary: the current word. In *JE Alatis* (ed) *Georgetown University Round Table on Language and Linguistics.* Washington DC: Georgetown.

Carroll, M. C. and O. Mordaunt. 1991. The frontier method of vocabulary instruction. *TESOL Journal* 1(1): 23-26.

Han, M. 1991. A study on Korean college students' vocabulary learning strategies. [In Korean] *Studies in English Education*:103-126.

Henrici, G., F. Kostrzewa and E. Zofgen. 1991. Zur Wirkung von Bedeutungserklarungsverhafen auf Verstehen und Behalten: Ergebnisse aus einem empirischen Projekt. *Zeitschrift für Fremdsprachenforschung* **2(2):** 30-65.

Howard, R. 1991. Teaching medical English vocabulary systematically. *EMP Newsletter* 8: 15-21.

Lockhart, W. F. 1991. Estimating the students' active and passive vocabularies. *Zutabe* 23.

McLure, E. A. 1991. A comparison of lexical strategies in L1 and L2 written English narratives. *Pragmatics and Language Learning* 2: 141-154.

As usual, the main analysis of the 1991 data set is principally interested in identifying the sources that are co-cited within the data set. The methodology for doing this has been described in detail in the earlier papers in this series (see Appendix 1). For 1991, the analysis identifies 1485 sources – about the same number that we identified in the 1990 data set. As usual, most of these sources are cited only once (1134 cases), but a small number of sources are cited more frequently than this, and appear to be more central to the field. The data is summarised in Table 11.

Table 11: The number of times sources are cited in the 1991 data set

frequency	25	24	23	22	21	20	19	18	17	16	15	14
cases											1	
frequency	13	12	11	10	9	8	7	6	5	4	3	2
cases	1	1	2	1	2	4	4	14	13	36	62	211

The most frequently cited sources in this data set are Meara (15 citations), Nation (13 citations), Carter (12 citations), Laufer and Richards (11 citations each), Atkinson (10 citations), Gairns and Redman (9 citations each), Aitchison, Krashen, McCarthy and Pressley (8 citations each). Meara, Nation and Carter continue to head up this list, as they did in 1990. Laufer, Richards

and McCarthy all improve their positions slightly. AD Cohen, Palmberg, Lockhart and Levenston, who were all highly cited in the 1990 data set, no longer appear in the list of most-cited sources. Their places have been taken by Atkinson, Gairns and Redman, Aitchison, and Pressley. Overall, the data shows a small increase in the number of sources cited 2, 3 or 4 times, but a slight decline in the number of very frequently cited sources.

3.2. *The analysis*

The next step in our analysis of the 1991 data is to construct a mapping which shows the co-citations among the most frequently cited sources in the data set. Conventionally, we do this by setting an inclusion threshold which identifies 100 most frequently cited sources. For the 1991 data set, it is difficult to set an inclusion threshold that is gives us anything close to this conventional figure: the best match appears to be four citations, but only 78 sources are cited four times or more in the data set – rather fewer than we would like. However, this threshold value is the same as the threshold we used in our analysis of the 1990 data set, and this somewhat facilitates the year on year comparisons. These 78 sources make up 29% of the sources that are cited more than once in the data set.

   Table 11 below lists the general characteristics of the data set, and provides comparison figures with the 1990 data set. At first glance, the two data sets appear to be very comparable, but the figures actually mask some important changes in 1991 and these changes will be discussed in more detail later.

   The co-citations among the 78 sources were extracted from the complete data set and the results analysed using the Gephi software package (Bastian, Heymann and Jacomy: 2009). Figure 3 shows a spanning tree mapping for this data set, where the edges show the strongest links between the nodes. The equivalent spanning tree for the 1990 data can be found in Appendix 3.
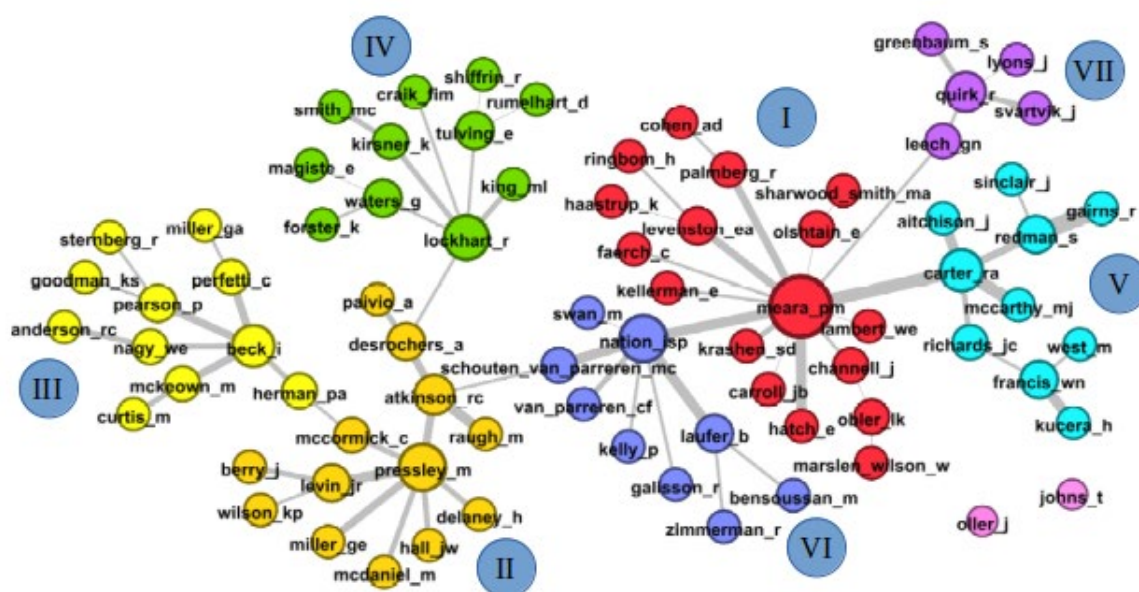

Figure 3: *The 1991 data set mapped as a spanning tree*

Gephi finds seven clusters in this data set, plus two detached nodes. See Table 11 and Table 12.

Table 11: *The general features of the 1990 and 1991 data sets*

	1990	1991
Sources included	66	78
Inclusion Threshold	4	4
Clusters	10	7+2
New sources		44
Lost sources	31	

Table 12: *The Clusters identified in the 1990 and 1991 data sets*

Cluster	1990	1991
I	Vocabulary acquisition and transfer (16)	Vocabulary acquisition and transfer (14)
II	Performance of bilinguals (11)	Mnemonics and imagery (13)
III	Practical applications (8)	L1 reading skills (11)
IV	Applications of semantic theory (5)	Performance of bilinguals (10)
V	L1 Reading skills (4)	Corpora and discourse (10)
VI	Inferencing and introspection	Vocabulary uptake and inferencing (9)
VII	L2 vocabulary learning	Descriptive approaches to English (5)
VIII	Error and uptake (4)	(Johns, Oller)
IX	Frequency counts (3 + 2)	
X	Dutch research (3)	
XI	Frequency counts 1 (3)	
XII	Frequency counts 2 (2)	

Cluster I, the largest cluster with 17 sources focussed on Meara, is mainly composed of sources with interests in transfer, and psycholinguistic features of L2 vocabulary acquisition. **Cluster II,** 13 sources focussed on Pressley, is an L2 mnemonics and imagery cluster. **Cluster III,** 11 sources focussed on Pearson and Beck, seems to a be set of sources whose main interest is L1 reading behaviour. **Cluster IV,** 11 sources focussed on Lockhart, is the familiar set psycholinguistic sources with interests in the behaviour of bilingual speakers, and the way bilingual lexicons are structured. **Cluster V,** 10 sources focussed on Carter and McCarthy, is mainly concerned with applications of corpora to vocabulary teaching. **Cluster VI,** 9 sources focussed on Nation, is a new cluster, which seems to be mainly made up of European L2 researchers with an interest in how learners compute the meaning of unfamiliar words. **Cluster VII**, 5 sources focussed on Quirk, is a group of researchers who work on descriptions of English. The two detached sources are Johns and Oller. Johns seems to be most closely linked with cluster V, as his work is principally concerned with concordances and their applications. Oller seems to be a representative of a strand of language testing, which has not figured so far in these maps**.**

Structurally, Gephi's analysis seems to give us three main groupings in the 1991 data-set. Cluster I and Cluster VI represent the main on-going research in L2 vocabulary learning and teaching. Clusters II, III and IV represent more empirical sources, most of whom are psychologists. Clusters V and VII represent descriptive linguistic approaches to vocabulary, with an emphasis on computer-based descriptions of English. The spine of the map is the set of strong co-citations linking Carter, Meara, Nation and Laufer.

Table 12 provides a comparison of these clusters with the equivalent clusters identified in 1990. The obvious point to make here is that the 1991 data set contains fewer, larger clusters than we find in the 1990 map. The surprising emergence of a very large mnemonics and imagery cluster, and the appearance of two clusters that deal with descriptions of English appear to mark a significant shift in the topics that are the main focus of research in 1991. Also striking is the large increase in the number of L1 reading sources – this set of sources now appears as cluster III, the third largest set of sources in the 1991 map.

These changes are also reflected in the membership of the clusters. The list of sources who make up the 1991 data set is substantially different from the sources we find in the 1990 data set, and there is a huge turnover between these two years.

Table 13 lists 31 sources appearing in the 1990 data set who do not play a role in the 1991 data set. Some of these sources are major figures who have significantly influenced the research we have logged in previous reports: H. Clark and R. Brown (important links to the L1 research), Corder (a hugely significant figure in UK Applied Linguistics), Thorndike and Lorge (an important word frequency count), Gass, Schumann, Stevick, Swain and Tarone (all important US SLA theorists), and Kasper (a key figure in European SLA research at this time) are particularly noteworthy in this respect. Also noteworthy is the loss of sources involved in text books and accounts of the research aimed at practitioners (Ostyn, Putseys and Rudzka, Morgan and Rinvolucri, Wallace).

Table 13: *Sources with a role in the 1990 data set, but failing to appear in the 1991 data set*

Anderson JR   Beheydt L   Brown R   Clark HH   Corder SP   Cutler A   Ehri L   Elley W   Feldman L   Gass SM   Green DW   Howatt APR   Ingle S   Jain M   Johansson S   Kaper G   Lorge I   McLaughlin B   Morgan J   Morton J   Ostyn P   Phillipson R   Putseys Y   Rinvolucri M   Rudzka B   Schumann J   Stevick E   Swain M   Tarone E   Thorndike EL   Wallace M.

In contrast, more than half of the sources that appear in the 1991 data set are new – though some of the sources are returners, sources who did not figure in the 1990 set, but are here re-asserting their status. The 44 new sources are listed in Table 14, which also records which cluster these new sources are associated with. Overall, there appears to be a noticeable shift towards sources who work in psycholinguistics, and a reduction in the number of sources whose main influence lies in the applications and popularisation of theory.

Table 14: *The 44 new sources and their cluster assignment in the 1991 data set. Returners shown in italics*

Cluster	
I	*Carroll JB Lambert WE Obler LK Olshtain E Sharwood Smith MA* Marslen-Wilson W
II	*Atkinson RC Berry J Delaney H Desrochers A Hall JW* LevinJR *McCormick C McDaniel M Miller GE Paivio A Pressley M Raugh M Wilson KP*
III	Beck I Curtis M Goodman KS McKeown M Pearson P Perfetti C Sternberg R
IV	Forster K *Tulving E* Waters G Rumelhart D Shiffrin R Magiste E
V	Sinclair J
VI	*Gallison R* Kelly P Swan M *Zimmerman R*
VII	Greenbaum S *Leech GN Lyons J Quirk R Svartvik J*
Detached	Johns T *Oller J*

Table 15: *The strongest links in the 1991 data set*

Link weight	1990	1991
9		Gairns~Redman
7	Gairns~Redman	Carter~Meara Carter~McCarthy Carter~Aitchison
6	Cohen~Meara Nation~Meara Kirsner~Smith Carter~McCarthy	Nation~Schouten-van Parreren Laufer~Nation Raugh~Atkinson Nation~Meara Levin~Pressley Kucera~Francis

In 1991, we have fewer clusters than in 1990, but the individual clusters are larger, and the 1991 map suggests that some re-positioning is taking place in the central part of the field. The biggest change between the two maps is that Meara's role as the single major hub in the 1990 data set has notably diminished. Instead, the core of the 1991 map is a spine of strongly linked sources, – Schouten-van Parreren, Laufer, Nation, Meara, Carter, McCarthy and Aitchison. (See Table 15).

Although the cluster focussed on Meara still remains the largest cluster in the 1991 map, the composition of this cluster has changed considerably. Gass, Ingle, and Howatt have all disappeared; George Miller has moved to Cluster III; Carter, McCarthy, West and Aitchison have moved to the new cluster V; Nation has moved to become the focus of the new cluster VI. This leaves Cluster I with a hard core of only four members: Meara, Cohen, Ringbom, and Kellerman who are joined by nine new members: Faerch and Haastrup, Levenston, Palmberg, and Channell (all members of smaller clusters in 1990), Sharwood Smith, Olshtain and Obler (returners from previous maps), and the only genuinely new source: Marslen-Wilson (a psychologist working on L1 word-recognition).

Clearly, the big winners in 1991 are the clusters, II, III and IV. The new cluster II is particularly important because it does not have a presence in the 1990 map, and represents a marked change of direction. This cluster contains two of the strongest co-citation links in the map: Raugh and Atkinson –co-authors of the classic papers on L2 mnemonics published in 1975 – and Pressley and Levin – co-authors of a series of papers that appeared between 1978 and 1985 (e.g Pressley and Levin: 1978 and Pressley, Levin et al.:1980). Most of the members of this cluster are actually returners – sources who were cited in papers published in the early 1980s, but not in more recent research. Most of the work cited was first published in the late 1970s, and it does not appear to have had much impact on research by applied linguists. Why this research is resurgent here is not entirely clear, but it may have something to do with the commercial exploitation of the keyword method by Michael Gruneberg, a psychologist working at Swansea University, and subsequent widespread discussion of his *Linkword* method in the UK media.

Cluster III (L1 reading) did have a small presence in the 1990 map, but here it appears to have doubled in size, and moved up to third place in the list of clusters. This change seems to be not so much a change of direction, but rather a change of emphasis, with new L1 sources being cited by L2 reading researchers. The volume of papers edited by McKeown and Curtis in 1987 seems to be a major influence here (McKeown and Curtis: 1987).

Cluster IV is unusual in that, although it is clearly the successor to Cluster II in the 1990 map, more than half of its membership has changed. The core members of this cluster – Craik and

Lockhart, Kirsner, King and Smith – are all long-standing members of the L2 performance cluster, but the priorities of this cluster seem to be shifting in the direction of bilingual memory, and formal models of bilingual lexicons. It is noticeable that most of the earlier members of this cluster have now disappeared from the mapping – only Lambert retains a tenuous presence in Cluster I.

Cluster V is also unusual, but for a different reason. All the members of this cluster were already to be found in the 1990 map, but there they mostly appeared in Cluster I. There is some evidence here that the linguistic approaches to L2 vocabulary acquisition are moving away from the mainstream L2 vocabulary research. We might expect this cluster to merge with the new Cluster VII in future maps. Notably absent from the 1991 mapping is a cluster that deals with L2 dictionary use. This strand of research is prominent in the 1987-91 map, where it appears as Cluster VI, focussed on Cowie, and a sub-cluster of (English) dictionary researchers focussed on Quirk, Carter and McCarthy. In 1991, the Quirk sub-cluster appears as a new independent cluster that is largely detached from the sources dealing directly with corpora.

Cluster VI is a new cluster focussed on Nation. This cluster seems to have brought together a number of previously disparate sources whose main interest is L2 reading. Noticeable sub-clusters here are the Dutch research sources and a strong Israeli presence including Laufer and Bensoussan. This cluster has also absorbed two sources who have played only a marginal role in our earlier maps – Galisson and Zimmerman, core sources for French language and German language research respectively.

The final point to note about the 1991 map is that it appears to indicate a shift away from practical applications of L2 vocabulary research. Previous maps highlighted the role of text books as influential sources on the research – Rudzka, Ostyn, Putseys and Channell (authors of *The Words you Need* series of textbooks) appeared as a separate cluster in several of our earlier maps, including the 1990 map, but these sources do not figure in the 1991 map. Likewise Morgan and Rinvolucri (1986), and Wallace (1982) whose introductory text books figured largely in the earlier maps, have all slipped out of the list of important sources in 1991. The sole remaining example of sources of this type is Gairns and Redman's (1986) work, which appears as a sub-component of Cluster V in 1991.

4. Discussion

Some readers may be surprised that the strongest co-citation link in the 1991 data set is Gairns and Redman. These names actually refer to a textbook that describes itself as "a practical guide for teachers on how to select, organise and teach vocabulary to all levels of students. It discusses the linguistic and psychological theories relevant to vocabulary learning … an ideal resource book for practising teachers and teachers in training" (publisher's blurb). This is a book that is genuinely reflective and practical. Even 37 years after its first appearance, this book bears re-reading and not just as a record of what people were thinking at the time.

The book is far from a traditional academic textbook. The approach it takes relies heavily on "reader activities" – tasks designed to make readers think about why vocabulary learning might not be a straightforward activity, and why we need to understand how words work. The text is divided into four parts: Words – their meanings and forms; Principles in learning and teaching vocabulary; Classroom activities; and Vocabulary in course books.

Working with Words first appeared in 1986, and is usually cited in the 1991 research literature as a general text that underlines the importance of vocabulary in language teaching. However, in reality it is much more than that, and in some ways the book could be considered as a pre-cursor to Nation's *Teaching and Learning Vocabulary* which appeared in 1990 – too late to have a significant impact on the outputs that appeared in 1991. Both texts cover much of the same ground, but *Working with Words* is considerably shorter than Nation's work, and it does not detail the background research as explicitly as Nation does. The background reading section runs to slightly less than a page, and cites only three research articles (Alptekin and Alptekin: 1984; Meara: 1980; and Richards: 1976) as compared to the very extensive bibliography (37 full pages) in Nation's book. This should not be taken as a criticism, however. *Working with Words* was reprinted 10 times by 1996, indicating that L2 vocabulary acquisition was not just a topic of obscure academic interest. Rather, the book was tapping into something that ordinary readers, not just vocabulary specialists, considered to be genuinely important at the time. The text is particularly strong in the way that it interprets current research in semantics, which explains why Gairns and Redman appear in Cluster V in the 1991 map, closely associated with Carter and McCarthy.

The main point to take away from these analyses is that the stability illustrated in the five-year map covering 1987-91 map may be deceptive. When we look in detail at the data for 1991, a much less stable picture emerges, with large changes both at the level of individual sources being cited, and a significant shift in the overall structure of the map. In both maps, we have three main territories – a set of descriptive linguistic sources, a set of L2 learning/teaching sources, and a large set of sources who come from a psychological tradition. These psychological sources taken together actually make up the largest component in the 1991 map – the first time that this has happened in these analyses. Nevertheless, the links between the psychological sources and the linguistic sources remain tenuous.

In the analyses reported in this paper, I have used a new method of displaying the co-citation patterns within the data sets. In my previous papers, the co-citation maps included a very large number of co-citation links. Once the basic parameters of the map were established, I drew maps which displayed as many co-citation links as were needed to show the overall structure of the data. The problem with this approach is that the resulting maps became increasingly complex as the data sets increased in size, and it was necessary to introduce arbitrary cut-off levels in order to keep them manageable. The resulting maps were not easy to read, and they were becoming increasingly complex as the number of outputs published in single year increased steadily. More importantly, perhaps my interpretation of the maps was becoming increasingly subjective.

In order to address these problems, I have used in this paper a stricter, more principled approach, displaying the data as a spanning tree in which every node is shown linked to the node it is most strongly associated with. The resulting trees are simpler and easier to read than the trees in my earlier papers. The new trees all have N-1 links, where N is the number of nodes in the data set (so, a data set with 100 nodes will be linked into a tree with 99 edges). The main advantage of this approach is that it makes it much easier to compare consecutive data sets: as long as two trees contain the same number of nodes, the number of links joining them together will be the same as well. This was definitely not the case with our earlier maps, where the number

of links on display could vary considerably between one map and its successor. The spanning tree maps make it easy to identify the structures in the data, and make it particularly easy to identify changes from one map to the next. The spanning tree maps also make it easy for us to identify the strongest co-citation links in the data set. In addition, we can easily identify hubs in the dataset – sources which act as the strongest link for a large number of other dependent nodes and play a major role in the structuring of the map. Again, this data was available in our earlier maps, but it was obscured by other factors – notably the raw number of citations that each node contributes, irrespective of the importance of these connections.

Of course, these advantages come at some cost. The basic problem is that the spanning tree maps encode more information than our earlier maps, but they do not always display this information directly – the 1991 map, for instance, is built around a set of only 75 co-citation links, since it shows only the reduced set of links that are sufficient to join all the nodes together into a single structure. More importantly, perhaps, it is sometimes necessary to invoke very weak links in the data set in order to complete the spanning tree, and to ignore stronger links that are redundant. This sometimes creates a false impression of the importance of specific nodes. (See the discussion of this point in Appendix 1.)

In Figure 3, for example, Cluster II and Cluster VI are joined by an edge that links Atkinson and Schouten-van Parreren which occurs only three times in the data set. In our earlier analyses, a link as weak as this would have been filtered out, as would the 12 edges with a weight of only 2 that appear in Figure 3. To some extent, we can correct for this shift by looking at the distribution of the edge weights, (see Table 16). Table 16 shows that the 1991 data set contains a handful of very strong links, but it also contains a larger number of weak links than we reported for the 1990 data set. Interestingly, seven of the twelve very weak links (Meara ~ Lambert, Meara ~ Carroll, Meara ~ Olshtain, Olshtain ~ Sharwood Smith, Obler ~ Channell, Obler ~ Marslen-Wilson and Haastrup ~ Levenston) are to be found in a single cluster – Cluster I in Figure 3. This surprising finding suggests that this cluster may be considerably less solid than it appears to be at first glance. It is worth noting, however, that a subtle feature of this sort, which strongly suggests that the 1991 maps need to be handled with some caution, would not have been obvious in our earlier maps.

Table 16: *The distribution of edge weights in 1990 and 1991*

	9	8	7	6	5	4	3	2
1991	1		2	7	9	18	25	12
1990			1	5	9	22	18	7

A further problem with the spanning tree maps is that they can sometimes give the false impression that there are no connections between the clusters other than the ones shown in the mapping. This is clearly not the case: as we saw in the earlier papers in this series, multiple connections between the clusters do exist, and sometimes these links are quite strong – indeed stronger than some of the links in the spanning tree diagrams. This loss of information clearly needs to be addressed.

The best way to address these problems seems to be to develop a way of looking in more detail at the individual clusters and the way they interact with other clusters in the dataset. I will report some new analyses that address these issues in the next paper in this series.

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Appendix 1: Co-citation analysis: The methodology

The co-citation method used in this paper was developed by Small in a number of papers published in the 1970s (e.g. Small: 1973). This approach, which was actually built on earlier bibliometric work by da Solla Price (1965), has been extensively used to analyse research in the natural sciences (e.g. White and Griffith 1981) but does not seem to have been adopted as a standard tool by researchers in the Humanities.

The raw data for a co-citation analysis consists of a list of all the authors cited in the set of papers to be analysed. For each paper in the data set, we make a list of every author that the paper cites; for each paper, each cited author counts only once, regardless of how many times they are cited in the paper; and for a cited paper with multiple authors, each of the contributors is added to the author list. Self-citations, where an author cites their own work, are treated in the same way as any other citation, on the grounds that authors only rarely fail to cite their own work. This raw data is then used to construct a large matrix showing which authors are cited together in each of the papers in the data set. The matrix can then be analysed using a program such as Gephi (Bastian, Heymann and Jacomy: 2009). Gephi performs a cluster analysis on the data, groups together authors who tend to be cited alongside each other in a number of papers, and outputs a mapping which shows the composition of the clusters and the relationship between them. The clusters are generally taken to represent "invisible colleges" in the data.

The maps presented in this paper are a simplification of the maps that appeared in the earlier papers in this series. The earlier maps tried to capture the relationships between the sources by including any co-citation link which was stronger than a chosen threshold value – for example, we might include any link with a weighting of 8 occurrences or more in the data

set. The threshold values were chosen to avoid cluttering up the visuals with very weak connections, but they varied from one report to another, and were essentially arbitrary.

In this paper, I have adopted an alternative solution to this problem, by displaying the data in the form of a **spanning tree.** In this alternative approach, we start with a list of nodes, a list of all the co-citation links between them ordered by their weight, and an empty map containing no nodes. We then build a map by working through the ordered list of links, and following the steps outlined in an algorithm developed by Prim (Prim: 1957). Starting with the strongest link, we add nodes and edges to the empty map as long as the new edge does not lead to a cycle. That is, if we have a new edge A ~ B, and our tree does not already contain a link (direct or indirect) between node A and node B, then we add the edge A ~ B to the map, adding new nodes as necessary. The map grows in a piecemeal way at first, adding pairs of strongly connected nodes to the map, but eventually, the algorithm finds a set of links that connects each node to another by its strongest connection.

Some advantages and disadvantages of this approach are discussed in the main body of the paper.

Appendix 2: Lotka's model

Lotka (1926) suggested that there might be a straightforward relationship between the number of authors who contribute a single paper to a field and the number of authors who make multiple contributions to the field. Suppose, for example, that we have 250 authors who make a single contribution to a data set, then it would be unusual to find only one author who makes two contributions, and it would likewise be very unusual to find that a single author who makes twenty contributions, while no other authors make more than one contribution to the data set. Lotka suggested that the expected relationship could be described as a power law:

$$E_N = T / N^x$$

where   T is the total number of authors who contribute a single paper to the data set,
            N indicates 2,3,4,5... outputs,
and E_N is the expected number of authors contributing to N outputs.

In practice, the value of x (the exponent in Lotka's formula) is usually around 2 – that is, a value of 2 for this exponent gives a fair approximation of what happens in real life. So, for a data set in which 250 authors contribute to just one paper in the data set Lotka's model predicts that we can expect $250/2^2 = 63$ authors who contribute to two papers in the data set, $250/3^2 = 28$ authors who contribute three papers to the data set, $250/4^2 = 16$ authors making four contributions to the data set, and so on as shown in the table below.

***Table 17:** An illustration of Lotka's Law with x=2 and N^1=250.*

contributions	10	9	8	7	6	5	4	3	2	1
Expected E_N	2	3	4	5	7	10	16	28	63	250

Clearly, this model predicts that the number of papers an active researcher might be expected to produce falls off rather quickly. Empirical tests of what has become known as "Lotka's Law" do seem to work well. However, the model works best when we are dealing with well-established fields, and very large data sets. The single year data sets that I have discussed in this series of papers are not a close match to Lotka's expectations, but the larger 5-year data sets are generally a better fit to the power law model. In both cases, however, we get a much better fit when the value of N^x is raised above 2. For example, we get the best fit for the 1987-1991 data set when x = 3.01. This is higher than the equivalent figure for 1986-90, which was x = 2.7, though both figures need to be treated with some caution because the data sets are relatively small. Higher values of x seem to be typical of immature, highly volatile fields. Generally speaking, the exponent values we find for the L2 vocabulary research literature are higher than we would normally expect. The rise in the 1987-91 figure seems to suggest that the field is still relatively immature, and far from settling down.

Appendix 3. The 1990 spanning tree.

The data for 1990 as reported in my last study is not directly comparable with the 1991 data reported here because 1991 data is reported in the form of a spanning tree, rather than an all-inclusive map. In order to facilitate the discussion, I have included here a map which displays the 1990 data in the form of a spanning tree based on the same procedures that generated Figure 3 for the 1991 data.
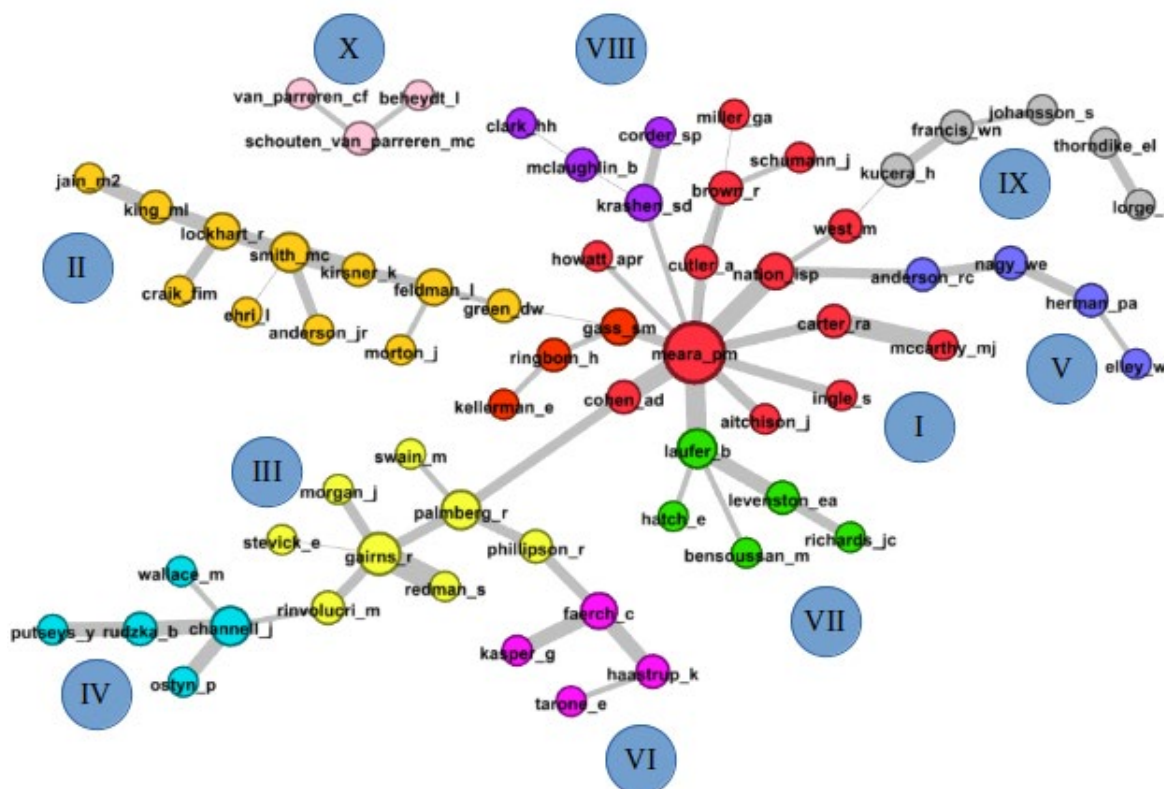

Figure 4: *The 1990 data set displayed as a spanning tree.*