

Bibliographical research in the study of Hebrew printing: a bibliometric analysis

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Abstract The study presents the state of bibliographical research in the discipline of Hebrew printing during a 30-year period, ranging from the latter quarter of the twentieth century until the beginning of the third millennium (1976–2006). Through bibliographical parameters it characterizes the publications dealing with Hebrew printing, examines whether the published material exhibits laws and systematic regularities that are consistent with Bibliometrics, and describes directions in which the field has developed.

Keywords Bibliometric analysis · Bibliography · Hebrew printing

Introduction

The documentation of bibliography provides us with a very detailed set of parameters that enable us to map the bibliographical research in the study of Hebrew printing. It enables quantification of parameters such as: the number of publications printed in a given time, the subject matter of the publications, number of publications per journal, number of publications per author, preferred form of publication (article, book etc.), language and so on. Quantitative analysis of bibliographical material using statistical tools enables us to investigate and learn about research trends, the development of research topics, research locations, languages and types of publications, to identify researchers in the field, to identify core periodicals and so on.

Bibliographical research in the study of Hebrew Printing deals with publications printed in Hebrew script in languages such as: Hebrew, Yiddish, Ladino, and also writings that were printed in Hebrew transliteration, such as Judeo-Arabic, Judeo-German etc.

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The goal of the present study is to present empirical data that use bibliometric analysis of the inventory of bibliographical research in the study of Hebrew printing published between the years 1976–2006; to characterize the publications, to examine whether the published material exhibits laws and systematic regularities that are consistent with bibliometric laws and regularities, and to describe directions in which the field has developed.

Definition of the field

The beginning of modern scientific bibliographical research on the Hebrew book can be found in the historical and informative records that documented the Jewish bookshelf (Tashma 1974). Since the nineteenth century, leading bibliographers, such as Moritz Steinschneider, have documented the wealth of Hebrew literature, starting from the early days of Hebrew printing. In the course of time, bibliographical documentation has become broader in scope and has become standard practice, carried out at regular intervals, with a predetermined, standard cataloguing policy. Bibliographical documentation was a necessary preliminary stage that served as a basis and provided tools for comprehensive, objective historical research on Hebrew culture. On the basis of bibliographical documentation, research on the history of Hebrew books expanded and adopted numerical research methods characteristic of other fields, such as the social sciences. With the help of statistical tools, new research methods developed for the study of the Hebrew printed book.

Very few studies have applied bibliometric methods to Hebrew bibliography for the purpose of studying Hebrew printing. In her paper “The study of the Hebrew book and the field of bibliometrics” (Baruchson 1989), Shifra Baruchson points out that bibliometrics and the discipline of “*Livre et Société* [book and society]” can, and should, be combined, and presents ideas for implementing bibliometric methods in the study of the Hebrew book. Bibliometrics, as used for the analysis of bibliographical material from the field of Jewish studies, is found in a paper written by Moshe Yitzhaki, who examined the place of Hebrew books and papers in Bible research (Yitzhaki 1982). By analyzing citation patterns in articles appearing in a journal specializing in the fields of Bible studies, the New Testament and the Ancient East, Yitzhaki concludes that Israel has become a centre for research in the field of Bible studies and the Ancient East, and that a marked rise has occurred in the number of Jewish researchers in the field. On the other hand, there is an indication that research worldwide makes little use of material that has been published in Hebrew and in Israel. Yael Atiyah utilizes bibliometrics to measure Israel’s contribution to Jewish studies research as compared to the rest of the world. Her findings show that although Israel leads in Jewish studies research, Jewish studies is an important, well-established academic field in many countries, and the gap between Israel and other countries is not great (Atiyah 2006).

Literature review

Research fields have typical life stages that recur in many fields. According to Goffman’s Epidemic Theory (Goffman 1964), the development of a scientific field is slow at first, and in a given period (for example, a year) few publications appear. In the course of time, one publication leads to another and at a particular point in time a sudden rise in the number of publications per period occurs, until saturation point is reached. At this point, the number of publications per period falls, and the growth in number of publications per period becomes slow once again. Quantitative analysis of scientific publications enables us to trace the stages of growth of a particular discipline.

By this means, Derek J. de Solla Price developed bibliometric models to describe and forecast the growth of scientific fields. Based on variation in the number of researchers in a certain field and variation in the number of papers published in each period, Price attempted to estimate the development of a certain field and to find laws and regularities in the behavior of scientific material in that field.

Price called attention to the exponential distribution in the growth of scientific knowledge (Price 1963).¹ He found that knowledge grew exponentially at the rate of approximately 5% over 200 years, with doubling time—the constant period in which the literature grows—of 15 years (Tague et al. 1981).

As far back as 1963, Price maintained that the exponential law may possibly become no longer applicable and that exponential growth cannot continue indefinitely. He foresaw that when a limit is imposed on growth in such a process, different reactions may be observed: the acceleration of a new process, loss of definition of the old process, a broad range of oscillation, or oscillation converging towards the limit. He felt that changes in the structure of communication among scientists resulting from technological innovations would lead to a new situation in which publications would be of secondary value compared to the new technologies, serving popular rather than scientific needs (Tague et al. 1981).²

Menard distinguished between three sub-fields: stable fields that tend to a slow rate of linear or exponential growth; growth fields that tend to a fast rate of exponential distribution; and cyclic fields that alternate between periods of stability and growth (Tague et al. 1981).³ It would seem that Menard's model is consistent with the epidemic theory.

A precondition for the development of a field of research is researchers' commitment to the field. Mullins studied a group of bacteriology researchers (Mullins 1972). Initially, the field developed in a way that showed promise of a new research field. However, for 30 years, its researchers, who came from molecular biology, showed no real commitment to bacteriology, and ultimately, it was absorbed into the field of molecular biology. When researchers see themselves as part of the field, "healthy" competition ensues—for prestige, professionalism, status and the positioning of the researcher within the field.

Another theory developed by Price of cumulative advantage processes, (Bensman 1982) states that in a situation in which we have to select one item out of a collection of similar items, success leads to further success. In other words, particularly prolific scientists repeat or increase their success, whereas very unproductive scientists tend to produce even less in the course of time. Similarly, a scientist prefers to publish a scientific paper in a journal in which the best papers in the field have appeared in the past. Since a journal that publishes the top papers will be cited frequently, it will also receive more papers, and so forth. This means that there is a productive core of researchers (and similarly, a productive core of periodicals) that is responsible for publishing papers in the field. According to Price's theory, the same researchers who were productive in their early years of research will continue to be prolific, even when their advancement is no longer dependent upon their writing. In contrast, researchers who published little in their early years will continue to be unproductive in their latter years, too. This data can be expressed on a graph in the form of a hyperbola, with the number of writers on the *X*-axis and their output on the *Y*-axis.

¹ A distinction must be made between growth in knowledge and growth in literature or number of publications. Growth in knowledge is a rather abstract concept, and in bibliometrics growth in the number of publications is sometimes used as an index or operative definition of growth in knowledge.

² Tague, Jean, et al., op. cit. p. 143.

³ Tague, Jean, et al., op. cit. p. 128.

Another way to examine the data is to investigate the concentration of output and to find a relation between writers and the number of publications that each one produced. Lotka found an inverse relationship between the number of writers who produced the same number of writings and the number of publications they wrote. The number of writers who each write n papers is approximately $1/n^2$ of those who each produce only one paper (Potter 1981). He also calculated that approximately 60% of writers publish only one paper each, and therefore, 15% published 2 papers, 6.6% published 3 papers each, 3.75% published 4 papers each,...0.6% published 10 papers each and so on (Bensman 1982).⁴

Since Lotka's law was established, many empirical studies were conducted in many fields. Askew Consuella, in her dissertation, presents tables which summarize bibliometric studies made in different fields, and if they follow Lotka's law or not (Askew 2008).⁵

On the basis of Lotka's equation, Price investigated further and found that half the publications were written by the square root of the number of writers (Bensman 1982).⁶ Cole & Cole calculated that half the publications were published by approximately 10% of writers (Bensman 1982).⁷ They posited that this phenomenon can be explained by means of two opposing theories. According to one theory, scientists who publish most of the significant work receive the widest recognition they deserve, while those who do not publish any significant work are ignored. According to the second theory, a small elite in a handful of universities and laboratories supported by the government dominate social institutions of science in such a way as to perpetuate their own ideas (Bensman 1982).⁸ In the Cole brothers' opinion, in nearly all cases in which the second theory is applicable, we find a cumulative advantage process at work. Those who are successful in their early days are more likely to be so in later periods, irrespective of their objective performance. Initial success constitutes an advantage in competition for prizes.

In 1949 George K. Zipf established the principle of least effort. According to this law, resources (people, knowledge, etc.) organize themselves so as to achieve maximum production with minimum resource. From a study he conducted he found that 20% of the resource was responsible for 80% of the production. That is, 20% of the authors were responsible for 80% of scientific studies.

Research aims

Bibliometric research attempts to estimate the development of disciplines, and to find laws and regularities in the behavior of scientific material in a certain discipline. Examining data in the light of bibliometric literature will give us an indication of the behavior of bibliographical research in the study of Hebrew printing as a research discipline.

Research questions

In this study the first questions we asked ourselves were: is bibliographical research of Hebrew printing a scientific field; does it meet bibliometric criteria for the study of laws and regularities in scientific fields? or does it belong to other fields?

⁴ Bensman, Stephen J. op. cit. p. 280. Concerning Lotka's law and its use in researches, see: Askew (2008).

⁵ Askew, Consuella Antoinette. "An Examination of Lotka's Law". op.cit. p. 25, Table 1.

⁶ Bensman, Stephen J. op. cit. p. 285.

⁷ Bensman, Stephen J. op. cit. p. 283.

⁸ *ibid.*

If it is indeed an independent scientific field, at what speed does bibliographical research develop, and what life stage has it reached?

Methodology

In order to conduct a bibliometric study in the study of Hebrew printing, a comprehensive scientific bibliography in the field is necessary. We found comprehensive bibliographical records of research studies in the field in two bibliographical databases: 'The Index of Articles on Jewish Studies' [Rambi] and 'Qiryat Sefer'. These databases contain bibliographical records of the research yield in the various fields of Jewish studies and the study of Eretz Israel, published around the world in any language. These comprehensive and authoritative bibliographical databases are under the auspices of the National Library of Israel.

From these databases we collected bibliographical studies published between 1976 and 2006 that discuss publications printed in Hebrew script: Hebrew, Yiddish, Ladino, and also writings that were printed in Hebrew transliteration, such as Judeo-Arabic and Judeo-German. Of the retrieved records we took a cross-section of writings that were published in Hebrew and in Latin script. We did not include writings that appeared in Cyrillic or Arabic script, unless a translation into Hebrew or English existed.

In the process of collecting the material, we bore in mind the question: is the principle subject of the work about Hebrew printing? Subjects like: the development of the various editions of a specific book, discussion of a particular edition, the development of Hebrew printing in general and in Jewish communities in particular, the history of the Hebrew book, the development of a specific Hebrew newspaper etc., all fell within our sphere of interest. We defined several general topics to cover the range of possible topics for bibliographical research: incunabula, bibliography, the development of printing, the development of a certain book, printed art, the development of the press or of a particular newspaper.

The retrieval of entries from the bibliographical databases was performed by means of keywords—in Hebrew and English—related to the topics: printing and publishing, incunabula, bibliography. In Rambi we focused on the section "Book knowledge and bibliography", and in Qiryat-Sefer we focused on the section "Book knowledge, general bibliographies, catalogues, archives and general indexes, databases, librarianship and information science".

We first considered the significant words in the title of the entry. We then examined the subjects assigned to the item by the cataloguers of the National Library. Very often we could determine the relevance (or irrelevance) by these subjects. Research publications, with regard to which we were still in doubt, were examined on an individual basis.⁹

A database was constructed, and for each item (publication) the following parameters were entered: researcher's name, subject of the study, period studied, language of the study, type of publication (paper, book, catalogue), its length (number of pages), name of the journal in which it appeared (in the case of papers), year of publication.

⁹ As a rule, Bible research was not included. The Bible is not specific to Hebrew publishing, despite the fact that it is the Jewish Book of Books: 1. other nations have also adopted it for themselves 2. It has been printed in all languages, and therefore we would have had to make it clear to which specific Hebrew edition we were referring. For example, the Ferrara Bible is a translation into Ladino printed in Latin characters, and therefore books and papers about it were not included in the database.

Table 1 Types of publications and their respective weighting

Type of publication	Weighting
Book	50
Short book: up to 50 pages	10
Catalogue editing	20
Editing a collection of papers	10
Paper: 10+ pages	10
Short paper: 1–9 pages	1
Critical review	1
Co-author	Fraction accounting

An entry was made for each author, with a link to his publications. In cases in which several authors collaborated on one publication, an entry was made for each additional author and a publication entry made, marked as a double entry.

We attempted to find biographical details about the authors, such as year of birth (and death), their professional affiliation and gender, with special emphasis on authors who published more than three publications.

Having attributed to each author his different kinds of publications, we sought to determine the degree of effort invested in the publication by means of a comparative points system. By setting the degree of effort we relied on Finkenstaedt's (1990) research. Also, we took into consideration the degree of effort as it used in the world of research (Table 1).

For each journal the following parameters were noted: name of journal, country of publication, frequency, the year it first appeared, year it became defunct, its definition as a research/rabbinic/popular journal.

What did we not include? We did not consider works that did not clearly deal with the study of Hebrew printing. A study that mentioned a Hebrew printing incidentally was of no interest to us. We also did not include research into Hebrew manuscripts, unless they were mentioned in their relation to a printed book.

We did not discuss the applied aspect of bibliography—bibliographical studies aimed at helping researchers and students find relevant material. We did not include in our study bibliographical research about personalities, unless it was clear that the bibliography contained only the writings of the person himself and not work about him.

Some papers and books appeared initially in printed format and were later reproduced on an electronic media platform. We included only the printed format.

Both researchers worked in parallel on the categorization and sifting of the material, comparing and consulting with each other in cases of doubt.

Findings and discussion

Publications and production

Throughout the period of 1976–2006, 1621 publications of different types appeared: books, papers and catalogues. Their output after quantification came to 15,241.95 points.

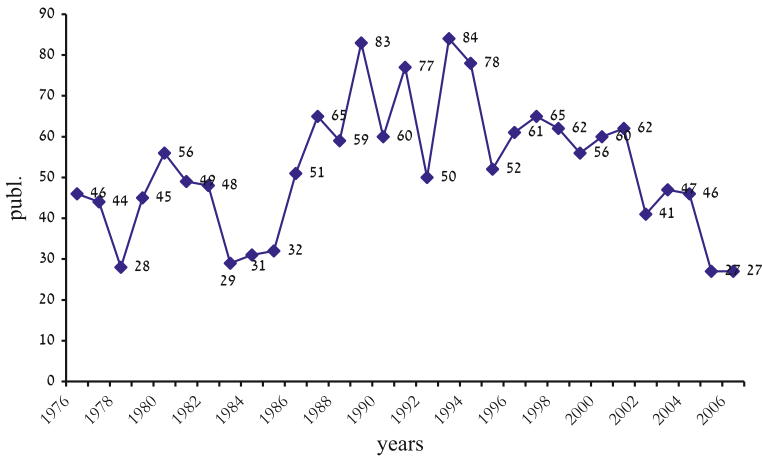


Fig. 1 No. of publications per year

Publications

The most productive year was 1993 with 84 publications that year. From 1994 to 2006 the trend changed, and the number of publications per year tended in a downward direction (Fig. 1).

Calculation of the correlation coefficients (r_2) of a linear function and an exponential function for the accumulative number of publications per year, offers an explanation for the trend of the distribution of the data (Table 2). The linear annual growth rate was calculated according to the constant increment (a) of the linear equation $y = ax + b$; The exponential annual growth rate and doubling time were calculated according to the exponential equations as explained in Table 3.

The data for the total period of the study, 1976–2006, tended to a significantly linear distribution. The annual rate of growth was 56.789 publications per year. When we divided the research period into sub-periods, our findings were consistent with Menard's theory. Analysis of the distribution of the cumulative number of publications and their weighted output reveals three sub-periods: during the first period the cumulative number of publications grew linearly, with a lower speed of growth than in the other periods. The cumulative number of publications during the second period exhibits an exponential distribution. In the third period, the data tends once again to be linear (Table 2).

Table 2 Correlation coefficient (r^2) of exponential and linear distributions

Period	No. of years	Publications (r^2)		Weighted output (r^2)	
		Linear	Expo.	Linear	Expo.
1976–2006	31	0.9934	0.8815	0.9886	0.9193
1976–1982	7	0.9932	0.9549	0.9972	0.9464
1983–1994	12	0.9895	0.9943	0.9927	0.9942
1995–2006	12	0.9872	0.9732	0.9986	0.9921

Between the years 1976–1982 the data tended to be linear, with an annual growth rate of 45.25 publications per year. In 1983–1994 the tendency was exponential, with an annual growth rate of 8.59% publications and doubling time of 8.4 years. In 1995–2006 the trend became linear once again with an annual growth rate of 51.703 publications (Table 3).

Since the linear and exponential correlation coefficients in defined periods of time were close to each other, we could reasonably deduce that the distribution of the data was consistent with both a linear function and an exponential function (Fig. 2). We thus found that the period 1983–1994 was also very productive in terms of its linear growth rate, at 62.738 publications per year.

Table 3 Linear and exponential growth rates and doubling times^a

Period	Publications			Weighted output		
	Linear annual growth ^b	Exponential annual growth (%)	Doubling time (years)	Linear annual growth ^c	Exponential annual growth (%)	Doubling time (years)
1976–2006	56.789			526.47		
1976–1982	45.25			384.11		
1983–1994	62.738	8.59%	8.4	521.63	7.77%	9.26
1995–2006	51.703			605.66		

^a The exponential annual growth (r) and doubling time (d) are calculated from the following set of equations: size at time $t - F(t) = ae^{bt}$ while: a —initial size at time t_0 ; b —The continuous growth rate which related to the percentage r by which the size increases each year. $r = 100 \times (e^b - 1)$, doubling time $d = (\log_2 2)/b$

^b Number of publications per year

^c Number of points per year

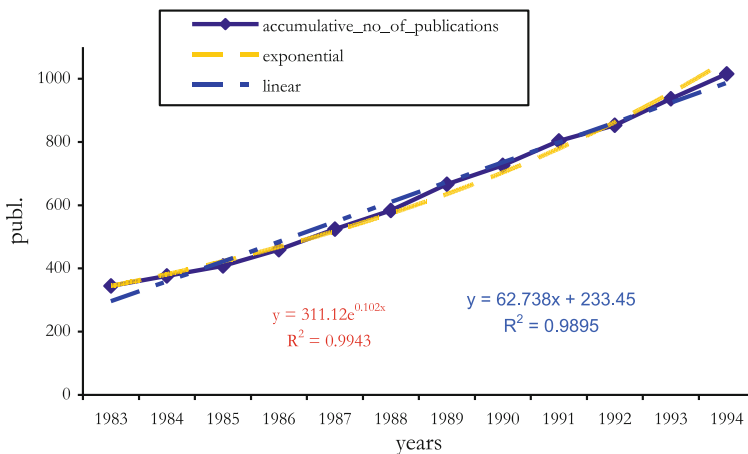


Fig. 2 Accumulative distribution of number of publications for 1983–1994

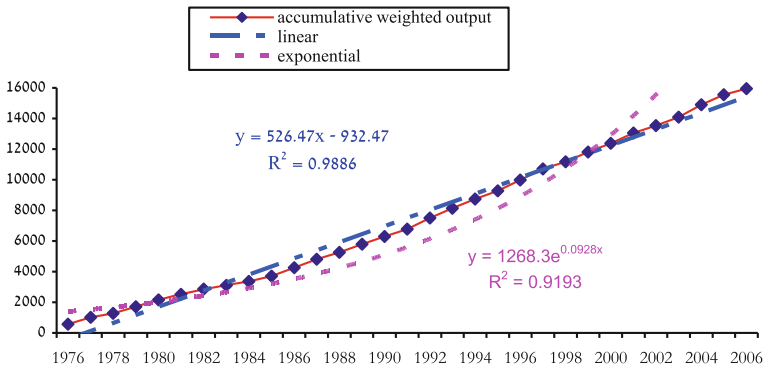


Fig. 3 Accumulative distribution of weighted output

Weighted output

A glance at the cumulative weighted output data shows a clear linear upward trend (Fig. 3) during the entire period. The rate of growth was 526.47 points. When we examined sub-periods, too, our findings were consistent with Menard's theory: between the years 1976–1982 the data tended to a linear distribution with a growth rate of 384.11 points per year (Table 3). In the years 1983–1994 the data tended to an exponential distribution with a growth rate of 7.77% per year and doubling time of 9.26 years. From 1995 to 2006, the direction of the data became linear again, with the fastest annual growth of 605.66 points per year.

Although in the third period fewer publications were printed than in the second one, the weighted output of the third period shows that these publications were of a type that was more valuable to the research field, such as books and comprehensive papers.

Authors

A total of 1610 publications were produced by 781 authors.¹⁰ Of these, 674 authors published 1402 papers in periodicals and collections of articles, some of them co-authors. Eight authors produced the most research output (Table 4). Interestingly, the most productive researcher, the Italian Guliano Tamani, a philologist of the medieval period and expert on Jewish manuscripts in Italy, refers to the study of Hebrew printing only incidentally. Similarly in the case of Giulio Busi, whose expertise is not specifically the study of Hebrew printing but who discusses the field as an offshoot of his research in Jewish studies. However, among of the rest productive authors—librarians, bibliographers, and researchers—the chief research interest was the study of Hebrew printing.

Lotka's law, which deals with the frequency with which authors publish, also applies to the bibliography of Hebrew printing. Examination of the contribution of authors to scientific output within different periods shows that the distribution of the number of papers per author is consistent with the law at the same order of magnitude (Table 5). The number of authors who published a single paper each constituted 66.52%; those who published two papers each—14.09% (according to Lotka's equation it should have been 16.63%); those

¹⁰ A further 11 publications were anonymous.

Table 4 Most productive authors (more than 200 points each)

Author	Production	Book	Paper	Catalogue	Total no. of publications
Tamani, Giuliano	336	5	16	3	24
Heller, Marvin J.	296	3	20	–	23
Yudelov, Yitzhak	277	3	33	1	37
Offenberg, Adriaan	255.66	2	26	3	31
Baruchson-Arbiv, Shifra	227	3	10	–	13
Attal, Avraham	215	4	10	–	14
Busi, Giulio	202	3	6	1	10
Baker, Zachary M.	201	–	19	1	20

Table 5 Contribution of authors to scientific production according to papers published (Lotka's law)

Period	Percentage of authors ^a				
	1 paper	2 papers	3 papers	4 papers	10 papers
1976–2006	66.52	14.09 (16.63)	7.12 (7.39)	2.72 (4.16)	0.76 (0.66)
1976–1982	70.91	13.33 (17.73)	6.67 (7.88)	4.24 (4.43)	– (0.71)
1983–1994	67.83	15.36 (16.96)	7.54 (7.54)	1.74 (4.24)	0.58 (0.68)
1995–2006	72.26	12.67 (18.07)	7.19 (8.03)	2.05 (4.52)	0.68 (0.72)
Lotka	60	15	6.60	3.75	0.60

^a The rate of authors according to number of papers per author: 1 paper, 2 papers...10 papers. The numbers in parentheses denote the rate of authors when calculated according to Lotka's law

who published 3 papers each—7.12% (according to Lotka's equation—7.39%); those who published 4 papers each—2.72% (according to Lotka's equation—4.16%); those who published 10 papers each—0.76% (according to Lotka's equation—0.66%). Lotka's law was also upheld for the sub-periods that were studied.

During the entire period, a high percentage of authors (66.52%) published a single paper each, as opposed to an extremely low percentage (0.76%) that published 10 or more papers each. In other words, scientific elite of researchers, each of whom publishes a large number of papers, is responsible for advancing the field. To express it in terms of Price's theory (1976), success breeds success – those who succeed in publishing their papers will continue to do so.

While Lotka found that 60% of authors published only one paper, we found that the number of authors who wrote a single paper was higher—66.52% (Table 5). A study of sub-periods showed that, with the progression of years, their proportion in the author population rose from 70.91% in the first period to 72.26% in the last period of 1995–2006. This fact could be attributed to lack of affiliation/lack of stability among the authors in the field. Zipf's principle of least effort (20/80) strengthens the aforesaid. Between the years 1976–2006 the ratio was approximately 20/55. That is to say that 20% of the authors were responsible for only 55% of the output.

A greater stability among authors in the field exists between the years 1983–1994. The percentage of authors who published a single paper each was the lowest (67.83%). The exponential tendency of the accumulative data strengthened this assumption.

Table 6 Authors' fields of expertise

Field	3 or more publications		2 or less publications		Total	
	No.	%	No.	%	No.	%
History	25	17.48	41	20.2	66	19.08
Jewish studies	33	23.08	69	33.99	102	29.48
Literature	25	17.48	11	5.42	36	10.4
Librarianship	44	30.77	41	20.2	85	24.57
Communications	13	9.09	22	10.84	35	10.12
Other	3	2.1	19	9.36	22	6.36
Total	143	100	203	100	346	100

Table 7 Proportion within the population of authors who published 50% of papers (Price, Cole & Cole)

Period	No. of authors ^a	$\sqrt{^b}$	No. of papers	Half the no. of papers	Actual no. observed		Proportion %	
					Authors ^a	Papers	Authors (%)	Papers (%)
1976–2006	660	25	1402	701	81	636	12.27	45.36
1976–1982	165	12	275	137.5	26	114	15.76	41.45
1983–1994	345	18	627	313.5	58	287	16.81	45.77
1995–2006	292	17	500	250	44	215	15.07	43

^a No. of primary authors, without co-authors

^b Square root of authors

Of all authors, 147 published 3 or more publications, among whom 143 authors were categorized according to their field of expertise. 203 additional authors, whose area of expertise was found, published one or two publications (Table 6). Of the authors who published 3 papers or more, the 30.77% who came from the field of librarianship, contributed most to publication output: librarians, bibliographers, booksellers (Table 6), while most of the authors, approximately 70%, came from other fields: Jewish studies (Talmud, Biblical studies, Kabala, Jewish thought, linguistics) history, literature, communications. We also found an anthropologist, geneticist and educator, who contributed 3 or more papers each.

Of the fields in which researchers produced up to 2 publications each, the predominant one was Jewish studies (34%), while only 20% came from the field of librarianship (Table 6). The majority of researchers (approximately 80%) came from related fields with some connection to Hebrew printing: Jewish studies, history, literature and communications. We also found that 9.36% of researchers were from totally different fields: agriculture, architecture, economics, statistics, education, law, sociology, politics, theatre and curatorship.

Our analysis of authors' production in according to Price's law¹¹ found inconsistency with the law.¹² Over the entire period, at least 81 primary authors were required to publish 636 papers, whereas according to Price's calculations only 25 authors were needed to

¹¹ Half of the papers were written by the square root of the authors.

¹² In all the following calculations we included only primary authors.

Table 8 Proportion within the population of authors responsible for 50% of production (Cole & Cole, Price)

Period	No. of authors ^a	$\sqrt{^b}$	Points	Half the production	Actual no. observed		Proportion %	
					Authors ^a	Points	Authors (%)	Points (%)
1976–2006	660	25	8320.83	4160.415	90	3709	13.77	44.57
1976–1982	165	12	1458.33	729.165	29	648	17.73	44.43
1983–1994	345	18	3327	1663.5	62	1547	18.08	46.5
1995–2006	292	17	3535.5	1767.75	49	1585.5	16.80	44.85

^a No. of primary authors, without co-authors

^b Square root of authors

produce 701 papers (Table 7). In order to produce a number of points as close as possible to half the authors' output (3709 points), at least 90 authors were required (Table 8), whereas according to Price, a mere 25 authors would be needed to produce half the output (4160.415 points). Even when we analyzed the sub-periods, we still found that the data was not consistent with Price's law.

In contrast, we found similar results of the same order of magnitude to those found by Cole & Cole in their research: over the entire period, 12.27% of the authors published 45.36% of the papers (Table 7), and 13.77% of authors produced 44.57% of production (Table 8).

Conclusions

Does the bibliographical research in the study of Hebrew printing behave as a scientific field? Testing data against several bibliometric laws has proven to us that this discipline behaves as a scientific field in the full sense of the term. With the help of the four bibliometric parameters and models discussed in this study, we have been able to describe the directions and rate of development of bibliographical research in the study of Hebrew printing as a research field: number of publications, their weighted value (production), number of authors and their fields of expertise.

The change of development speed can be divided into three periods: (a) 1976–1982, (b) 1983–1994, (c) 1995–2006. The number of publications and the authors' production in these periods behave as Menard predicted.

In the first period, the fields demonstrate a tendency for low values of linear growth. The growth rate of publications was 45 publications per year and production measured 384.11 points. The second period was the most productive, reaching a peak in 1993 with 84 publications. The fields tend to an exponential distribution, with a growth rate of 8.59% publication per year and a doubling time of 8.4 years. The annual growth rate of production in these years reached only 7.77% points, with a doubling time of 9.26 years. During the third period, 1995–2006, the fields return once again to a linear distribution, with a growth rate of 51 publications per year and with the highest level of production, 605.66 points. The increased production in this third stage of the field's life is consistent with Menard's theory. He found that the growth rate varies from stable fields in the first

stage of a particular discipline's life, to fields that tend to an exponential distribution in the second life stage, and then, in the third stage, to circular fields, which alternate between periods of stability and periods of growth.

Another parameter that we examined was the frequency with which an author published. Our findings are consistent with Lotka's law. Over the entire period 66.52% of the authors each wrote only one paper and only 0.76% wrote 10 or more papers. In other words, according to Price's law regarding 'cumulative advantage processes', success leads to success, and especially prolific scientists continually increase their production, whereas scientists who have published little will continue to publish little, if at all. Price's law, which states that half the papers are written by the square root of authors, was not supported by our data. In contrast, 12.27% of the authors published 45.36% of papers and 13.77% produce 44.57% of the weighted output. This data is consistent with Cole & Cole's law at the same orders of magnitude.

All the parameters indicate that, consistent with Goffman's epidemic theory, bibliographical research in the study of Hebrew printing is now at the third stage of its life as an independent research field, the phase of decline. The annual growth rate of publications is falling, the number of authors who have published only one paper has risen from 70.91% at the first stage to 72.26% at the last stage, and only 31% of the writers who published 3 or more papers each are from the field of librarianship. Most studies published nowadays on the bibliography of Hebrew printing are written by researchers coming from other, mainly related, fields, such as Jewish studies, Jewish thought, Jewish history, linguistics and so on.

Forty percent of the authors who published three or more papers each and for whom we have details of professional affiliation, worked in the field of the bibliography of Hebrew publications: bibliographers, librarians, booksellers and bibliophiles. The large number of researchers (60%) who do not come from the field of librarianship testifies to the decline in research into Hebrew printing. Over the years, bibliographical research developed as an autonomous research sub-field of Jewish studies. When schools of librarianship were set up at the universities, the history of Hebrew printing belonged to this field. However, researchers were not always committed to the field. Many researchers came from other fields, and the history of Hebrew printing was an offshoot of their research. They made their small contribution and returned to their major research interests. Avraham Meir Haberman, an enthusiastic collector of antique Hebrew books, specialized in the study of Hebrew printing, but his major occupation was medieval literature. Israel Moshe Ta-shma, who founded the bibliographical journal 'Aleí Sefer', published several papers on Hebrew printing, but he was a Talmud researcher by profession. This situation has continued right up to the present day, and the number of bibliography researchers is constantly falling, to such an extent that the field no longer exists as an independent field. When a field no longer exists as an independent entity, there are no researchers with a commitment to the field, no teamwork, no mutually fruitful cooperation between researchers to stimulate academic writing, research is random and does not serve as a basis for long term research, with the result that research in this specific field dwindles.

We found that the annual growth rate in number of publications dropped between the years 1995–2006 compared to the previous period: 51 publications as compared with 62 during the previous period. We would also expect a decrease in the annual growth rate of production, but, surprisingly, we found that this period saw a peak in the production growth rate—605.66 points. The length of a paper does not necessarily indicate its quality, but it is reasonable to assume that if the growth rate of publications decreased and production rose, the points that each paper received was higher. In other words, longer papers were written,

with an investment of more work and more time, and this is what improved the production balance. Therefore, the probability that they are significant and not random is greater.

Modern bibliographical research began in order to document the treasures of Jewish culture. This mission was begun under the auspices of the nineteenth century “Wissenschaft des Judentums” movement, by bibliographers such as Moritz Steinschneider, Aharon Freiman, Elyakim Carmoli and others. It has continued into the present with the research of contemporary bibliographers and researchers of Hebrew printing such as Avraham Ye’ari, Moshe David Gaon, Avraham Meir Haberman and Yitzhak Yudelov. Ta-shma, in his 1976 paper, discusses the need to continue developing bibliographical research and offers different suggestions for further research. There were years when Prof. Ta-shma’s call to establish the field as an academic one in Israel was heeded. In addition to the School of Librarianship and Archive Studies of the Hebrew University of Jerusalem, a school of librarianship was also established at Bar-Ilan University, Haifa University, and in colleges such as Bet Berl and the David Yellin College of Education. However, the school of librarianship in Jerusalem closed down in 2002. Due to lack of student interest, Bar-Ilan University’s department of information sciences closed its track for the study of Hebrew printing although a small number of theses and doctoral papers on the subject are still written in the department. The other academic institutions that offer librarianship studies do not include the study of Hebrew printing as a specialization in their curriculum. This is also reflected in the fact that the leading researchers in the field of Hebrew printing are not figures with an academic training, such as librarians, booksellers and rabbis. Others, who are academics, come from other fields related to the study of Hebrew printing. Among them we found Talmud and Bible researchers, linguists and historians. Nowadays, the field has ceased to exist as an autonomous scientific field in most research institutes throughout the world.

Has the study of this field exhausted itself? Possibly. However, other reasons, such as lack of interest among students, may account for the decreased output. The last quarter of the twentieth century saw a decline in the interest of young researchers in the humanities as a whole, and particularly in Jewish studies. As a field affiliated with Jewish studies in general, the findings of this study support the claim made by Anita Shapira that academic interest in Jewish studies in general waned in the final quarter of the twentieth century (Shapira 1996). Following the Holocaust and the establishment of the State of Israel, Jewish studies departments sprang up in many, not necessarily Jewish, universities in the world. The Six-Day War increased the interest in Jewish studies, which was in demand among students. Many students, who were trained as researchers in this profession in the 70s, reached the status of researchers in the academic world of the 80s. We find evidence of their research output in the increase that began in the early 80s and continued until the first half of the 90s. From the 80s onwards, interest in Jewish studies at university waned, a fact that was reflected in the small number of student researchers. The lack of training among young researchers expressed itself in a fall in the annual publications growth rate in the latter half of the 90s, up until the twenty-first century. The lack of a ‘home’ for the study of Hebrew printing is reflected in the age of the researchers. Most researchers for whom we found biographical details were aged 55+.

This is a preliminary study that presents the state of bibliographical research in the study of Hebrew printing during a 30-year period, ranging from the latter quarter of the twentieth century until the beginning of the third millennium (1976–2006). In order to complete the picture, further research may be conducted, in which data can be examined using other bibliometric algorithms, for example, quality of research as against exponential growth according to Rescher’s equations. Taking a different angle, in which periodicals are the

studies published? Do periodicals stand the test of bibliometric laws: do they reflect Bradford's law of scattering and Garfield's law of concentration?

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