

Galton 2011 revisited: a bibliometric journey in the footprints of a universal genius

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Abstract

Commemorating the 100th death anniversary of Francis Galton, this paper is a bibliometric impact analysis of the works of this outstanding scientist and predecessor of scientometrics. Citation analysis was done in Web of Science, Scopus and Google Scholar (Publish or Perish) in order to retrieve the most cited books and journal articles. Additionally references were identified where Galton was rather mentioned than cited in order to analyze the phenomenon of obliteration by incorporation. Finally occurrence counts of Galton's works in obituaries, Festschrift, the website Galton.org, major encyclopaedias and biographical indexes were compared to citation counts.

As an outcome Galton's works are increasingly cited or mentioned. Obliteration (use of eponyms) applies to one third of Galton's works and seems to be typical for fields like mathematics or statistics, whereas citations are more common in psychology. The most cited books and journal articles are also the most mentioned with remarkable correlation.

Overall citation analysis and occurrence counting are complementary useful methods for the impact analysis of the works of "giants".

Keywords

Francis Galton, citation analysis, web of science, scopus, google scholar, obliteration, occurrence counts, historiometry, history of science

Background

Our passion for Francis Galton goes back to the reading of De Solla Price's book „Little science, big science“, a book that crystallized a new element in the historiography and sociology of science (De Solla Price, 1963). An entire chapter – titled “Galton revisited” - is devoted to the all-rounder of science, one of the most versatile and curious minds of the nineteenth century. Apart from his achievements in various fields as explorer, geographer, meteorologist, geneticist, psychologist and eugenicist, particular emphasis has been placed on his passion to count and quantify everything and reduce it to statistics, e.g. computing the additional years of life enjoyed by the Royal Family and the clergy because of the prayers offered up for them (the surprising result being a negative number), or correlating the number of a painter's brush strokes needed for a portrait (approx. 20.000) with the hand movements that went into the knitting of a pair of socks (Pearson, 1930).

His obsession was not only the stimulus for the foundation of biometrics. It can also be considered as the rise of a new era for the social sciences based on the solid foundation of quantified measurements

and statistical methods. This is especially true for new emerging disciplines like bibliometrics or scientometrics. Being a statistician, Galton introduced new statistical concepts like regression and correlation in order to analyze the large amounts of data he accumulated (Obituary, 1911; Forrest, 1974; Gillham, 2001). He introduced also the idea of the percentiles as a criterion for the measurement of the distribution of quantitative parameters (Enciclopedia Italiana, 1950).

A neglected but influential contribution by Galton is also the measurement of science (Godin, 2007). In Galton's monograph "English Men of Science" (1874), he conducted a sociological study based on a survey of 180 outstanding British scientists. This analysis inspired the launch of Cattell's directory "American Men of Science" (Cattell, 1906). Moreover the method described in Hereditary Genius (Galton, 1869) can be regarded as the first example of historiometry (Wikipedia English, 2010). Furthermore Galton was one of the first scientists who made use of "mapping" methods. Thus he developed a "beauty-map" of the British Isles, based on how many pretty women he encountered, giving London the highest score and Aberdeen the lowest. Today Galton's "beauty-map" is still a hot topic, as corroborated by a study done by Swami & Hernandez (2008) who compiled a more empirical beauty-map of London. They discussed their results in relation to the association between wealth and attractiveness, and compared their findings to Galton's original beauty-map.

Galton was an extraordinary and prolific scientist, producing almost 20 books and more than 300 papers. In commemoration of the 100th anniversary of Galton's death and in appreciation of his crucial contributions to scientometrics, we devote this bibliometric study to this likewise controversial but also fascinating personality.

Introduction

The achievements and merits of a famous scientist or - reusing Galton's vocabulary - of a "genius", can be tracked by several methods:

- 1) Obituaries: announcement of a death including a short biography giving an account of the life of a notable individual focusing on the most important works and deeds.
 - 2) Festschriften: an article or book honouring a respected person, especially an academic
 - 3) Biographies: detailed descriptions or accounts of someone's life. A biography is more than a list of impersonal facts (education, work, relationships, and death), it also portrays the subject's experience of those events (<http://en.wikipedia.org/wiki/Biography>). Biographies need to be considered as subjective, since their authors mostly have a certain agenda and subject expertise.
 - 3) Websites: with the advent of the internet many historical celebrities have their own website maintained by institutions like foundations, museums, societies, libraries, etc. keeping them in honouring memory.
 - 4) Entries in major encyclopaedias or biographical indexes
 - 5) Citations
- As Cronin stated "by citing other works, authors create footprints in the landscape of scholarly achievement" (Cronin, 1984 & 1995). Citation analyses enable to identify the most influential works (publications) of a renowned scientist. In our study, influential can be regarded as a synonym for "most impact".

However, their works are not always cited but merely mentioned.

6) Mentions (Occurrences)

Mentions can be tracked by the counting of occurrences in biographical sources. This also includes “Obliteration by incorporation” (OBI), a concept introduced by Robert K. Merton (1949) and picked up again by Garfield, occurs when at some stage in the development of a science, certain ideas become so generally accepted that their contributors are no longer cited (Merton, 1968; Garfield, 1975). Discoveries and innovations are then often named after the (supposed) discoverer. And eventually, its source and creator are forgotten (“obliterated”) as the concept enters common knowledge (is “incorporated”). In the process of OBI both the original idea and the literal formulations of it are incorporated due to prolonged and widespread use in the title, abstract or full-text of the documents, and enter into everyday language (eponyms) or at least the controlled language of a given academic discipline (descriptors in thesauri), and can either be attributed to their creator or not.

Scope of the analysis

This bibliometric analysis comprises of the following aspects:

- 1) Citation versus mentioning: volume proportions and time line
- 2) Analysis of citing/mentioning institutions/countries: Who is still citing/mentioning Galton?
- 3) Analysis of citing/mentioning sources: In which journals/research fields is Galton still cited/mentioned?
- 4) Analysis on the loss of citations caused by OBI, i.e. by mere mentioning instead of citing or by using eponyms (in the form of descriptors)?
- 5) Identification of Galton’s high impact publications (monographs and journal articles)
- 6) Analysis of citation differences based on the selected data source, comparison of the 3 most important citation databases WoS, Scopus and Google Scholar; correlation of the results
- 7) To which extent are Galton’s most highly cited publications in agreement with the publications considered as the most relevant by a) his biographers or by b) other sources like encyclopaedias, dictionaries, etc. (see Introduction); correlation of the results
- 8) General purpose:
Are bibliometric and scientometric methods, like citation or occurrence counts, appropriate for the study of the history and sociology of science? Can their results be validated by other qualitative measurements?

Methodology

Web of Science (WoS), Scopus and Google Scholar were used as the major citation databases for the citation analyses. Searches were done in September 2009, and all retrieved records were manually disambiguated respectively in order to identify the most cited documents (monographs and journal articles).

WoS

The main analysis (citation and obliteration) was performed in WoS due to its strict selection criteria focusing on the “best” (higher impact) literature, due to its interdisciplinary character and its comprehensive coverage (“Century of Science”).

The citation analysis was conducted using the “Cited reference search” feature in WoS. All citing documents and all citations to documents authored by “Galton F” were retrieved. An additional search for “Galton” was performed in order to identify all citations where Galton was cited without or with a wrong first name. Citations of co-authored publications (e.g. the famous one with Watson) have been also retrieved searching for the co-author name. Citations have been added accordingly.

Two different types of documents were separately analyzed: monographs (books) and journal articles. For monographs citations were collected separately for the “most correctly cited edition”, for the “most cited edition”, and to “all editions”. The latter were used to calculate the correlation.

According to Galton’s publication strategy, i.e. publication of articles with the same title in multiple journals, articles were aggregated on title level.

A complementary search was performed in WoS in order to retrieve all publications mentioning “Galton” either in their titles, descriptors or abstracts. This should give an idea of how many citations have already been assimilated by the scientific community (OBI) and how many publications have therefore ceased to be cited directly any longer.

The search was restricted to the field “Topic”. All the retrieved documents were separately analysed regarding their occurrence in the above mentioned bibliographical fields. Finally all these documents were classified according to which Galton’s eponym, “notion” or “concept” was mentioned or referred to.

Complementary analyses in Scopus and Google Scholar

The search in Scopus was performed in the “References” field. All references containing the name “Galton” were retrieved. Data cleansing was done to exclude “wrong” Galton references as well as citations to secondary literature. The most cited articles and books were aggregated and analyzed separately.

The search in Google Scholar was done with the help of the open source “Publish or Perish” tool, and the retrieved items were either assigned to monographs or to journal articles. The results were compared those obtained from WoS and other bibliographical sources, and either corrected or added.

Sources for assignment of disambiguated records

Correct assignment of the manually disambiguated Galton publications was done by using the sources described in *Correlation analyses*. Furthermore, JSTOR, a trusted full-text digital archive of over one thousand academic journals across the humanities, social sciences, and sciences, as well as select monographs and other scholarly content, was helpful to find the one or the other original article in PDF-format.

Correlation analyses

Correlation analyses of the most cited documents with occurrences in biographical sources and encyclopaedias were performed using the Pearson correlation coefficient. The analyses were initially done for monographs. In a subsequent study correlation analyses will also be performed for journal

articles. Their inclusion would have been too bulky and therefore out of the scope of this paper.

Part A:

Citations were first compared with the retrieved occurrences in the following selected biographical sources:

1) Obituaries, Festschrift and Galton.org:

The obituaries on Galton from the Royal Statistical Society (Obituary, 1911) and from Gray (1911) in “Man” were considered due to their wider scope, however, both still have a subject specific focus. Others like the one from the Royal Geographical Society Institute (Obituary, 1911a) and from Bedoe (1911) were either too specific or did not include bibliographical items. They were therefore not considered in this approach.

As a showcase for a Festschrift the commemorative article by Corney (1984) was included.

The website “Galton.org” was added to this subset due to its similar characteristics.

It is a non-funded initiative edited and maintained by Gavan Tredoux. It aims to provide access to everything that Galton wrote, usually in facsimile format. Most of it is searchable, however, OCR recognition has known limits and retrieval accuracy depends on the quality of the scanned resources. The website furthermore contains reviews of Galton’s works, extensive biographical information as well as photographs and portraits of the protagonist.

The website is organized according to the different subject areas Galton dealt with. These sections contain selected works, which are subsets of the whole bibliography available as “Collected Works”.

Occurrences of Galton’s works were retrieved manually in obituaries and the Festschrift. Occurrences retrieved in the subject specific sections of Galton.org were counted separately from the ones retrieved in “Collected Works”.

2) Biographies

The four most famous and also most cited (in WoS and Scopus) biographies from Gillham, Pearson, Bulmer and Forrest were chosen.

a) Gillham’s biography (A Life of Sir Francis Galton: from African Exploration to the Birth of Eugenics, 2001): one of the most recent, most reviewed and most cited biographies on Galton. Occurrences were identified manually in the prologue “Francis Galton in Perspective” (providing an overview of the most important facts and works).

b) Pearson’s biography (The Life, Letters and Labours of Francis Galton, 1914, 1924, 1930): a facsimile version is provided at “Galton.org”, and occurrences were identified manually in the “table of contents” part (“Contents”).

c) Bulmer’s biography (Francis Galton: Pioneer of Heredity and Biometry, 2003): available via Google Books

(http://books.google.com/books?id=vL0hq80XXqMC&hl=de&source=gbs_ViewAPI):

Occurrences were identified manually in the “table of contents” part and in the “chronology” part.

The biography of Forrest could not be considered for Part A of this analysis, since preface and “table of contents” part do not contain any bibliographical references.

3) Major encyclopaedias and biographical indexes

Occurrences of Galton's work were identified manually in entries of the following encyclopaedias:

Britannica (, Larrousse, Colliers, Brockhaus, Espasa Calpe, Encyclopaedia Americana and Enciclopedia Italiana.

Complementary analyses were done in both the English and the German edition of Wikipedia, Poggendorff and Oxford DNB.

For detailed information on titles and editions see References.

Spearman correlations between occurrence counts in 1), 2) and 3) and the number of citations in WoS, Google Scholar and Scopus were calculated separately for each subset as well as in total.

Part B

Complementary to Part A the overall occurrences of the 4 selected biographies were determined.

In Gillham as well as in Forrest book titles were looked up in the index and the corresponding pages were counted. A previous analysis showed that occurrence counts in the book's full text highly correlated with the above mentioned page counts (Spearman correlation coefficient = 0.97).

In Pearson the overall occurrences were retrieved by using the "Search function" provided by the facsimile version on Galton.org, whereas in Bulmer they were identified with the help of the "Search function" in Google Books. Both were checked for correctness and false hits removed.

Spearman correlations between page/occurrence counts for each biography and the number of citations in WoS, Google Scholar and Scopus were calculated.

Results

Results from the comparison "citing" vs. "mentioning":

The WoS search for "Galton F*" resulted in 1336 hits that were further analysed to extract 5628 citations, 1835 citing articles and to determine the value of the indicator "citations per citing article" (3.07).

The additional search for "Galton" was performed to identify data base entries with either no or the incorrect first name. That way another 240 citations and 172 citing documents were retrieved. The "Citations per citing article" indicator was determined as 1.53. Details are shown in the table below.

Table 1: Citation analysis in WoS

Searchstring in WoS	Hits	Citations	Citing Publications	Citations per publication
Galton F*	1.336	5.628	1.835	3,07
Galton or Galton X*	240	263	172	1,53
Total	1.576	5891	2007	2,93

A complementary search for publications where Galton was rather mentioned than cited (TS=(galton*)) resulted (after data cleansing) in the retrieval of 1.083 mentioning publications and 121 (4%) citing & mentioning publications (see Fig. 1).

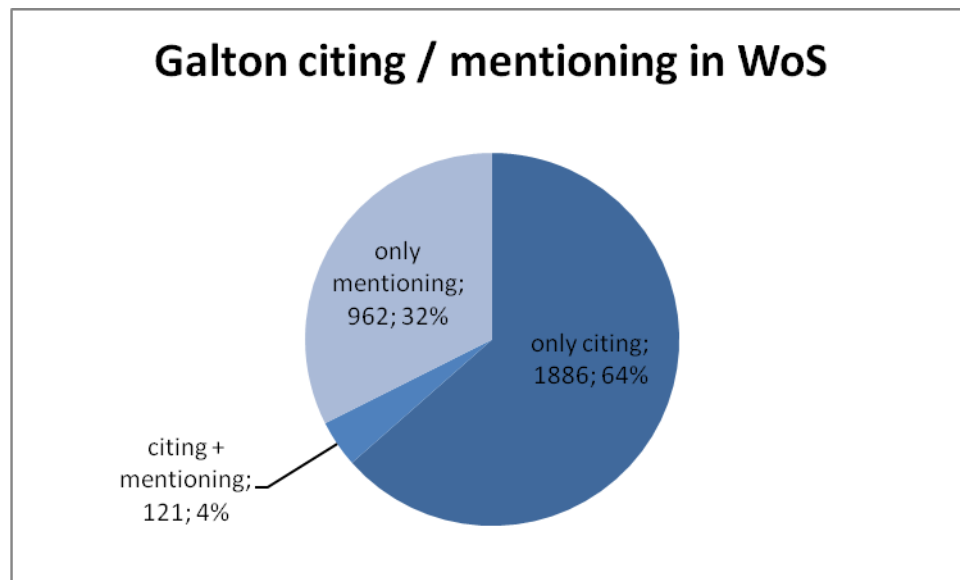


Fig. 1: citing vs. mentioning in WoS

The following figure shows comparative timelines of citing vs. mentioning articles.

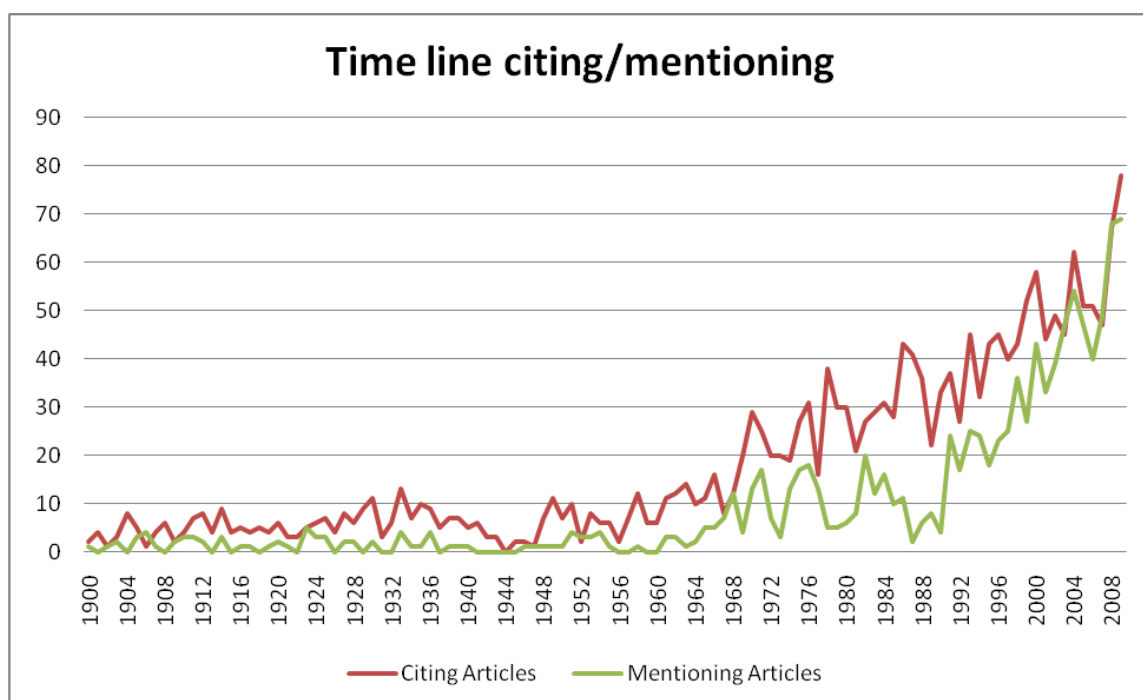


Fig. 2: Time line of citing / mentioning articles in WoS

Both the number of citing and mentioning articles has gradually increased within the last 50 years according to the increment of growth in the scientific world output.

The run of both curves is similar, thus citing is not replaced by mentioning in the course of time. Both rather coexist to the same extent.

A comparison of citation vs. mention behaviour was done according to subject areas, sources, institutions and countries.

Subject Areas:

Psychology, Anthropology, Psychiatry and History & Philosophy of Science are the top “Galton-citing” disciplines, whereas in Statistics and Mathematics the mentioning culture is most established. Detailed results are shown in Table 2.

Table 2: Top subject areas in citing versus mentioning Francis Galton.

WoS Subject Category (Citing)	Counts	%	WoS Subject Category (Mentioning)	Counts	%
PSYCHOLOGY, MULTIDISCIPLINARY	272	13,55	STATISTICS & PROBABILITY	432	39,89
PSYCHOLOGY	123	6,13	MATHEMATICS	96	8,86
ANTHROPOLOGY	107	5,33	MATHEMATICS, APPLIED	58	5,36
PSYCHIATRY	105	5,23	BIOLOGY	47	4,34
HISTORY & PHILOSOPHY OF SCIENCE	98	4,88	HISTORY & PHILOSOPHY OF SCIENCE	45	4,16
PSYCHOLOGY, SOCIAL	97	4,83	ANTHROPOLOGY	45	4,16
GENETICS & HEREDITY	96	4,78	PSYCHOLOGY, MULTIDISCIPLINARY	40	3,69
SOCIOLOGY	87	4,33	GENETICS & HEREDITY	36	3,32
PSYCHOLOGY, EXPERIMENTAL	83	4,14	SOCIAL SCIENCES, BIOMEDICAL	33	3,05
PSYCHOLOGY, EDUCATIONAL	81	4,04	MATHEMATICAL & COMPUTATIONAL BIOLOGY	32	2,95
EDUCATION & EDUCATIONAL RESEARCH	76	3,79	MULTIDISCIPLINARY SCIENCES	30	2,77
STATISTICS & PROBABILITY	62	3,09	SOCIAL SCIENCES, INTERDISCIPLINARY	29	2,68
BIOLOGY	60	2,99	ECONOMICS	26	2,40
NEUROSCIENCES	56	2,79	PHYSICS, MULTIDISCIPLINARY	22	2,03
HISTORY	54	2,69	PSYCHOLOGY, CLINICAL	20	1,85
MEDICINE, GENERAL & INTERNAL	49	2,44	COMPUTER SCIENCE, SOFTWARE ENGINEERING	19	1,75
MULTIDISCIPLINARY SCIENCES	49	2,44	EVOLUTIONARY BIOLOGY	18	1,66
EDUCATION, SPECIAL	43	2,14	PSYCHOLOGY	17	1,57
PSYCHOLOGY, DEVELOPMENTAL	41	2,04	PHYSICS, MATHEMATICAL	16	1,48
EVOLUTIONARY BIOLOGY	40	1,99	ECOLOGY	16	1,48
PSYCHOLOGY, CLINICAL	39	1,94	POLITICAL SCIENCE	14	1,29
ECONOMICS	38	1,89	BEHAVIORAL SCIENCES	13	1,20

Sources:

In compliance with the results obtained for “Subject Areas”, the top-citing sources are psychological and anthropological titles, whereas the top-mentioning sources belong to statistics. Detailed results are listed in Table 3.

Table 3: Top WoS sources in citing versus mentioning Francis Galton.

WoS Source (Citing)	Counts	%
AMERICAN PSYCHOLOGIST	31	1,54
PERSONALITY AND INDIVIDUAL DIFFERENCES	26	1,30
AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY	22	1,10
GIFTED CHILD QUARTERLY	20	1,00
JOURNAL OF PERSONALITY AND SOCIAL PSYCHOLOGY	20	1,00
INTELLIGENCE	17	0,85
JOURNAL OF CREATIVE BEHAVIOR	15	0,75
ZEITSCHRIFT FUR MORPHOLOGIE UND ANTHROPOLOGIE	15	0,75
JOURNAL OF THE HISTORY OF THE BEHAVIORAL SCIENCES	15	0,75
AMERICAN JOURNAL OF PSYCHOLOGY	14	0,70
MANKIND QUARTERLY	14	0,70
PSYCHOLOGICAL REPORTS	14	0,70
ISIS	13	0,65
PSYCHOLOGICAL BULLETIN	13	0,65
AMERICAN JOURNAL OF PSYCHIATRY	12	0,60
CREATIVITY RESEARCH JOURNAL	12	0,60
MEMORY & COGNITION	12	0,60
JOURNAL OF HEREDITY	11	0,55
NATURE	11	0,55
AMERICAN SOCIOLOGICAL REVIEW	10	0,50
BRITISH JOURNAL FOR THE HISTORY OF SCIENCE	10	0,50
IEEE TRANSACTIONS ON PATTERN ANALYSIS AND MACHINE INTELLIGENCE	10	0,50
PSYCHOLOGICAL MONOGRAPHS	10	0,50

WoS Source (Mentioning)	Counts	%
JOURNAL OF APPLIED PROBABILITY	84	7,76
ANNALS OF PROBABILITY	35	3,23
ADVANCES IN APPLIED PROBABILITY	34	3,14
THEORY OF PROBABILITY AND ITS APPLICATIONS	29	2,68
STOCHASTIC PROCESSES AND THEIR APPLICATIONS	29	2,68
STATISTICS & PROBABILITY LETTERS	24	2,22
EUGENICS REVIEW	24	2,22
ANNALS OF MATHEMATICAL STATISTICS	15	1,39
PROBABILITY THEORY AND RELATED FIELDS	13	1,20
ANNALES DE L INSTITUT HENRI POINCARÉ-PROBABILITES ET STATISTIQUES	13	1,20
BEHAVIOR SCIENCE RESEARCH	11	1,02
JOURNAL OF THE HISTORY OF THE BEHAVIORAL SCIENCES	11	1,02
RANDOM STRUCTURES & ALGORITHMS	11	1,02
ANNALS OF APPLIED PROBABILITY	11	1,02
NATURE	10	0,92
CURRENT ANTHROPOLOGY	9	0,83
ISIS	9	0,83
STOCHASTIC ANALYSIS AND APPLICATIONS	9	0,83
BEHAVIOR GENETICS	8	0,74
JOURNAL OF THE HISTORY OF BIOLOGY	7	0,65
ANNALS OF SCIENCE	7	0,65
JOURNAL OF THEORETICAL PROBABILITY	7	0,65

Institutions:

The top-citing institutions are entirely Anglo-American, whereas the ranking list of mentioning institutions is more diverse and also includes institutions from Spain, France, Bulgaria, Germany and Taiwan (see Table 4).

Table 4: Top institutions citing versus mentioning Francis Galton.

WoS Institutions (Citing)	Counts	%
UNIV CALIF DAVIS	45	2,24
UNIV MINNESOTA	27	1,35
DUKE UNIV	27	1,35
HARVARD UNIV	27	1,35
UNIV ILLINOIS	22	1,10
UNIV CHICAGO	21	1,05
UNIV CALIF BERKELEY	19	0,95
JOHNS HOPKINS UNIV	17	0,85
YALE UNIV	17	0,85
MICHIGAN STATE UNIV	17	0,85
COLUMBIA UNIV	17	0,85
UNIV WISCONSIN	16	0,80
YORK UNIV	16	0,80
CORNELL UNIV	15	0,75
UNIV MICHIGAN	15	0,75
UNIV WESTERN ONTARIO	15	0,75
UNIV N CAROLINA	14	0,70
INST PSYCHIAT	13	0,65
PENN STATE UNIV	13	0,65
UNIV CAMBRIDGE	13	0,65
UNIV TORONTO	13	0,65
UCL	12	0,60
UNIV LONDON	12	0,60
UNIV TEXAS	12	0,60

WoS Institutions (Mentioning)	Counts	%
UNIV CALIF BERKELEY	31	2,86
UNIV EXTREMADURA	26	2,40
UNIV PARIS 11	17	1,57
UNIV PARIS 06	15	1,39
UNIV WISCONSIN	14	1,29
UCL	13	1,20
YORK UNIV	13	1,20
BULGARIAN ACAD SCI	13	1,20
ECOLE NORMALE SUPER	13	1,20
HARVARD UNIV	13	1,20
CHALMERS UNIV TECHNOL	12	1,11
UNIV CHICAGO	12	1,11
NORTHWESTERN UNIV	12	1,11
NATL TAIWAN UNIV	11	1,02
UNIV FRANKFURT	11	1,02
CHALMERS	10	0,92
UNIV MELBOURNE	10	0,92
UNIV OXFORD	10	0,92
UNIV RENNES 1	9	0,83
UNIV SHEFFIELD	9	0,83

Countries:

The comparison of the country rank lists shows much compliance in the 6 top ranks. The other countries show less consistency in their preferences. Some nations rather prefer to cite than to mention and vice versa, e.g. the percentage of citing vs. mentioning articles is twice as high for the USA, whereas the percentage of mentioning vs. citing articles is five times higher for France. Details are shown in Table 5.

Table 5: Top countries citing versus mentioning Francis Galton.

WoS Country (Citing)	Counts	%	WoS Country (Mentioning)	Counts	%
USA	836	41,65	USA	187	17,27
ENGLAND	204	10,16	ENGLAND	105	9,70
CANADA	113	5,63	FRANCE	103	9,51
AUSTRALIA	59	2,94	CANADA	66	6,09
GERMANY	46	2,29	GERMANY	59	5,45
FRANCE	38	1,89	AUSTRALIA	45	4,16
NETHERLANDS	26	1,30	RUSSIA	35	3,23
ITALY	25	1,25	SPAIN	33	3,05
INDIA	23	1,15	SWEDEN	31	2,86
ISRAEL	18	0,90	PEOPLES R CHINA	26	2,40
SCOTLAND	17	0,85	ISRAEL	21	1,94
NORTH IRELAND	13	0,65	AUSTRIA	20	1,85
PEOPLES R CHINA	13	0,65	NETHERLANDS	18	1,66
SWITZERLAND	13	0,65	JAPAN	18	1,66
SPAIN	12	0,60	INDIA	17	1,57
SWEDEN	12	0,60	BULGARIA	13	1,20
DENMARK	10	0,50	TAIWAN	12	1,11
TURKEY	10	0,50	ITALY	9	0,83
JAPAN	9	0,45	MEXICO	9	0,83
WALES	9	0,45	SCOTLAND	8	0,74
CZECH REPUBLIC	8	0,40	BELGIUM	8	0,74
IRELAND	8	0,40	WALES	8	0,74

Results of „mentioning“ analysis in WoS:

Fig. 3 below shows that mentions can be found in almost equal shares in the descriptor or title or abstract field. A more detailed view is given in Tables 6-10.

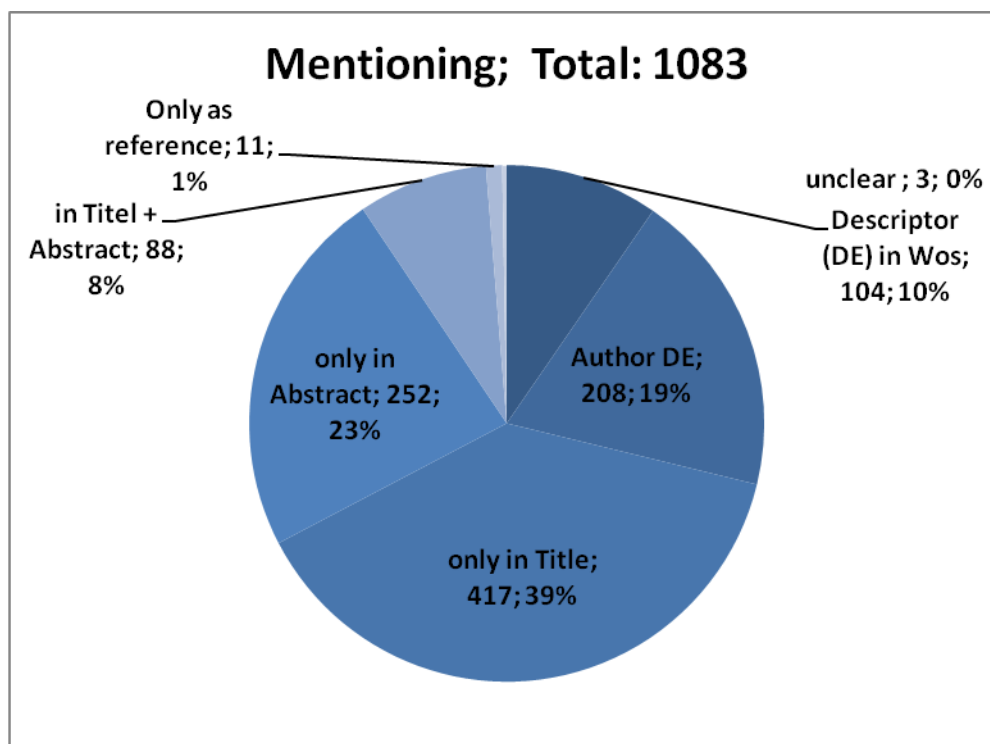


Fig. 3: Bibliographical occurrences of mentions

Table 6: Most mentioned as Descriptor in WoS (109 Items)

Rank	WoS Descriptor	Items	%
1	GALTON-WATSON PROCESSES	48	46.15
2	GALTON-WATSON TREES	30	28.85
3	GALTONS FALLACY	11	10.58
4	GALTONS PROBLEM	8	7.69
5	GALTONIA-CANDICANS	4	3.85
6	GALTON, FRANCIS	1	0.96
7	GALTON, FRANCIS / HEREDITY	1	0.96
8	GALTON-BOARD	1	0.96

Table 7: Most mentioned as Author-Descriptor in WoS (208 Items)

Rank	Author Descriptor	Items	%
1	Galton-Watson process	62	29.81
2	Galton-Watson tree or trees	45	21.63
3	Galton-Watson Branching Process	38	18.27
4	Galton	9	4.33
5	Galton-Watson	8	3.85
6	Galton's problem	7	3.37
7	Galtonia candicans	5	2.40
8	Galton's board (Galton board)	5	2.40
9	Bienayme Galton Watson process (BGW)	5	2.40
10	Galton's data	2	0.96
11	Galton's fallacy	2	0.96
12	Galton Institute	1	0.48
13	Galton Society	1	0.48
14	Galton statistic	1	0.48
15	Galtonia	1	0.48
16	Galtonian Inheritance	1	0.48
17	Galtonian Revolution	1	0.48
18	Galton's Whistle	1	0.48
19	Galton-Watson type process	1	0.48
20	Galton-Watson forest	1	0.48
21	<i>Galton / Twin</i>	1	0.48
22	<i>Galton / Quincunx</i>	1	0.48

Table 8: Most mentioned forms in title and abstract (88 Items)

in title and abstract (title)	Items	%
GALTON-WATSON PROCESSES	26	29.55
Galton-Watson Tree, family trees	20	22.73
Galton board, Optical Galton board	10	11.36
Galton-Watson forest	3	3.41

Galton's Problem	3	3.41
Galtonia candicans	3	3.41
Galton's Fallacy	2	2.27

Table 9: Most mentioned forms only in title (417 Items)

only in title	Items	%
Galton-Watson process, branching process	139	33.33
Francis Galton	87	20.86
Galtons problem	38	9.11
Galton	36	8.63
HEREDITARY GENIUS	13	3.12
Eugenics	8	1.92
Galton-Watson tree	7	1.68
Galton Data	6	1.44
Galtonia candicans	6	1.44
Galton whistle	4	0.96
Bienayme-Galton-Watson process	3	0.72
Galton's board	3	0.72

Table 10: Most mentioned forms only in abstract (252 Items)

only in abstract	Items	%
Galton-Watson (branching) process	76	30.16
Galton-Watson tree	22	8.73
Bienayme-Galton-Watson branching process (BGW)	19	7.54
Galton board	11	4.37
Galton regression	9	3.57
Galton's problem	9	3.57
Galton-Pearson correlation coefficient	7	2.78
Galton's Eugenics	7	2.78
Galton and Pearson	5	1.98
Galtonian conception of intelligence	5	1.98
Galton (as Person)	4	1.59
Galton's quincunx	4	1.59
Galton Spearmann psychometrics	3	1.19
Galton, Pearson	3	1.19
psychometrics of Galton	3	1.19
Galton Twin Studies	3	1.19
Galton's fallacy	3	1.19
Heredity	3	1.19
Genius	3	1.19

Galtonia candicans	2	0.79
visuo-spatial representations of numbers	2	0.79
IQ testing	2	0.79

Fig. 4 below gives an overview of the most used mentions for Galton in WoS.

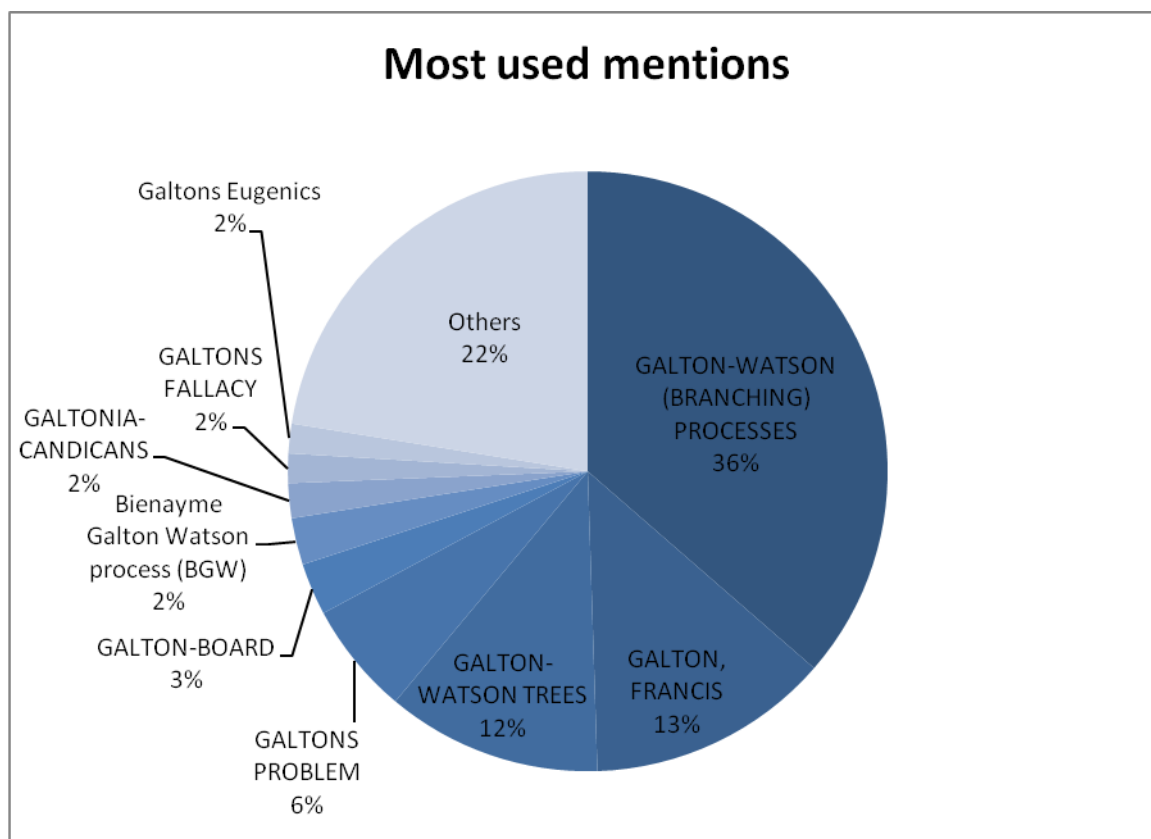


Fig. 4: Most used Galton mentions and eponyms in WoS

“Galton–Watson (branching) process” is the most used mention incl. “Galton-Watson tree” and “Bienayme Galton-Watson process” as sublevels of the term. Most of the mentions in WoS can also be found in encyclopaedias, such as “Galton's problem” and “Galton–Watson process”, etc. Furthermore synonyms like Bean Machine, Quincunx or Galton box (instead of Galton board) and Galtonia (instead of Galtonia-Candicans) are included in “Others”. Even book titles can be rather mentioned than cited (Hereditary Genius with 15 overall mentions).

Results of the citation analysis:

General results:

Table 11: Citation analysis of Galton works in the three data sources

Data Source	Hits	Citations	Citing Publications	Citations per publication	h-index	h-index without books
WoS	1336	5891	2007	2.93	25	21

Google Scholar	240	7397	n.a.	23.04	30	26
Scopus	n.a.	n.a.	2447		21	16

Note: Publish or Perish does not provide information about the number of citing publications but only the citation number.

The reference search in Scopus allows only to search in all the reference fields but not in each reference.

Most cited monographs:

The table below gives an overview of Galton's most cited monographs comparing their ranking position and number of citations in WoS, Scopus and Google Scholar.

Table 12: Most cited Galton's books and book editions.

Rank WoS	Title (Abbreviation)	WoS				Google Scholar		Scopus	
		Most correct- ly cited Ed. MCCE	Most cited Ed. MCE	PY MCE	Cits (C) to all Eds	Rank	C	Rank	C
1	INQUIRIES HUMAN FACU*	673	839	1883	1066	11	13	2	351
2	HEREDITARY GENIUS	274	503	1869	912	1	2004	1	363
3	NATURAL INHERITANCE	274	356	1889	387	2	657	3	156
4	ENGLISH MEN SCI THEI	114	222	1874	252	3	377	4	80
5	FINGER PRINTS	154	213	1892	250	4	338	5	74
6	MEMORIES MY LIFE	54	111	1908	142	5	185	6	49
7	ESSAYS EUGENICS	31	48	1909	55	7	85	7	33
8	NARRATIVE EXPLORER T**	18	28	1853	52	6	101	8	19
9	FINGER PRINT DIRECTO	6	20	1895	24	9	21	14	1
10	ART TRAVEL SHIFTS CO	6	8	1855	24	8	31	11	5
11	METEOROGRAPHICA METH	8	12	1863	12	15	3	9	6
12	GENIE VERERBUNG***	6	10	1910	10	10	15	12	4
12	NOTEWORTH FAMILIES	9	10	1906	10	12	6	9	6
14	RECORD FAMILY FACULT	3	3	1884	3	12	6	15	0
15	DECIPHERMENT BLURR S	3	3	1893	3	14	5	13	2

Comments:

*also includes 24 citations for the alternative spelling "enquiries"; in Google Scholar only book chapters, but not the entire book cited

**also published and cited as „Tropical South Africa“ (see Galton.org) and aggregated with "Narrative Explorer" cites

***German translation of “Hereditary Genius” and explicitly cited with German title, could however be aggregated with the cites for the English title

The correlation between the results obtained from the three different used data sources either including or excluding “Inquiries Human Faculty”¹ are shown in Table 13.

Table 13: Correlation of the results obtained for the most cited monographs in WoS, Scopus and Google Scholar with and without “Inquiries Human Faculty”

	Corr WoS GS	Corr WoS Scopus	Corr GS Scopus
incl. Nr.1 (Inquiries)	0.610	0.992	0.689
excl. Nr.1	0.990	0.995	0.994

Journal articles

The table below gives an overview of Galton’s most cited journal articles (Top 40 in WoS) listing their number of citations in Scopus and Google Scholar for comparison.

Table 14: most cited Galton’s journal articles in WoS (Top 40)

Rank WoS	Title (Abbreviation)	PY	Vol	Page	correct cited	total cited WoS	Citations Google	Citations Scopus
1	J ANTHR I	1886	15	246	133	176	347	120
2	BRAIN	1879	2	149	125	164	313	95
3	J ROYAL ANTHR I	1876	5	391	27	99	233	21
4	MACMILLANS MAGAZINE	1865	12	157	75	81	218	39
6	P ROYAL SOC	1888	45	135	67	80	157	27
5	NATURE	1880	21	252	76	76	2	55
7	P ROY SOC	1879	29	365	65	68	88	26
8	J ANTHR I	1879	8	132	12	56	162	3
9	MIND	1880	5	301	41	55	94	22
10	FORTNIGHTLY REV	1884	36	179	38	54	0	33
11	FORTNIGHTLY REV	1872	12	125	38	47	97	32
11	FRAZERS MAGAZINE	1875	12	566	32	47	0	10
13	MACMILLANS MAGAZINE	1865	12	318	41	45	2	33
14	NATURE	1878	18	97	40	41	0	3
15	P ROY SOC LONDON	1886	40	42	35	41	84	21

¹ „Inquiries Human Faculty“ is an exception, since „some chapters were reprints , while others expanded on topics alluded to in earlier articles“ (Gillham, 2001, p. 207).

16	P ROY SOC LONDON	1897	61	401	32	39	40	15
17	NATURE	1880	21	494	17	27	2	22
18	P ROYAL SOC	1871/2	19	393	21	25	44	16
18	J ANTHROPOL INST*	1875	4	138	2	24	159	28
20	J ANTHR I	1885	14	275	18	22	15	2
21	NATURE	1907	75	450	21	21	69	21
22	MACMILLANS MAG	1871	23	353	19	20	34	2
23	NATURE	1877	15	492	19	19	0	5
23	MIND	1887	12	79	15	19	3	2
25	P ROYAL I GREAT BRIT	1877	8	282	18	18	0	12
25	J ANTHR I	1881	10	85	2	18	127	10
27	NATURE	1907	75	414	17	17	34	10
27	NATURE	1888	38	14	14	17	0	6
29	AM J SOCIOL	1904	10	1	14	15	94	13
29	J ANTHR I GREAT BRIT	1885	14	205	14	15	30	2
29	P ROYAL SOC LON	1871/2	20	394	11	15	30	3
29	CONTEMP REV	1875	27	80	11	15	0	7
33	T ETHNOLOGICAL SOC L	1865	3	122	9	14	29	6
34	PHILOS MAG	1875	49	33	11	13	19	6
34	NATURE	1877	15	512	13	13	0	2
34	NATURE	1877	15	532	12	13	2	6
37	J ANTHR I	1890	19	27	0	12	25	1
37	NATURE	1901	64	659	12	12	0	5
37	J ANTHR I	1876	5	329	4	12	35	9
37	PHILOS T ROY SOC LON	1891	B182	1-23	7	12	8	2
41	BIOMETRIKA	1902	1	385	1	11	31	7
42	POPULAR SCI MONTHLY	1875	8	345	10	10	4	3
43	Educational Times	1873		17	2	10	21	1
44	CITED INDIRECTLY				10	11		

*This famous paper is co-authored by H.W. Watson

A comparison of the results obtained from WoS and from Google Scholar revealed that many of the references listed in the WoS Top 40 cannot be found amongst Google Scholar's Top 40 (see Table 15).

Table 15: References from Google Scholar's Top 40 not represented amongst WoS Top 40

Rank GS	Title (Abbreviation)	PY	Vol	Page	Corr. Cited WoS	Total Citations C WoS	C Google S	C Scopus
12	J of Anthr Inst GB	1889	18	177	0	1	90	8
25	J of Anthr Inst GB	1889	18	155	0	2	27	0
26	Fraser's Magazine	1873	7	116	0	0	26	2
28	The North American Rev	1890	150	419	0	0	25	5
32	Nineteenth Century*	1879	?	?	*	*	16	2
33	NATURE	1910	83	127	0	7	15	3

35	PHOTOGRAPHIC NE 0417	1885	29	243	0	6	13	7
34	MIND	1894	3	362	1	3	12	0
37	P ROYAL I GREAT BRIT	1879		161	4	5	11	2
	Synaesthesia: Classic and							
37	Contemporary Readings	1880		43	4	8	11	8
37	Fortnightly Review	1882	29	729	0	0	11	0
40	Psychological Review	1894	1	61	6	7	10	1
41	MIND	1890	15	373	0	10	9	3
41	Nature	1895	52	174	0	0	9	0

The results of the aggregation at title level and the corresponding Spearman correlation coefficients are shown in the tables below:

Table 16: Most cited article titles

Title	Rank WoS	Citations WoS	Rank GS	Citations GS	Rank Scopus	Citations Scopus
Regression towards mediocrity in hereditary stature	1	176	1	347	1	120
Psychometric experiments	2	162	2	313	2	95
The history of twins, as a criterion of the relative powers of nature and nurture.'	3	156	3	237	5	34
Hereditary talent and character	4	126	4	220	4	57
Visualised numerals	5	121	8	131	3	85
COMPOSITE PORTRAITS	6	97	5	162	>10	6
Co-relations and their measurement	7	80	7	157	9	27
On the probability of the extinction of families	8	75	6	159	8	28
The geometric mean	9	68	>10	88	10	26
Typical Laws of Heredity	10	63	>10	84	11	25
Statistics of mental imagery	11	55	10	94	12	22
Measurement of character	12	54		0	6	33
Statistical inquiries into the efficacy of prayer	13	47	9	97	7	32

Table 17: Correlation of the results obtained for the most cited journal articles in WoS, Scopus and Google Scholar

	Correlation WoS GS	Corr WoS Scopus	Corr GS Scopus
Normal Count	0.817	0.904	0.752
Aggregated	0.912	0.761	0.697

Correlation analysis: citations vs. occurrences in other biographical sources

The results for Part A and Part B are shown in the tables below.

Part A

Table 18: Occurrence counts for the 14 most cited Galton's books.

	INQUIRIES HUMAN FACU	HEREDITARY GENIUS	NATURAL INHERITANCE	ENGLISH MEN SCI THEI	FINGER PRINTS	MEMORIES MY LIFE	ESSAYS EUGENICS	EXPLORER T NARRATIVE	FINGER PRINT DIRECTO	ART TRAVEL SHIFTS CO	METEOROGRAPHICA METH	NOTEWORTH FAMILIES	RECORD FAMILY FACULT	DECIPHERMENT BLURR S
Rank WoS	1	2	3	4	5	6	7	8	9	10	11	12	13	13
WoS Citations	1066	912	387	252	250	142	55	52	24	24	12	10	3	3
Obituary RS 1911	3	5	2	0	1	3	0	0	1	1	0	0	0	1
Obituary Man 1911	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Comm. Paper -Corney	1	1	1	1	1	1	0	0	0	1	0	0	0	0
Website	3	3	2	2	2	2	1	2	2	2	2	1	1	2
Gillham's Prologue	1	3	3	1	1	0	0	0	1	1	0	0	0	0
Pearson's Contents	1	2	1	1	1	1	0	0	1	0	0	1	1	1
Bulmer's Contents	0	3	1	1	0	0	0	0	0	0	0	0	0	0
Bulmer's Chronology	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Britannica	3	6	1	0	0	0	0	0	0	0	0	0	0	0
Wikipedia English	3	4	0	1	1	1	0	1	1	1	0	0	0	1
Wikipedia Deutsch	1	4	1	1	1	1	1	2	0	2	2	0	0	1
Poggendorff	1	1	0	1	0	1	0	1	0	1	1	0	1	0
Larrousse	0	1	1	0	0	0	1	1	0	0	0	0	0	0
Colliers	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Espasa Calpe	1	1	1	1	1	1	0	1	1	1	1	1	0	0
Enciclopedia Italiana	0	1	1	1	0	0	1	0	1	0	0	1	0	0
Encyclopedia														
Americana	0	1	1	1	1	1	0	1	1	1	1	0	0	0
Brockhaus	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Oxford DNB	1	0	2	0	0	1	0	0	0	1	0	0	1	0
Total	22	41	20	13	11	14	5	10	10	12	7	4	4	6

Table 19: Spearman correlations with citations in the three major citation databases

Correlations	WoS	GS	Scopus
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Obituaries, Festchriften, Website	0.831	0.704	0.880
Biographies: ToC, Prologue, Summary	0.735	0.906	0.765
Encyclopaedias & Dictionaries	0.815	0.863	0.856
All	0.849	0.881	0.891

Part B

Table 20: Pages in indexes of four selected biographic sources

Rank		WoS	Gillham	Pearson	Bulmer	Forrest	Total
WoS	Title (Abbreviation)	C	2001 Counts	1924 Counts	2003 Counts	1974 Counts	Counts
1	INQUIRIES HUMAN FACU*	1066	6	13	9	16	44
2	HEREDITARY GENIUS	912	31	34	42	23	130
3	NATURAL INHERITANCE	387	23	28	40	13	104
4	ENGLISH MEN SCI THEI	252	5	8	9	9	31
5	FINGER PRINTS	250	4	12	4	9	29
6	MEMORIES MY LIFE	142	10	23	5	3	41
7	ESSAYS EUGENICS	55	0	0	2	0	2
8	NARRATIVE EXPLORER T	52	6	8	6	1	21
9	FINGER PRINT DIRECTO	24	3	2	0	4	9
10	ART TRAVEL SHIFTS CO METEOROGRAPHICA	24	5	15	5	11	36
11	METH	12	1	7	0	1	9
12	NOTEWORTH FAMILIES	10	1	12	3	2	18
13	RECORD FAMILY FACULT	3	0	8	2	4	14
13	DECIPHERMENT BLURR S	3	1	5	0	0	6

Table 21: Spearman correlations with citations in the three major citation databases

Spearman's correlations	WoS	Gillham	Pearson	Bulmer	Forrest	All
WoS		0.634	0.576	0.628	0.855	0.696
Google S	0.610	0.707	0.763	0.857	0.750	0.875
Scopus	0.992	0.707	0.632	0.702	0.870	0.759
Gillham	0.634		0.906	0.962	0.774	0.980
Pearson	0.573	0.897		0.848	0.736	0.933
Bulmer	0.645	0.947	0.880		0.774	0.970
Forrest	0.855	0.774	0.760	0.795		0.853

Conclusions

Beyond doubt Francis Galton is a perfect choice for a bibliometric study. Doing research in many subject fields, showing versatile skills and being a prolific author he left a rich legacy for posterity. Galton's versatility and interdisciplinary interest certainly allow a more extended view on the nature of citations as well as on the phenomenon of obliteration. His works are not only still, but increasingly cited or mentioned, which is proof for the timeliness of this outstanding scientist.

Challenges with citation analysis

Citation analysis of Galton's most cited journal articles in WoS turned out to be more complicated in comparison to the analysis of the most cited books due to inaccurate citations.

These arise from

- typos in publication year (e.g. 1975 instead of 1875, 1879 instead of 1876, 1890 instead of 1899)
- articles published in journals with volumes covering two publication years (e.g. 1870-71) → either the one or the other publication year is cited
- Galton's publication strategy: the publication of articles with the same title in multiple journals (e.g. "Typical laws of heredity", "Theory of heredity", "On blood-relationship"). The purpose was to target scientific experts as well as a broader public audience. A random check did not reveal obvious differences regarding the citation frequency of science vs. popular science articles.

In spite of the fact that the citation analysis of books is comparatively easier there are also challenges like dealing with different editions, different spellings or title changes.

The sources for citation analysis and their correlation

Without dispute WoS is the most suitable database for retrospective citation analyses according to their strict selection criteria and its enormous coverage (reaching back to 1900 = Century of Science). However, it is a matter of common knowledge that the "citations part" shows increasing signs of neglect and has such limited functionality (first authors only, no titles, no sorting, no grouping, no export options) in comparison to the "source part". This is unfortunate, since this "reference part" once was the product's key feature or unique selling proposition in the world of bibliographic databases. A well maintained "reference part" would be invaluable for studying the history of science, but unfortunately it has obviously become a step-child business.

The "reference part" of Scopus shows comparatively more usability. Scopus provides complete bibliographic information including the title which is extremely helpful in the citation data cleansing process and allows an impact estimation of the secondary (and not only of the primary) literature. Furthermore notes and footnotes of citing authors are displayed, which is interesting for historians. The downside of Scopus is the less comprehensive coverage in comparison to WoS including significant gaps. On the other side, it doesn't allow a separate search in different fields of the reference, which hampers citation analysis considerably.

Google Scholar (in combination with "Publish or Perish") is of limited utility due to its lacking sustainability, low reliability and non-disclosed selection criteria. It can only be seen as a complementary tool for the identification of potentially "lost" (= non-indexed in WoS or Scopus)

publications especially in Arts & Humanities or in Social Sciences. It offers a large number of bibliometric indicators, however, most of them need to be proofed and/or corrected.

Scientometric analyses for historiometric purposes should rely on various databases – the more, the better. Therefore WoS, Scopus and Google Scholar perfectly complement one another, and the results obtained from the citation analyses of the most cited documents are overall consistent.

This is supported by the Spearman correlations which are very high for the three databases.

As already mentioned in a footnote in the Results part of this paper, Galton's "Inquiries into human faculty" takes an exceptional position among his works. A considerable part of it has review character (either being reprint articles or expanding on former articles). Furthermore this book contains the first description of a new technology called "composite photography" and also introduces the term "eugenics" (his theory of improving the human race by controlling hereditary factors). Taking all this into consideration it is no wonder that "Inquiries" has so far resulted in more citations (and mentions) than any of Galton's other books. That is why the correlation of the results obtained for the most cited monographs in WoS, Scopus and Google Scholar was calculated with and without this book. Excluding "Inquiries" the correlation is excellent for all monographs. Otherwise the correlation becomes somewhat weaker between WoS and GS as well as between GS and Scopus.

The correlation of the results obtained for the most cited journal articles in WoS, Scopus and Google Scholar is best between WoS and Scopus for non-aggregated titles, and best between WoS and GS for aggregated titles.

Citation versus obliteration

Citation analysis is definitely appreciated as a useful tool to study the impact of the works of "giants", especially by historians and biographers who by this means can easily detect publications with utmost impact. However, on its own it is too restrictive. The authors therefore recommend including the phenomenon of obliteration and thus detect eponyms.

They originate from "key words in title" or from author keywords, and gradually develop to official database descriptors. Unfortunately descriptors are only in general use since the 1950s and only available in WoS from 1990 onwards. Full text databases like JSTOR and Science Direct are therefore useful for the identification of eponyms in retrospective studies.

"Galton-Watson (branching) process" and "Galton-Watson trees" are the most used eponyms, followed by "Galton's problem" and "Galton board".

Whether scientists are (properly) cited or rather only mentioned might either depend on the respective subject area or on the country-specific cultural behaviour. Our findings suggest that obliteration is probably more common in subject areas like mathematics and statistics (the naming of formulas, processes, effects, etc.) than in e.g. psychology. Moreover the Americans (USA) seem to cite more often, whereas the Europeans tend to only mention.

According to our results Galton's impact comprises of almost one third (32%) obliteration by incorporation vs. the remaining two thirds of citations (64%) and both (4%). Interestingly a recent paper on the "Nash Equilibrium" by John Forbes Nash (McKain & McKain, 2010) suggests quite the opposite proportion with two thirds of articles where Nash is no more cited but only mentioned. Further studies of this kind will be necessary to make more well-grounded statements.

Citation vs. occurrence counts

In our study citation counts were furthermore compared to occurrence counts in obituaries, encyclopaedias and biographical indexes. As a result the most cited books and journal articles also turned out to be the most mentioned ones. The authors found an astonishingly positive correlation, and stumbling across single cases with low consistency reveal discrepancies otherwise missed. Except for Google Scholar the correlation between citations and mentions are higher for general obituaries, festschriften, encyclopaedias and dictionaries than for biographical texts. Furthermore occurrences retrieved in the “Table of Contents” or in the “Preface” sections seem to produce better correlations than those retrieved “anywhere in the full text”. Therefore it is recommended to weight the occurrences accordingly.

Citation analysis and the counting of occurrences in biographical sources, facilitated by the advent of electronic books, are important methods for the study of the history and sociology of science. Both support the retrieval of the most relevant or most influential works of giants or geniuses, and the combination of both approaches even better allows the unmasking of a “giant’s” publication strategy. The used methods can be regarded as complementary, bringing together the objective nature of citations and the subjective peer perspective of a biographer.

Certainly this kind of retrospective bibliometric analyses present an interesting and promising field of activity for librarians and information specialists.

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