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Measuring the Scientific Productivity, Web Visibility of the Nobel Laureate Carolyn Ruth Bertozzi

Tathagata Dhar*

Abstract

Introduction: Google Scholar is a search engine that solely searches academic resources. It stands out from regular Google searches because of its scholarly and authoritative focus.

Purpose: The study made an effort to determine and evaluate the research outputs of Prof. Carolyn Ruth Bertozzi, (a Nobel laureate in chemistry) from 1970 to 2023.

Methodology: The data was retrieved from the Google Scholar database. The study uses various scientometric parameters to find top publications, most cited articles, authorship patterns, and the most prolific sources of Prof. C. R. Bertozzi. The collected data was then processed and analysed in various software programs such as publish or perish, open refine, VOSViewer and microsoft excel.

Objectives: The study is to examine and assess the different quantitative aspects of publications and citations of Prof. Carolyn Ruth Bertozzi as indexed in the Google Scholar database.

Research Problem: No study was undertaken to display the research visibility of nobel lauterate Prof. C. R. Bertozzi.

Findings: The study found that during 1970-2023, Prof. Bertozzi produced 922 documents in which she gets an overall 81,269 citations. The highest number of citations and cites per year received by the article "Bioorthogonal chemistry: fishing for selectivity in a sea of functionality". Highest citations (6468) were received in the year of 2021. Prof. Bertozzi contributed the most 119 publications in the American Chemical society. J. A. Prescher, E. M. Stallen were the most prolific co-authors of Prof. Bertozzi. The collaboration rate was 0.89, which identifies the majority of her writings were written in collaboration. It was also observed that the most number of publications belongs to the group of two authorships (173, 20.86%).

Keywords: Web Visibility, Carolyn Ruth Bertozzi, Citation Metrics

Introduction

Dr. Bertozzi obtained her Ph.D. at UC Berkeley with a specialisation on the chemical synthesis of oligosaccharide analogues after completing her undergraduate studies in chemistry at Harvard University. She completed her postdoctoral research from UC San Francisco on the role of endothelial oligosaccharides in enhancing cell adhesion in inflammatory areas. She started teaching at UC Berkeley in 1996 and joined Stanford University in June 2015 as one of the first faculty members to join the multidisciplinary centre ChEM-H (Chemistry, Engineering & Medicine for Human Health). Dr. Bertozzi, who was named a MacArthur Fellow in 1999, has won several honours for her commitment to chemistry and to educating the next generation of scientists fluent in both areas' chemistry and biology. She awarded nobel prize in chemistry for her development of biorthogonal reactions. Professor Carolyn Bertozzi's research focuses on studies of cell surface sugars related to human health and disease, using this information to develop new diagnostic and therapeutic approaches, particularly in immuno-oncology. Her exploration group makes changes in cell surface glycosylation which is associated with cancer bacterial infection and inflammation. Using this

* Librarian Grade III, All India Institute of Medical Sciences (AIIMS), Raipur, Chhattisgarh, India.
Email: tathagatadhar@aiimsraipur.edu.in

information, they develop new remedial approaches in the area of immune-oncology (Carolyn Bertozzi). Anurag Acharya started the Google Scholar project during his time as a student at the Indian Institute of Technology's Kharagpur campus. He alongside Alex Verstak created Google Scholar dated back on 20 November 2004, which is an academic search engine that makes it simple for scholars to look, find, and access academic publications or sources. It indexes millions of full-text articles, abstracts, theses, preprints, books, and chosen web pages (web pages collections) from a variety of fields as a subset of Google. It encompasses a wide range of academic topics, including social studies (education and counselling) and science, technology, engineering, and medicine (STEM) (Levy, 2014) (G, 2023). Google Scholar Profiles impart authors an easy method to highlight their scholarly content. We may find who is referencing our work, chart citation trends over time, and calculate a variety of citation metrics. We may also choose to make our profile visible to the scholarly world, which will allow it to show up in Google Scholar search results when someone types in our name. The best part is that it's quick and easy to set up, even if we've produced hundreds of papers and our name is used by many other academicians. Our citation metrics are generated and updated automatically when Google Scholar discovers new citations to our work on the web, and we may add groups of relevant articles rather than simply one item at a time (About Google Scholar).

Objectives

- To identify the top publications metrics based on GS rank.
- To determine the most cited articles written by Prof. C. R. Bertozzi.
- To find out the total number of publications with citations.
- To identify the authorship patterns.
- To discover the author collaborative networks.
- To know the most prolific sources communicated by Prof. C. R. Bertozzi.
- To find out the most used keywords.

Review of Related Literature

(Fitria et al., 2022) has carried out a study during 2017–2021 which demonstrated step-by-step bibliometric data analysis using VOSViewer to produce network visualisation of co-work maps and density maps of co-works, and evaluates the analysis of digital learning articles in pre and post COVID-19. The Publish or Perish reference manager application was used to conduct the literature review.

(Munnolli et al., 2011) has tried to analyse the scientometric portrait of Harald zur Hausen, who was a renowned scientist and Nobel laureate in Physiology. The study was conducted during 1964–2009. The findings of the study stated that his highest collaboration rate was found 13 times in his 46 years of career. His most preferred journals for publishing papers were the International Journal of Cancer, Virology, Journal of Virology, Cancer Research, and Medical Microbiology and Immunology. Lastly, his publication density was 3.60, publication concentration was 3.49, and his productivity coefficient was 0.50.

(Sinha, 2017) has studied the scientometric profile of Nobel laureate Amartya Sen. The study identified that during the period 1960-2015, he produced 43 books. Jean Dreze was the most noticeable contributor to Dr. Sen. The study also identified that, in addition to his contributions to the field of education, he is well renowned for his work on social issues, politics, government, and financial economics.

(Bansal, 2018) has examined the publication output of Chemistry Nobel Prize winner Arieh Warshel, who received his Nobel Prize in the year of 2013. He contributed 393 publications between 1968 and 2016, including 25 book chapters. His articles are reviewed in terms of year, authorship patterns, and modes of communication. The data has been downloaded from the website of the Warshel Centre for multiscale simulations for this study

(Kademani et al., 1996) has tried to explore the well-known astrophysicist, S. Chandrasekhar. His articles were examined according to year, subject, pattern of collaboration and keywords. The study found that by

the end of 1990, not only he had published 91 papers in the fields of stellar structure and atmosphere, but also he had contributed 80 papers in radiation transfer and the negative ion of hydrogen. The study also found that during 1983-87 his highest collaboration coefficient was 0.5 and productivity coefficient was 0.46.

Methodology

The research publications of Carolyn Ruth Bertozzi were retrieved from her Google Scholar profile using Publish or Perish software. The papers were downloaded in a variety of file formats for further analysis. The downloaded data was then processed and analysed using tools like Open Refine and VOSViewer in order to better comprehend and visualise the downloaded data. She has written 922 papers and received 81, 269 citations from 1970-2023. The h index and g index of her Google scholar profile are 137 and 272 respectively. She received 1533.38 citation per year and 88.14 citation per paper.

Papers	*Cites*	*Publication Years*	*h Index*	*g Index*	*Cite/Year*	*Cites/Paper*	*Citation Years*
922	81269	1970-2023	137	272	1533.38	88.14	53

Data Analysis

Top Publications Metrics

Table 1: Top Publications Metrics Based on GS Rank

Cites	*Year*	*GS Rank*	*ECC*	*Cites Per Year*	*Cites Per Author*	*Author Count*	*Age*
3033	2009	1	3033	216.64	1517	2	14
2951	2000	2	2951	128.3	1476	2	23
2911	2004	3	2911	153.21	970	3	19
2227	2001	4	2227	101.23	1114	2	22
2073	2007	5	2073	129.56	259	8	16
1919	2005	6	1919	106.61	960	2	18
1688	2010	7	1688	129.85	844	2	13
1646	2005	8	1646	91.44	823	2	18
1299	1990	9	1299	39.36	325	4	33
1241	2002	10	1241	59.1	310	4	21
1113	2008	11	1113	74.2	278	4	15
1060	2011	12	1060	88.33	530	2	12
980	1997	13	980	37.69	327	3	26
884	2006	14	884	52	177	5	17
849	2004	15	849	44.68	283	3	19
819	2000	16	819	35.61	273	3	23
808	2015	17	808	101	115	7	8
805	2008	18	805	53.67	201	4	15
800	2010	19	800	61.54	267	3	13
708	2008	20	708	47.2	354	2	15

Table 1 describes the top publications metrics of Prof. C. R. Bertozzi based on GS rank. From this table we can observe that, 3033 citations received in the year of 2009 which obtained first GS rank (216.64 cites per year), which had two authorships followed by 2nd, 3rd and 4th GS rank received in the year 2000, 2004 and 2001 where she received 2951 citations (128.3 cites per year), 2911 citations (153.11 cites per year) and 2227 citations (101.23 cites per year) respectively.

Most Cited Articles

Table 2: Most Cited Articles

Sr. No.	Cites	Title	ECC	Cites Per Year
1	3033	Bioorthogonal chemistry: fishing for selectivity in a sea of functionality	3033	216.64
2	2951	Cell surface engineering by a modified Staudinger reaction	2951	128.3
3	2911	A strain-promoted [3 + 2] azide? alkyne cycloaddition for covalent modification of biomolecules in living systems	2911	153.21
4	2227	Chemical glycobiology	2227	101.23
5	2073	Copper-free click chemistry for dynamic in vivo imaging	2073	129.56
6	1919	Glycans in cancer and inflammation—potential for therapeutics and diagnostics	1919	106.61
7	1688	Cu-free click cycloaddition reactions in chemical biology	1688	129.85
8	1646	Chemistry in living systems	1646	91.44
9	1299	Coadsorption of ferrocene-terminated and unsubstituted alkanethiols on gold: electroactive self-assembled monolayers	1299	39.36
10	1241	Incorporation of azides into recombinant proteins for chemoselective modification by the Staudinger ligation	1241	59.1
11	1113	In vivo imaging of membrane-associated glycans in developing zebrafish	1113	74.2
12	1060	From mechanism to mouse: a tale of two bioorthogonal reactions	1060	88.33
13	980	Engineering chemical reactivity on cell surfaces through oligosaccharide biosynthesis	980	37.69
14	884	A comparative study of bioorthogonal reactions with azides	884	52
15	849	Chemical remodelling of cell surfaces in living animals	849	44.68
16	819	A “traceless” Staudinger ligation for the chemoselective synthesis of amide bonds	819	35.61
17	808	Symbol nomenclature for graphical representations of glycans	808	101
18	805	Synthesis, characterisation, and theory of [9]-, [12]-, and [18] cycloparaphenylene: carbon nanohoop structures	805	53.67
19	800	Rapid Cu-free click chemistry with readily synthesised biarylazacyclooctynones	800	61.54
20	708	The glycosylphosphatidylinositol anchor: a complex membrane-anchoring structure for proteins	708	47.2

Table 2 illustrates the most cited articles written by the Prof. C. R. Bertozzi. It can be observed from the table that “Bioorthogonal chemistry: fishing for selectivity in a sea of functionality” article received both the highest number of citations and cites per year followed by “Cell surface engineering by a modified Staudinger reaction” (2951 citations) and “A strain-promoted [3 + 2] azide? alkyne cycloaddition for covalent modification of biomolecules in living systems” (2911 citations) respectively.

Total Number of Publications with Citations

Table 3: Total Number of Publications with Citations

Year	*New*	*Total Citations*
1996	209	962
1997	238	1200
1998	277	1477
1999	343	1820
2000	366	2186
2001	596	2782
2002	706	3488
2003	803	4291
2004	1095	5386
2005	1227	6613
2006	1466	8079
2007	1842	9921
2008	2257	12178
2009	2850	15028
2010	3379	18407
2011	3810	22217
2012	4011	26228
2013	4442	30670
2014	4961	35631
2015	4960	40591
2016	5320	45911
2017	5062	50973
2018	5281	56254
2019	5130	61384
2020	5419	66803
2021	6468	73271
2022	6134	79405
2023	1864	81269

Table 3 depicts the clear picture of the year wise citations received by the CR Bertozzi during 1996–2023. It can be observed from the table that she received total 81269 citations. Out of which in the year of 2021 she received the highest citations (6468) followed by the year of 2022 (6134) and 2020 (5419) respectively.

Authorship Patterns

Table 4: Authorship Patterns

One authored	94	10.18%
Two authored	173	20.86%
Three authored	123	13.32%

Four authored	112	12.13%
Five authored	93	10.07%
Six authored	106	11.48%
Seven authored	169	18.30%
Eight authored	45	4.87%
Nine authored	7	0.75%
Ten authored	1	0.10%

Table 4 illustrates that a total of 94 (10.18%) documents are one-authored, 173 (20.86%) documents are two-authored, 123 (13.32%) documents are three-authored. Out of the remaining, she wrote 112 documents in four authorship, 93 documents in five authorship, 106 documents in six authorship, 169 documents in seven authorship, and 45 (4.87%), 7 (0.75%), and 1 (0.10%) document in eight, nine and tenth authorship respectively. The most number of publications belongs to the group of two authorships with 20.86% of the total. The collaboration rate found 0.89, which indicates that most of the work of Prof. Carolyn Ruth Bertozzi was written in collaborative ways.

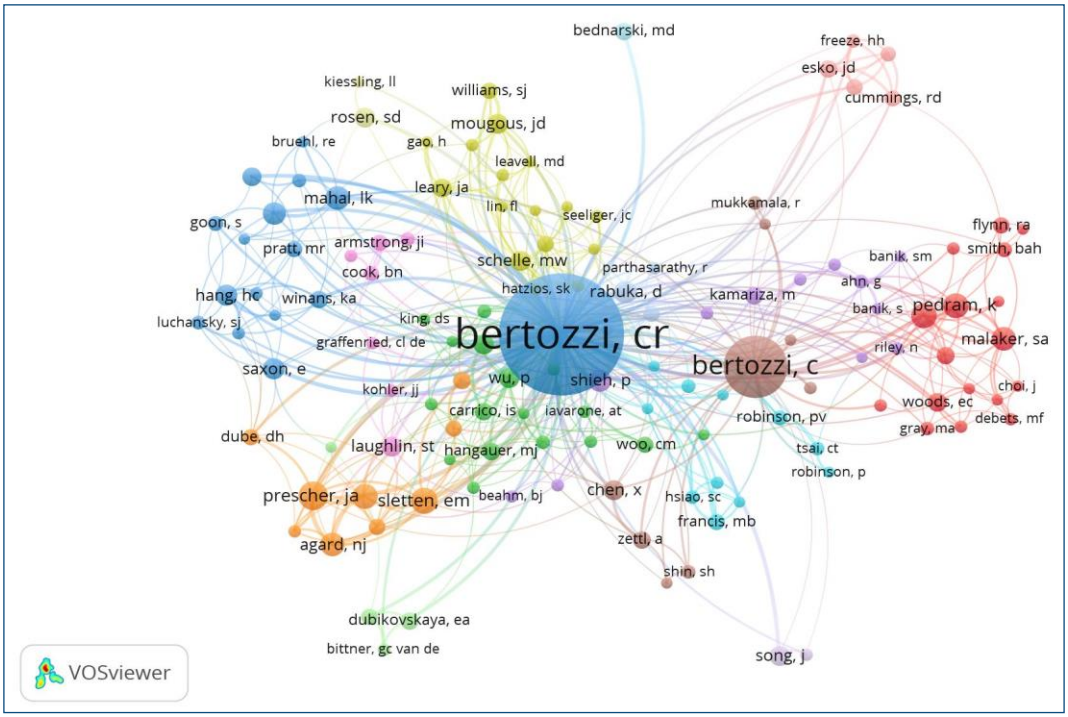

Fig. 1: Author Collaboration Network

Fig. 1 depicts a clear picture of the author collaboration network generated by the VOSViewer. From a total of 1306 authors, 132 authors meet the threshold. For this study, the researcher considers the author having a minimum of 5 documents. As observed from Fig. 1, Prof. Bertozzi had very strong collaboration with J. A. Prescher, E. M. Stallen. The other notable top contributing authors are J. M. Baskin, K. Pedram, S. A. Malaker, N. M. Riley, etc.

Most Prolific Sources

Table 5: Most Prolific Sources Communicated by Prof. C. R. Bertozzi

Sr. No.	*Sources*	*Count*
1	Abstracts of papers of the American Chemical society	63
2	Journal of the American Chemical Society	56
3	Proceedings of the National Academy of Sciences	48
4	Glycobiology	44

Sr. No.	*Sources*	*Count*
5	ACS Central Science	21
6	Journal of Biological Chemistry	20
7	Biochemistry	18
8	Angewandte Chemie	14
9	Chemistry & Biology	13
10	Angewandte Chemie International Edition	12

Table 5 describes the most prolific sources preferred by Prof. Bertozzi. We can see from the Table that Prof. Bertozzi published 119 publications in the American Chemical Society, which is one of the largest scientific societies in the world. She contributed 48 publications in Proceedings of the National Academy of Sciences, followed by 44 publications in Glycobiology. She also contributed 21 publications in ACS Central Science which is a diamond open access journal published by the American Chemical Society.

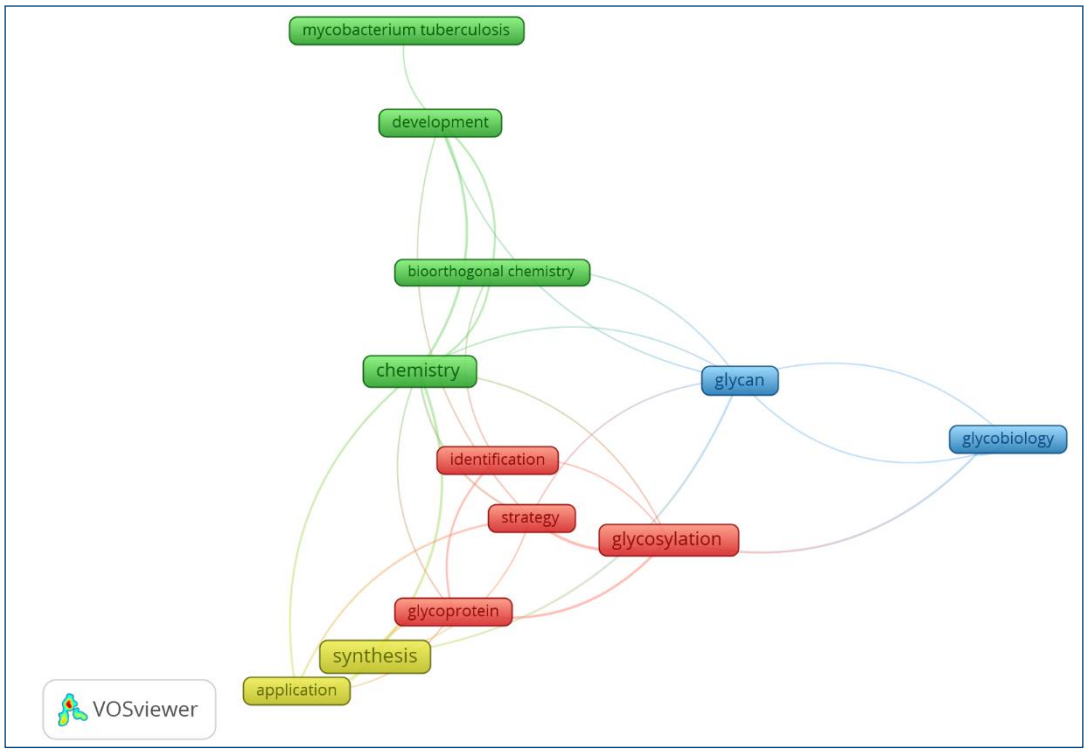

Fig. 2: Visualization of Cooccurrence Networks by Keyword

Fig. 2 shows the four clusters which are identified in the analysis. The most occurring key terms are "glycosylation", "glycoprotein" belonging to the red cluster, while other most visible terms are "bioorthogonal chemistry", "mycobacterium tuberculosis", "chemistry" and "synthesis" from the green and yellow clusters, respectively. The figure also shows that "glycobiology" and "glycan" are the visible terms from blue cluster.

Findings

- Prof. Bertozzi received highest citations (3033) in the year of 2009, which obtained first GS rank (216.64 cites per year), which had two authorships.
- The most cited article was "Bioorthogonal chemistry: fishing for selectivity in a sea of functionality".

- The study found that Prof. Bertozzi received the highest citations (6468) in the year of 2021.
- The study indicated that the most number of publications belong to the group of two authorships (173, 20.86%). The collaboration rate found 0.89 which indicates that most of the work of Prof. Carolyn Ruth Bertozzi was written in collaborative ways.
- The study found that Prof. Bertozzi had very strong collaboration with J. A. Prescher, E. M. Stallen.
- Prof. Bertozzi published the highest number of publications (119) in the American Chemical Society.
- The study reveals that the most occurring key terms are "glycosylation", "glycoprotein".

Conclusion

The present study reveals the research contribution of Prof. C. R. Berotozzi during 1970–2023. A total of 922 documents have been extracted from the Google Scholar database. Publish or Perish has been used to extract data from the database. MS excel and VOSViewer have been used for further data rectification and visualisation purpose. The study revealed that she had very strong collaboration with J. A. Prescher, E. M. Stallen. It has been found that Prof. Bertozzi contributed most of the paper in two authorship.

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