

# Memory of Eugene Garfield

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## ABSTRACT

Eugene Garfield was the founder of the Institute for Scientific Information (ISI) and a pioneer in the field of citation analysis. He founded the ISI in 1960 and developed an indexing system for science literature, based on the analysis of citations used within a given work. Works earn an "impact factor," a measure of citations to other science journals that serves as an indicator of their importance in the field. The more citations in reputable journals, the higher the impact factor. The ISI sold subscriptions to their publication the *Science Citation Index*, and over time grew to include the *Social Sciences Citation Index* (SSCI) and the *Arts & Humanities Citation Index* (A&HCI). These databases now form the foundation of the online research tool called the Web of Knowledge. *The Scientist*, a magazine for science researchers. *His Essays of an Information Scientist* (1977) collects columns published as *Current Contents* between 1962 and 1976, and is considered a classic in the field of information science. The ISI was acquired by Thomson Scientific in 1992. The paper highlights some insights from Eugene Garfield research work by analysing his research collaboration from 1952-2012. The 3-D graphs are presented to visualise the structure.

**Key words:** Eugene Garfield, Institute for Scientific Information, Current Contents, Collaboration Structure, 3-D patterns.

## INTRODUCTION

However, The Scientometrics Pioneer, Dr. Eugene Garfield passed away on 26 February 2017 at the age 91. The following introduction is formulated by SatishMunolli, ISSI@LISTSERV.Redix.ES:Contributions of Garfield to the 'World of science' are immense. It is a great loss to the library and information science profession and the entire world of science community.

His theories and concepts were discussed and debated across the world by the scientific community. Garfield founded the Institute for Scientific Information (ISI) in 1955. In addition to the ISI's Science Citation Index,



Eugene Garfield at the Heritage Day awards in 2007  
[Photo Source: Chemical Heritage Foundation, CC BY-SA 3.0, <http://bit.ly/2psLrtR>]

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a system used to chart connections between pieces of scientific literature that became part of Web of Science. Garfield launched Current Contents, an early effort of 'Current Awareness Service' that sought to compile content pages of upcoming issues of peer-reviewed journals across various disciplines. He was the founder of science news magazine - *The Scientist* in 1986. He was a businessman and an entrepreneur.

## Eugene Garfield's Collaboration Structure From 1952-2012

The degree-centrality of Garfield is equal to the number of all of his 56 co-authors from 1952-2012. All of these authors are connected with him, i.e. this small network was centered by one person: Eugene Garfield.

### Example

There was a great honor for A. Pudovkin, H. Kretschmer and J. Stegmann to be invited by E. Garfield in 2012 to publish a paper together with him:

**Scientometrics.** (2012) 93:3–16 DOI 10.1007/s11192-012-0659-z

Research evaluation. Part I: productivity and citedness of a German medical research institution A. Pudovkin • H. Kretschmer • J. Stegmann • E. Garfield.

In other words, we are 3 of the 56 co-authors of Garfield.

### Structure of a Single Small Network Centered by One Person

Three-dimensional visualization and animation of emerging patterns (“Social Gestalts”) by the process of self-organization in collaboration networks are already presented and described in several papers published by the two authors H. and T. Kretschmer (1999, 2002, 2015), sometimes in combination with co-authors. In contrast to a single power function distribution (2-D graphs) the new mathematical model of “Social Gestalts” visualizes 3-D graphs, using animation in form of rotation of these graphs.

“Social Gestalts” are holistic configurations whose components (co-authorship pairs) constitute a regular Gestalt structure, mathematical described by the mathematical model of Social Gestalts published in the open access (OA) paper: Kretschmer, *et al.* 2015, <http://dx.doi.org/10.1016/j.joi.2015.01.004>.

Fundamental findings in psychology and physics are used as basis for the development of the “Intensity Function of Interpersonal Attraction” to describe the “Social Gestalts”. This function is explained in the Sections 2.2–2.4 of the OA paper mentioned above: <http://dx.doi.org/10.1016/j.joi.2015.01.004>.

The theoretical mathematical function for describing the gestalts of the distribution of co-author pairs' frequencies results in the logarithmic version.

Remarks:  $N_{ij}$  is equal to the sum of co-author pairs of authors who have the number of publications  $i$  in co-authorship with co-authors who have the number of publications  $j$ .

Theoretical patterns are obtained by regression analysis. The overlay of the empirical distributions (dots) and the theoretical pattern (lines) into a single frame is possible for comparison.

## METHODS

Eugen Garfield's collaboration structure is presented with the data from 1952-2012 in 3-D graphs, using animation in form of rotation of these graphs.

For comparison, Garfield's smaller collaboration structure is presented with the data from 1982–2012 only. The method is presented in detail in the paper by Hildrun Kretschmer & Theo Kretschmer 2016 (pp. 103-130) published in the OA Festschrift on the occasion of András Schubert's 70<sup>th</sup> Birthday.

“András Schubert - A world of Models and Metrics” is available for reading and free download in ISSI Services, festschrifts, András Schubert. (ISSI: International Society for Scientometrics and Informetrics)”.

Hildrun and Theo Kretschmer were invited for publication in this issue.

Their paper entitled: “Emergence of 3-D Order in Regular Shapes of Co-author Patterns Mirrored in “András Schubert – Google Scholar Citations” is published on the pages 103-130 including the details:

- The special method of counting co-author pairs, based on social network analysis (SNA) producing a symmetrical matrix of  $N_{ij}$  is described on the pages 108-110.
- The logarithmic binning procedure is explained on the pages 110-111.
- The method of visualizing the 3-D collaboration patterns is described on the pages 112-115.
- The method of visualizing the theoretical pattern and overlay of empirical and theoretical patterns into a single frame is explained on the pages 115-117.

- Statistical results of the “Social Gestalts” based on the mathematical function of the “Social Gestalt” model called “Intensity Function of Interpersonal Attraction” can be found on the pages 117-120.

These OA details can be used directly for explanation the results in the present paper.

**Result: Matrix of  $\log N'_{ij}$  in dependence on  $\log i'$  and  $\log j'$  based on the data from 1952 - 2012.**

The method of visualizing the 3-D collaboration patterns (based on the data presented in the matrix below) is described on the pages 112-115.

The method of visualizing the theoretical pattern and overlay of empirical and theoretical patterns into a single frame is explained on the pages 115-117 and the “Social Gestalts” (3-D patterns) can be found on the pages 117-120.

The 3-D patterns are presented, using animation in form of rotation of these graphs. The black dots are the empirical data and the 3-D patterns the theoretical, cf. the Figures 1-3.

**Result : Matrix of  $\log N'_{ij}$  in dependence on  $\log i'$  and  $\log j'$  based on the data from 1982 – 2012.**

**Eugene Garfield: 1952 - 2012**  
**Matrix of  $\log N'_{ij}$  in dependence on  $\log i'$  and  $\log j'$**

| $\log i' / \log j'$ | 0       | 0.301   | 0.602    | 0.903   | 1.204   | 1.505 | 1.806 | 2.107 | 2.408   |
|---------------------|---------|---------|----------|---------|---------|-------|-------|-------|---------|
| 0                   | 1.34242 | 0.54407 | 0.176091 | -0.301  | -0.6021 |       |       |       | -0.8172 |
| 0.301               | 0.54407 | 0.47712 | -0.60206 | -0.9031 | -1.2041 |       |       |       | -1.679  |
| 0.602               | 0.17609 | -0.6021 |          | -1.5051 | -1.8062 |       |       |       | -2.4158 |
| 0.903               | -0.301  | -0.9031 | -1.50515 |         |         |       |       |       | -3.0103 |
| 1.204               | -0.6021 | -1.2041 | -1.80618 |         |         |       |       |       | -3.6124 |
| 1.505               |         |         |          |         |         |       |       |       |         |
| 1.806               |         |         |          |         |         |       |       |       |         |
| 2.107               |         |         |          |         |         |       |       |       |         |
| 2.408               | -0.8172 | -1.6679 | -2.40824 | -3.0103 | -3.6124 |       |       |       |         |

$\log i'$ : logarithm of the number of publications i  
 $\log j'$ : logarithm of the number of publications j  
 $\log N'_{ij}$ : logarithm of co-author pairs' frequencies  
 Squared Multiple R= 0.994.

**Eugene Garfield: 1982 - 2012**  
**Matrix of  $\log N'_{ij}$  in dependence on  $\log i'$  and  $\log j'$**

| $\log i' / \log j'$ | 0       | 0.301   | 0.602   | 0.903   | 1.204 | 1.505 | 1.806 | 2.107   | 2.408 |
|---------------------|---------|---------|---------|---------|-------|-------|-------|---------|-------|
| 0                   | 0.77815 | -0.301  | -0.6021 | -0.426  |       |       |       | -0.9031 |       |
| 0.301               | -0.301  |         |         | -0.9031 |       |       |       | -1.9311 |       |
| 0.602               | -0.6021 |         |         |         |       |       |       | -2.4082 |       |
| 0.903               | -0.426  | -0.9031 |         |         |       |       |       | -3.0103 |       |
| 1.204               |         |         |         |         |       |       |       |         |       |
| 1.505               |         |         |         |         |       |       |       |         |       |
| 1.806               |         |         |         |         |       |       |       |         |       |
| 2.107               | -0.9031 | -1.9311 | -2.4082 | -3.0103 |       |       |       |         |       |
| 2.408               |         |         |         |         |       |       |       |         |       |

$\log i'$ : logarithm of the number of publications i  
 $\log j'$ : logarithm of the number of publications j  
 $\log N'_{ij}$ : logarithm of co-author pairs' frequencies  
 Squared Multiple R= 0.9719

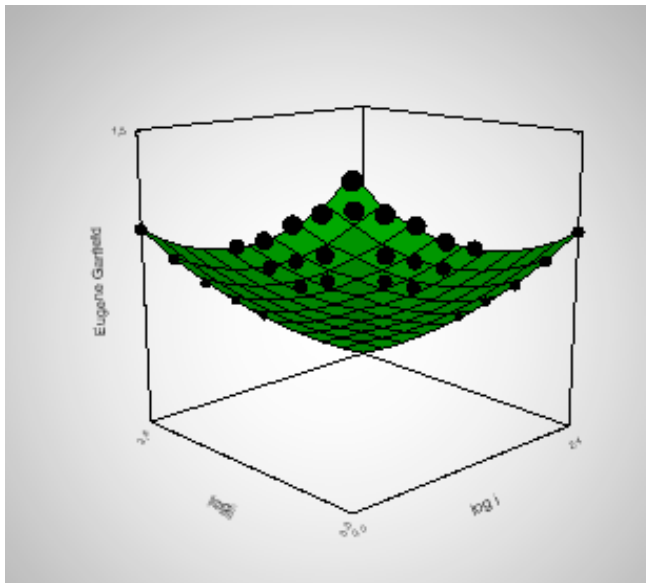


Figure 1: 3-D pattern in front, including black dots.

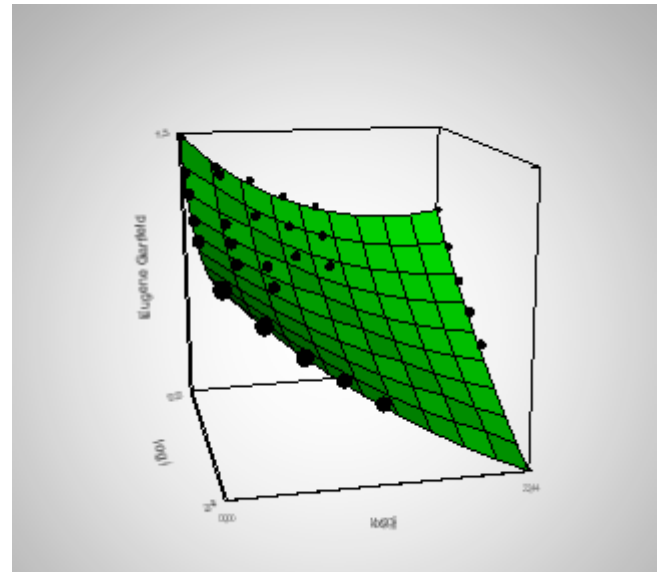


Figure 2: 3-D pattern on the left, including black dots.

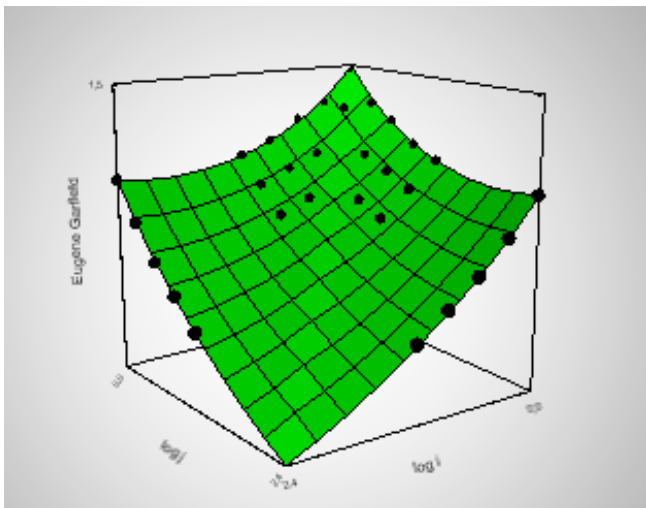


Figure 3: 3-D pattern on the bottom, including black dots.

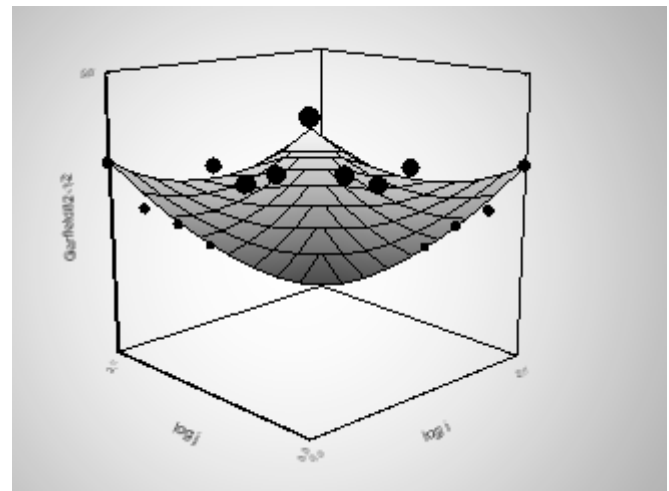


Figure 4: 3-D pattern on the bottom, including black dots.

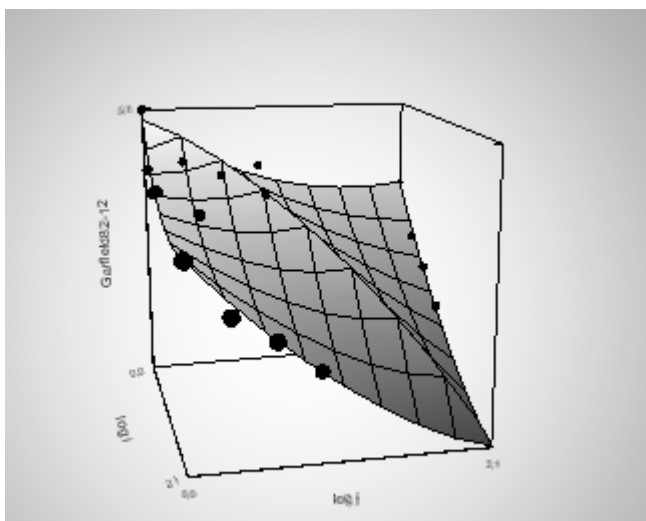


Figure 5: 3-D pattern on the left, including black dots.

The method of visualizing the 3-D collaboration patterns (based on the data presented at the matrix below) is described on the pages 112-115.

The 3-D patterns are presented, using animation in form of rotation of these graphs. The black dots are the empirical data and the 3-D patterns the theoretical, cf. the Figures 4-6.

## CONCLUSION

1. The Scientometrics Pioneer, Dr. Eugene Garfield passed away on 26 February 2017.
2. The memory of Eugene Garfield is selected as the center of this paper.

3. Eugene Garfield's collaboration structure is presented from 1952-2012 in 3-D graphs using animation in form of rotation of these graphs.
4. For comparison, Garfield's smaller collaboration structure is presented with the data from 1982-2012 only.
5. The method of visualizing the theoretical patterns of collaboration and overlay of empirical and theoretical patterns into a single frame is explained.
6. 3-D patterns are presented, using animation in form of rotation of these graphs. The black dots are the empirical data and the 3-D patterns the theoretical, cf. the Figures 1-3 and the Figures 4-6.
7. The 3-D patterns show the way for development in future.

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