

# Prototyping Methods for Bibliographic Network Visualization

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# Navigation in the scientific papers of your field is an important skill

- Writing literature review - essential research skill.
- Citation are like bibliographical footprints of the author.
- Citation choice can be decisive in the success of the paper
- This skill is tacit and can be transmitted from the supervisor to the student or students can try to figure out the literature on their own. The second option can lead to many errors and a literary review, because they will not have an understanding of what kind of papers should be included there.



# Citation Patterns and Citation Typologies

Why people cite:

- Ritual - to gain a foothold in the scientific field
- Strategic use - support statements, show critical thinking
- Can be a gesture of respect - papers that “have to be cited”
- Personal reasons and personal characteristics of author

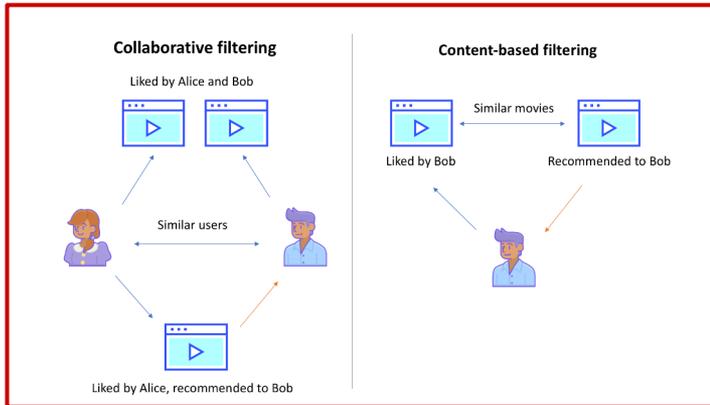
Functional typologies: source, exemplification, evaluation, attribution, statement of use and others...

More than 1/3 of the citations are often non-essential.

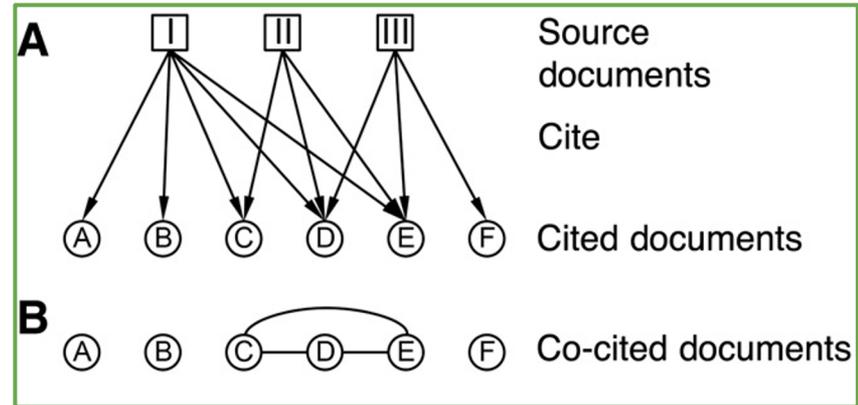
# Citation Recommendation

Many tools for citation recommendation - mostly focus on simple similarity of articles and don't show connections in the scientific field

Among methods: collaborative filtering; content based matching; Social Networks Analysis (co-citation networks)



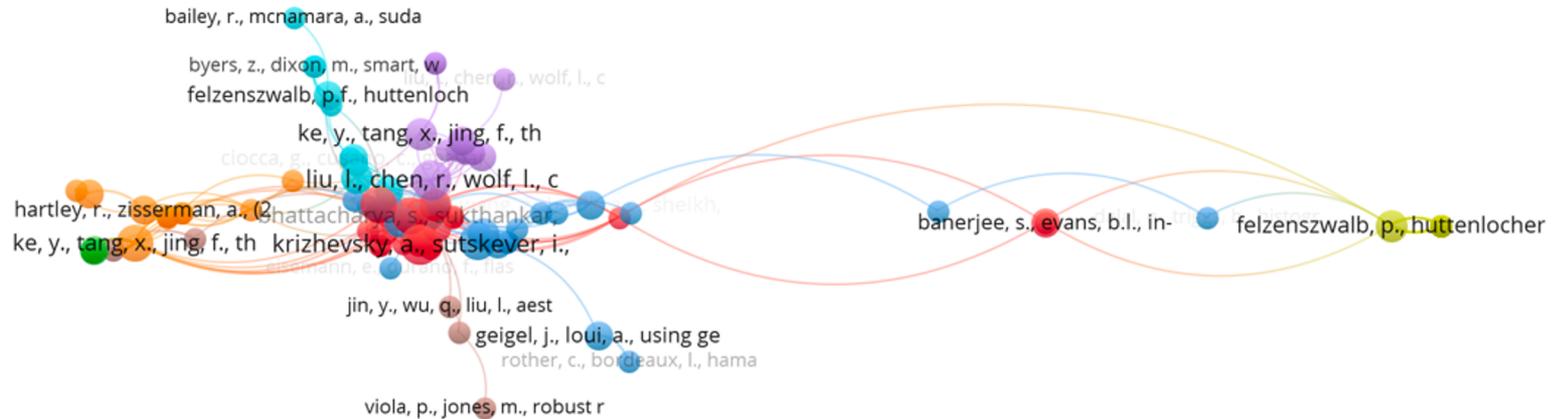
<https://towardsdatascience.com/how-do-netflix-and-amazon-know-what-i-want-852c480b67ac>



<https://advances.sciencemag.org/content/4/1/e1701130.full>

# Main idea

Heuristic set for co-citation network that would facilitate the navigation through them and can be used as the basis for citation recommendation



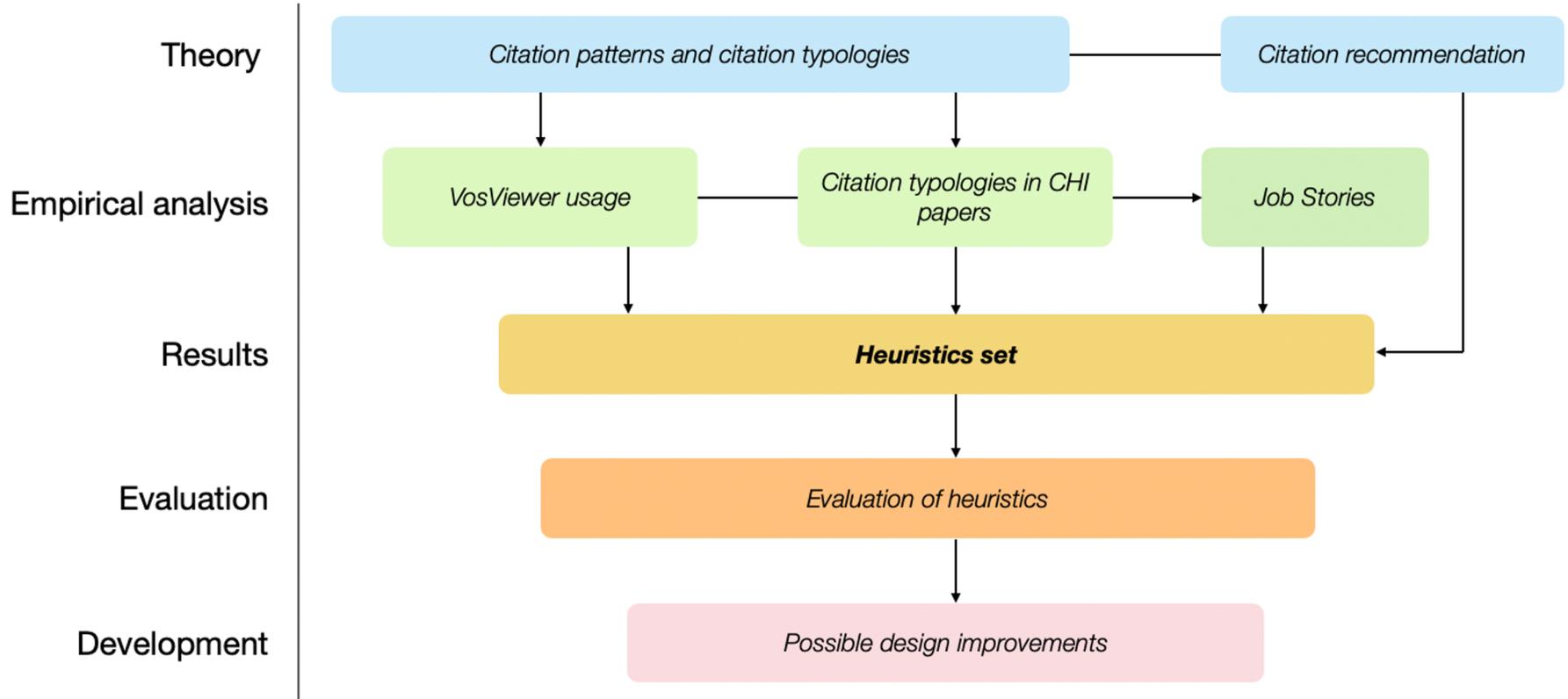
**VosViewer**

Bibliographic dataviz tool

**Mendeley**

Research management tool

# Design process



# How users make reviews based on networks?

20 papers from the list of VosViewer applications. How users navigate through these networks, on what they focus on, what make it difficult to use it

Use for:

- Description of the field (also journal / organization)
- Clusters methodology
- Data visualization
- Literature review

**Users with a lower level of research skills don't use all features of the service and follow basic paths of its usage - limited interaction**

# What citation behaviour exist in CHI papers?

Petrić + Thompson typology. The usage of citation types in 15 CHI 2019 Best

Citation type	% of usage
Other -> Source	47%
Exemplification	24%
Comparison of one's work with that of other authors & Evaluation	11%
Attribution + Application	10%
Statement of use	4%
Further reference	2%
Establishment of links between sources	2%

All these types are distributed among different parts of the paper

**Different citation types - different places in the co-citation network**

# Job Stories

#	Situation	Motivation	Outcome
<b>JS3 - beginner</b> 	The first acquaintance with the scientific field. Lack of research skills.	Understand how my scientific field is organized and what papers are worth reading.	Understanding of the structure of the field, main articles for the literature review.
<b>JS1 - middle</b> 	Review of a scientific field with an initial acquaintance with it. Some existing research skills.	Evaluate the scientific field from above and understand interaction of researchers inside it works.	Specific works for the main topic and future research.
<b>JS2 - advanced</b> 	Interactive research of existing gaps in the whole scientific field. Existing research skills.	Find a scientific gap in an area where I could add something from my own research.	Existing opportunities for further development of research.

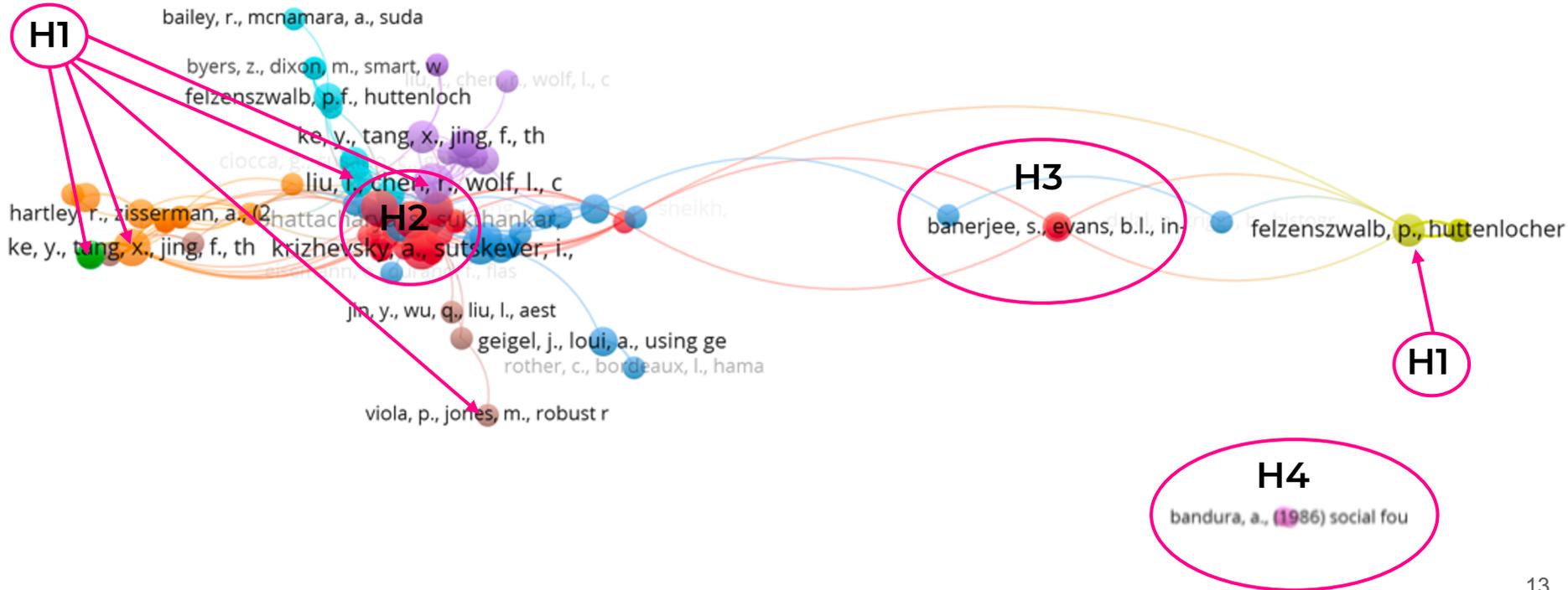


# Heuristics for clustered co-citation network

#	Heuristics	Why?
H1	General view: at least 1 paper from each cluster with the highest degree (number of links).	Helps to get familiar with the whole field. <i>Other-statement, Statement, Exemplification</i>
H2	Detailed analysis of central articles in the cluster which describe the topic in details.	Show the focus of the study and the whole set of other works in it. <i>Other-statement, Exemplification, Further reference</i>
H3	Search for structurally important papers (connecting some subfields): based on betweenness centrality.	To show the relationship between scientific subfields. <i>Comparison of one's work with that of other authors, Evaluation, Establishment of links between sources</i>
H4	Search for isolated items is taken into account if they relate to the main subfield. Optional.	Can be important but at the same time be outside of the main network.

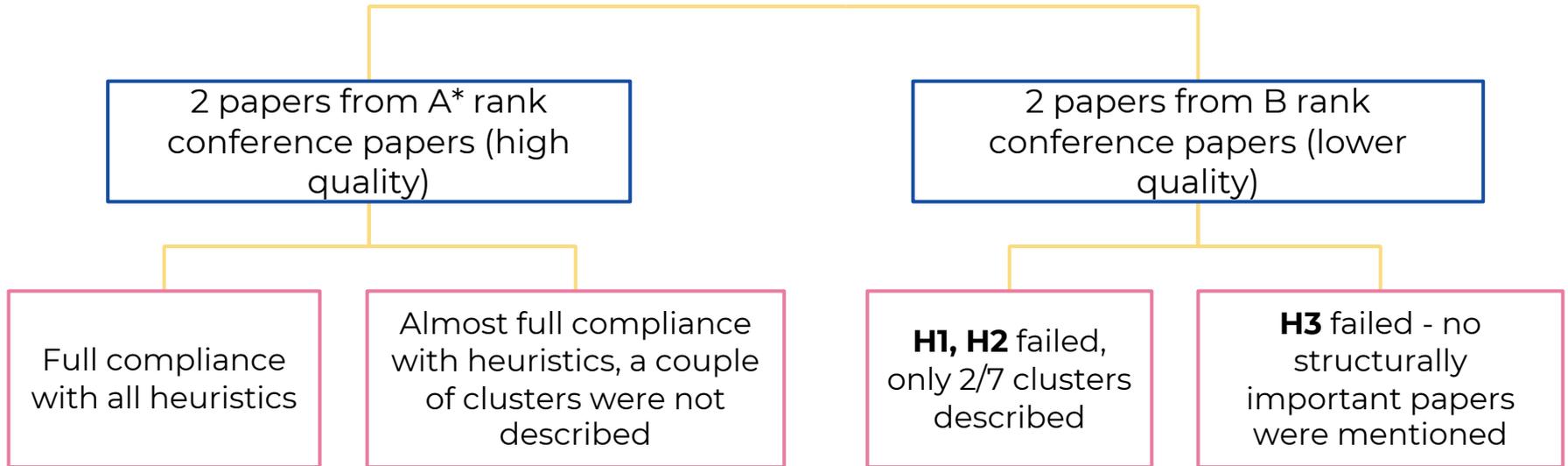
#	Heuristics	Why?	Operationalization
H1	General view: at least 1 paper from each cluster with the highest degree (number of links).	Helps to get familiar with the whole field.  <i>Other-statement, Statement, Exemplification</i>	Clustered co-citation network with a counted degree for each node. Take nodes with the highest degree within each cluster.
H2	Detailed analysis of central articles in the cluster which describe the topic in details.	Show the focus of the study and the whole set of other works in it.  <i>Other-statement, Exemplification, Further reference</i>	Top-5 papers for each cluster based on their degree.
H3	Search for structurally important papers (connecting some subfields): based on betweenness centrality.	To show the relationship between scientific subfields.  <i>Comparison of one's work with that of other authors, Evaluation, Establishment of links between sources</i>	Arranged list of articles with the highest betweenness centrality.
H4	Search for isolated items is taken into account if they relate to the main subfield. Optional.	Can be important but at the same time be outside of the main network.	List of articles which are not connected to the giant component.

# Heuristics shown on co-citation network



# Heuristics evaluation

Co-citation network from the reestablished Scopus query - > check whether authors cited articles from this network following the heuristics



*heuristics are applicable and can be used for citation recommendation*

# Possible design implementations

- Bibliographic dataviz tool VosViewer. No **beginner users**. Tacit skill of making literature review with this instrument. **H1** is implemented now.
- Research management tool Mendeley. No **advances users**. Has not integration for bibliographic data analysis. Doesn't support **H**.



# Possible design implementations

To show how heuristics could be integrated to practice on the example of popular instruments:

- Bibliographic dataviz tool VosViewer - support heuristics through design improvements and guide.
- Research management tool Mendeley - redeveloping of existing “Suggest” part (similar articles recommendation).

Implementations to these instruments are just examples of possible usage, the whole design fits into the existing one

# Clusters export - H1, H2

The screenshot shows the VOSviewer interface with a network visualization on the left and a table of cluster export data in the center. A pink box highlights the table, and a pink arrow points from the text 'Helpful for middle' to the 'Export clusters in tables' button in the left sidebar.

Export info about clusters for quick navigation in them, in `csv` format like:

Title	Cluster	Tags	Degree	Betweenness	Citations
bhattacharya, s., sukthankar, r., shah, m., a framework for photo-quality assessment and enhancement based on visual aesthetics (2010) acm multimedia, pp. 271-280	1	tag1, tag2, tag3...	22	2	5
nishiyama, m., okabe, t., sato, y., sato, i., sensation-based photo cropping (2009) acm multimedia, pp. 669-672	1		20	3	4
cheng, b., ni, b., yan, s., tian, q., learning to photograph (2010) acm multimedia, pp. 291-300	1		17	2	3
chen, j., bai, g., liang, s., li, z., automatic image cropping: a computational complexity study (2016) cvpr	1		15	2	3
luo, j., subject content-based intelligent cropping of digital photos (2007) icme, pp. 2218-2221	1		15	1	2

**Helpful for middle**

Items: 146 Clusters: 8 Links: 921 Total link strength: 1463 VOSviewer version 1.6.11

# Clusters legend - H1, H2

Network Visualization | Density Visualization | How to cite?

*Clusters can be renamed and recolored*

 Cluster 1 /	 Cluster 5 /
 Cluster 2 /	 Cluster 6 /
 Cluster 3 /	 Cluster 7 /
 Cluster 4 /	 Cluster 8 /

*Helpful for ALL JS*

Visualization  
Scale: [Slider]  
Weights: Citations  
Labels  
Size variation: [Slider]  
 Circles  
 Frames  
Max. length: 30  
Font: Open Sans  
Lines  
Size variation: [Slider]  
Min. strength: 0  
Max. lines: 1000  
 Colored lines  
 Curved lines  
Colors  
Cluster Colors...  
 Black background  
Filtering options  
Show nodes as:  
 authors  
 tags  
 journals  
 titles

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# Tagging - H2, H3

**Helpful for middle**

Serene Banerjee and Brian L Evans. 2007. In-camera automation of photographic composition rules. IEEE Transactions on Image Processing 16, 7 (2007), 1807–1820.

Keywords: no

Tags: add /

Expand abstract:

**Show nodes as:**

- authors
- tags
- journals
- titles

Items: 146 | Clusters: 8 | Links: 921 | Total link strength: 1463 | VOSviewer version 1.6.11

# Filtering - H2, H3, H4

VOSviewer - Interactive Visual Guidance.csv - Photo Composition.csv - Photography Assistance.csv

Network Visualization Density Visualization How to cite?

File Items Analysis

Map

Create...

Open...

Save...

Screenshot...

Info

Manual

About VOSviewer

Export clusters in tables

bailey, r., mcnamara, a., suda

byers, z., dixon, m., smart, w., the wolf, l., c

felzenszwalb, p.f., huttenloch

ke, y., tang, x., jing, f., th

liu, l., chen, r., wolf, l., c

hartley, r., zisserman, a., hattacharya, s., thakur, k.

ke, y., tang, x., jing, f., th krizhevsky, a., sutskever, i.,

jin, y., wu, d., liu, l., aest

geigel, j., loul, a., using g

rother, c., boix, l.,

viola, p., jones, m., robust r

huttenloch

Conditions

- Author
- Title
- Source
- Year
- Tags

- Is equal to
- Is not equal to
- Contains
- Does not contain
- Starts with
- End with

AND Switch to OR with the click

Title

Contains

Degree

Betweenness

Visualization Scale:

Weights: Citations

Labels

Size variation:

Circles

Frames

Max. length: 30

Font: Open Sans

Lines

Size variation:

Min. strength: 0

Max. lines: 1000

Colored lines

Curved lines

Colors

Cluster Colors...

Black background

Filtering options

Show nodes as:

- authors
- tags
- journals
- titles

Items: 146 Clusters: 8 Links: 921 Total link strength: 1463

VOSviewer version 1.6.11

**Helpful for advanced**

# How to cite - all Heuristics guide

VOSviewer - Interactive Visual Guidance.csv - Photo Composition.csv - Photography Assistance.csv

Network Visualization Density Visualization How to cite?

## 1) Start from the top works in each cluster:

### Cluster 6

- oliva, a., torralba, a., modeling the shape of the scene: a holistic representation of the spatial envelope (2001)

### Cluster 7

- ke, y., tang, x., jing, f., the design of high-level features for photo quality assessment (2006)

### Cluster 2

- liu, t., sun, j., zheng, n., tang, x., shum, h., learning to detect a salient object (2007)

### Cluster 5

- liu, l., chen, r., wolf, l., cohen-or, d., optimizing photo composition (2010)

### Cluster 1

- bhattacharya, s., sukthakar, r., shah, m., a framework for photo-quality assessment and enhancement based on visual aesthetics (2010)
- nishiyama, m., okabe, t., sato, y., sato, i., sensationbased photo cropping (2009)
- cheng, b., ni, b., yan, s., tian, q., learning to photograph (2010)

### Cluster 4

- felzenszwalb, p., huttenlocher, d., efficient graph-based image segmentation (2004)

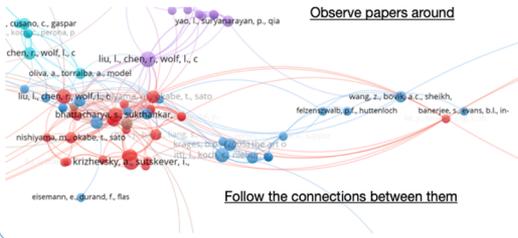
### Cluster 3

- itti, l., koch, c., computational modelling of visual attention (2001)
- banerjee, s., evans, b., unsupervised automation of photographic composition rules (2004) spie sensors, color, cameras, and systems for digital photographyconers

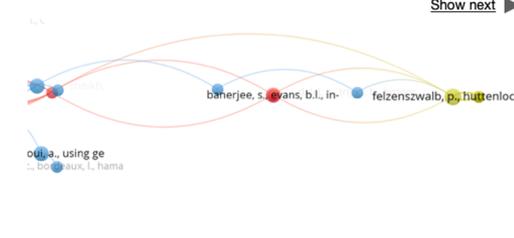
### Cluster 8

- yao, l., suryanarayan, p., qiao, m., wang, j.z., li, j., oscar: on-site composition and aesthetics feedback through exemplars for photographers (2012)

## 2) Focus on the most important for your work clusters



## 3) Find structurally important works



Visualization

Scale:



Weights: Citations

Labels

Size variation:



Circles

Frames

Max. length: 30

Font: Open Sans

Lines

Size variation:



Min. strength: 0

Max. lines: 1000

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Export clusters in tables

# Articles to cite

Top by degree for each cluster - H1, H2, H4

Articles for you Articles to cite

## Cluster 1

- Artificial intelligence and robotic surgery: Current perspective and future directions

Bhandari M, Zeffiro T, Reddiboina M

Current Opinion in Urology (2020)

6 5 2  
Citations Degree Betweenness

### Abstract

Purpose of review This review aims to draw a road-map to the use of artificial intelligence in an era of robotic surgery and highlight the challenges inherent to this process. Recent

[View more](#)

- A Malicious Attack on the Machine Learning Policy of a Robotic System

Clark G, Doran M, Glisson W

Proceedings - 17th IEEE International Conference on Trust, Security and Privacy in Computing and Communications and 12th IEEE International Conference on Big Data Science and Engineering, Trustcom/BigDataSE 2018 (2018)

3 4 2  
Citations Degree Betweenness

### Abstract

The field of robotics has matured using artificial intelligence and machine learning such that intelligent robots are being developed in the form of autonomous vehicles. The anticipated

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## Cluster 2

- Exploring machine intelligence with IAMRs

Doty K

Task Directions (2009)

1 4 1  
Citations Degree Betweenness

**Helpful for beginner and middle**

Articles for you Articles to cite

Artificial intelligence and machine learning are rapidly expanding fields with increasing relevance in anesthesia and, in particular, airway management. The ability of artificial

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Top by betweenness - H3

## TOP-5 betweenness papers

- Artificial intelligence, machine learning and the pediatric airway

Matava C, Pankiv E, Ahumada L, Weingarten B, Simpao A

Paediatric Anaesthesia (2020)

1 2 5  
Citations Degree Betweenness

### Abstract

Interpersonal intelligence is one of the goals in elementary school education. Interpersonal intelligence is a key element in the adaptation of children in their social relationships. SDN

[View more](#)

- Towards a cooperative learning approach using intelligence based learners grouping

Chikh A, Hank S

Computer Applications in Engineering Education (2016)

3 2 4  
Citations Degree Betweenness

### Abstract

Grouping learners in cooperative learning can help interaction and discussion among learners. However two main problems must be settled so as to group learners. The first is how to build

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**Helpful for middle and advanced**

# To conclude

**Main result:** Heuristics set, which support all users needs and allow both expert and non-expert users to bridge the gap between advanced scientometric methods and practice. Applicable for integration to the existing instruments.

**Limitations:** Only CHI field papers; analysis of user needs only through published papers.

**Future:** increase the sample of papers for heuristics evaluation, correct them depending on the scientific field, iteratively improve heuristics. Discuss with Centre for Science and Technology Studies in Leiden (VosViewer), meanwhile develop instructional videos.

# Thank you!

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