

Search Interfaces for Mathematicians

Andrea Kohlhasse

Jacobs University, Germany

FIZ Karlsruhe, Germany

MathSearch Project

$$(a_n)_{n \in \mathbb{N}}$$

MathWebSearch

FormulaSearch = MathWebSearch

How to make best use of it for Mathematicians?

Design for Mathematicians?

The screenshot shows the Zentralblatt MATH website interface. At the top, there is a navigation bar with the logo, language selection (English), a search bar, and links for ZBMAT and Contact. Below this is a secondary navigation bar with links for World of Mathematics, Database (ZBMATH), MSC 2000, MSC 2010, Reviewer Service, and Subscription (ZBMATH). The main content area is divided into several sections. On the left is a sidebar with a list of links: ZBMATH Database, Simple Search, Advanced Search, Command Search, Author Search, Citation Check, New Interface, About Zentralblatt, Partners & Projects, Subscription, Serials and Journals, Help, Highlights, News, Mirror Sites, Contact, Copyright, Imprint, and Site Map. The main content area features a header announcement about a new interface, a section titled 'Zentralblatt MATH - ZBMATH Online Database' with a description of the database and its editors, a search bar with a 'Query:' label and a 'Search' button, and a 'Facts and Figures' section. On the right side, there are three vertical panels: a 'Login' panel with fields for Username and Password, a 'News' panel with links to Abel prize 2010, I. M. Gelfand 1913-2009, and MSC2010, and a 'Highlights' panel with links to Scientific prize winners of the ICM 2010, Overhang, and Lie groups, physics and geometry. At the bottom right is a 'Master Server' panel with information about the Zentralblatt MATH Berlin [Germany] master server and links to other mirror sites. The footer includes the FIZ Karlsruhe logo and copyright information for 2014.

Zentralblatt MATH

Language: English Search: ZBMAT Contact

World of Mathematics Database ZBMATH MSC 2000 MSC 2010 Reviewer Service Subscription ZBMATH

ZBMATH Database

Zentralblatt MATH has released its [new interface!](#)
For an improved author identification, see the [new author database](#) of ZBMATH. [Read more](#) | [Try MathML](#) | [Hide](#)

Zentralblatt MATH - ZBMATH Online Database

ZBMATH - The database Zentralblatt MATH
The ZBMATH Database contains more than 3 million entries drawn from about 3500 journals and 1100 serials from 1826 to present.
This database is edited by
• the European Mathematical Society,
• FIZ Karlsruhe,
• Heidelberger Akademie der Wissenschaften.

Query:

Enter a query and click »Search«... [Clear](#) [Search](#)

Facts and Figures:
• 3345780 items indexed | • 18069 items added in 2014 | • 6954 active reviewers

The Zentralblatt MATH Database is produced by the Berlin editorial office of FIZ Karlsruhe (in cooperation with European academies and mathematical institutes).

The [One-line Search](#) offers a number of new functions. It is aimed at making the use of our database easier. Should you, however, prefer to stick to the search environment you are used to, please select [Advanced Search](#).
Without specifying a search field, the basic index is searched. If the number of hits surpasses a threshold, you may simply refine your query without leaving the hit list.

Login
Username:
Password:
[Login](#)

News
• [Abel prize 2010](#)
• [I. M. Gelfand 1913-2009](#)
• [MSC2010](#)

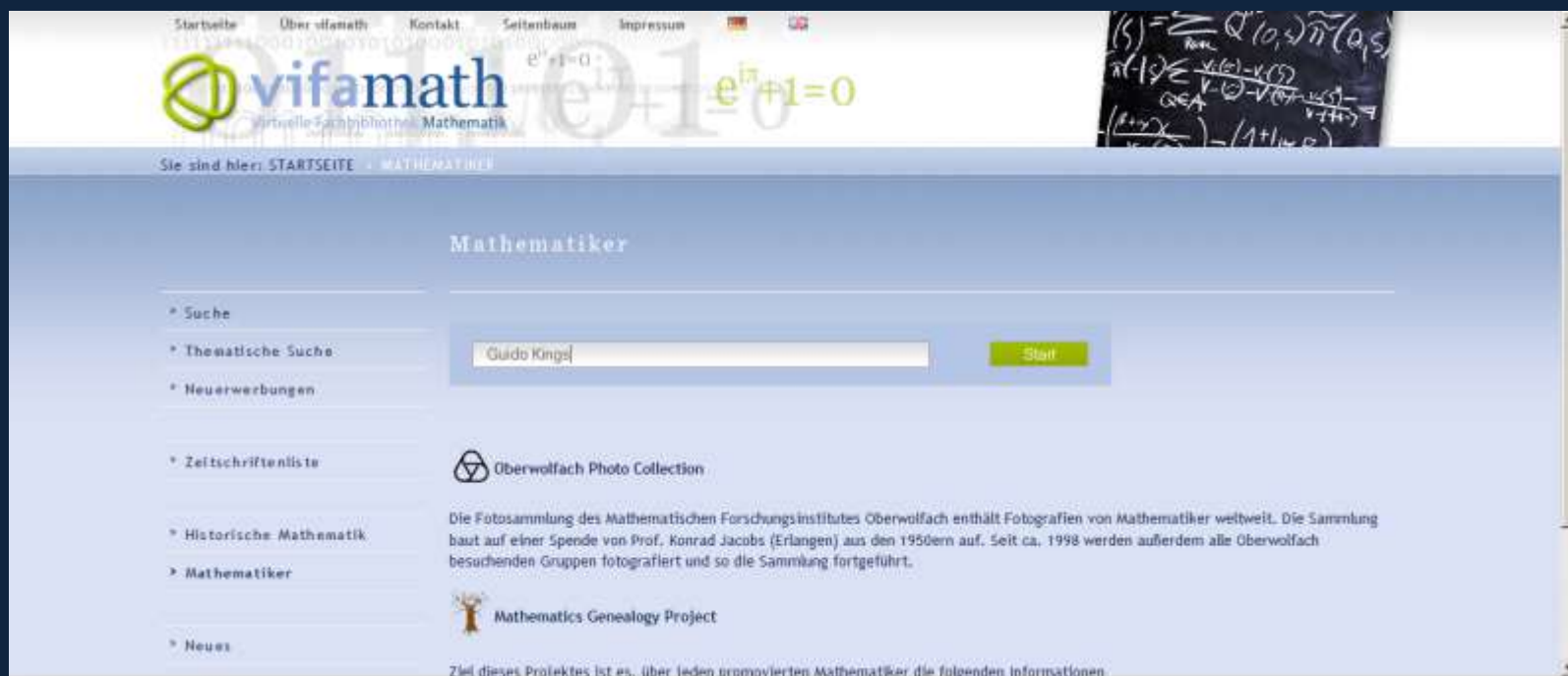
Highlights
• [Scientific prize winners of the ICM 2010](#)
• [Overhang](#)
• [Lie groups, physics and geometry. An introduction for physicists, engineers and chemists.](#)

Master Server
Zentralblatt MATH Berlin [Germany]
© FIZ Karlsruhe GmbH
• [Zentralblatt MATH](#) master server is maintained by the Editorial Office in Berlin, Section Mathematics and Computer Science of FIZ Karlsruhe and is updated daily.
[Other Mirror Sites](#)

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Leibniz Institute for Information Infrastructure

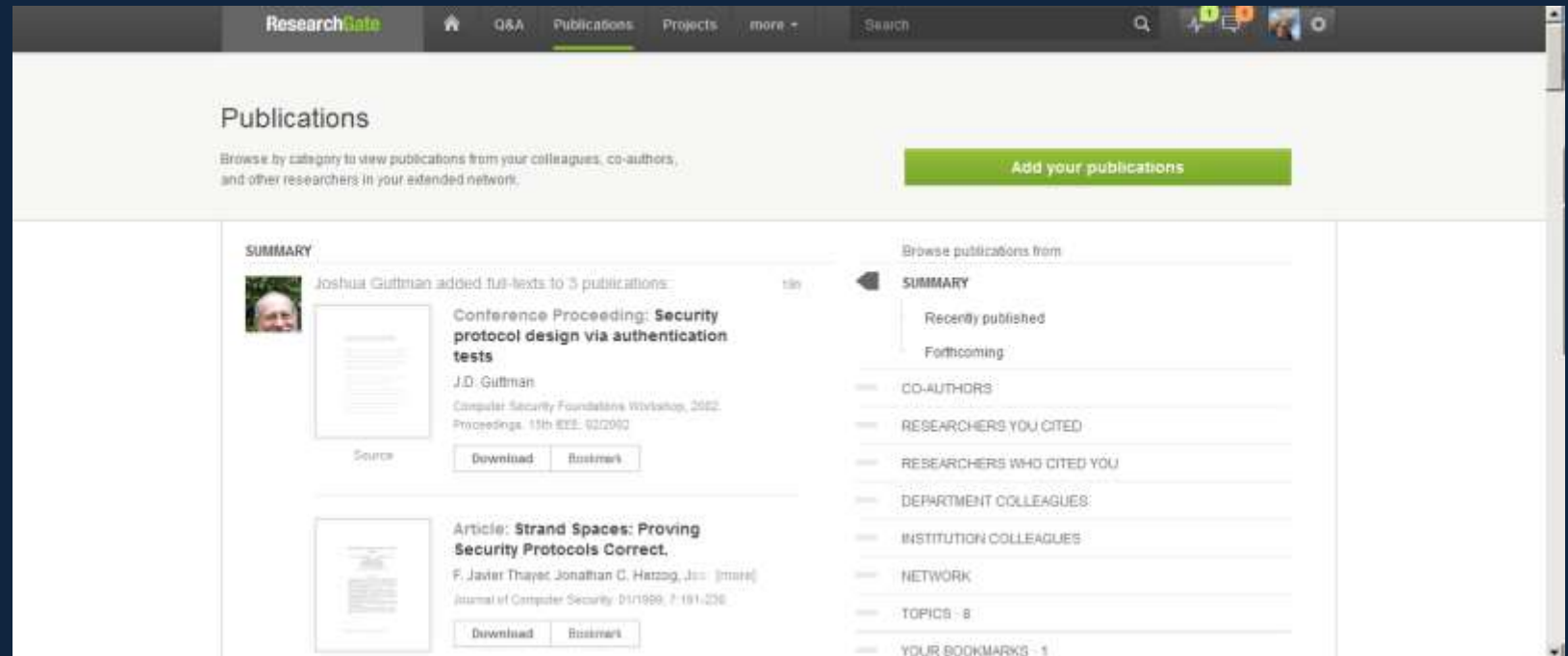
An older version of zbMath ...

Design for Mathematicians?



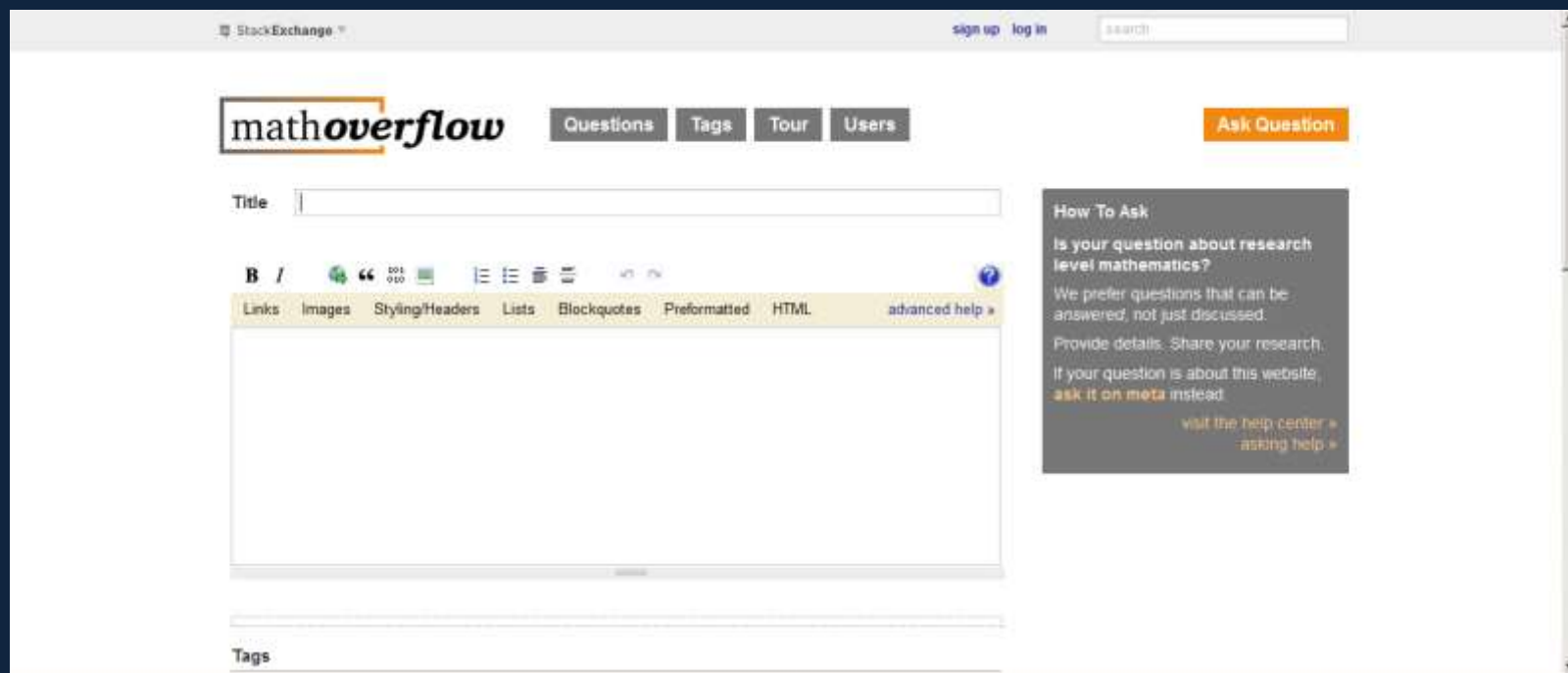
vifamath

Design for Mathematicians?



ResearchGate

Design for Mathematicians?



mathoverflow

Design for Mathematicians?

AMERICAN MATHEMATICAL SOCIETY
MathSciNet
Mathematical Reviews
ISSN 2167-5163

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Zentralblatt für Mathematik 

Publikationen | Autoren | Zeitschriften | Citations

Stichworte

Text des Referats	(a_n) n in N	und
Titel		und
MSC Primär-Klassifikati		und
Irgendwo		

Zeitspanne wählen
☒ Gesamte Datenbank
☐ Jahr
☐ Zeitspanne: bis

Publikationstyp
☒ Alles ☐ Bücher ☐ Zeitschriften ☐ Tagungsberichte

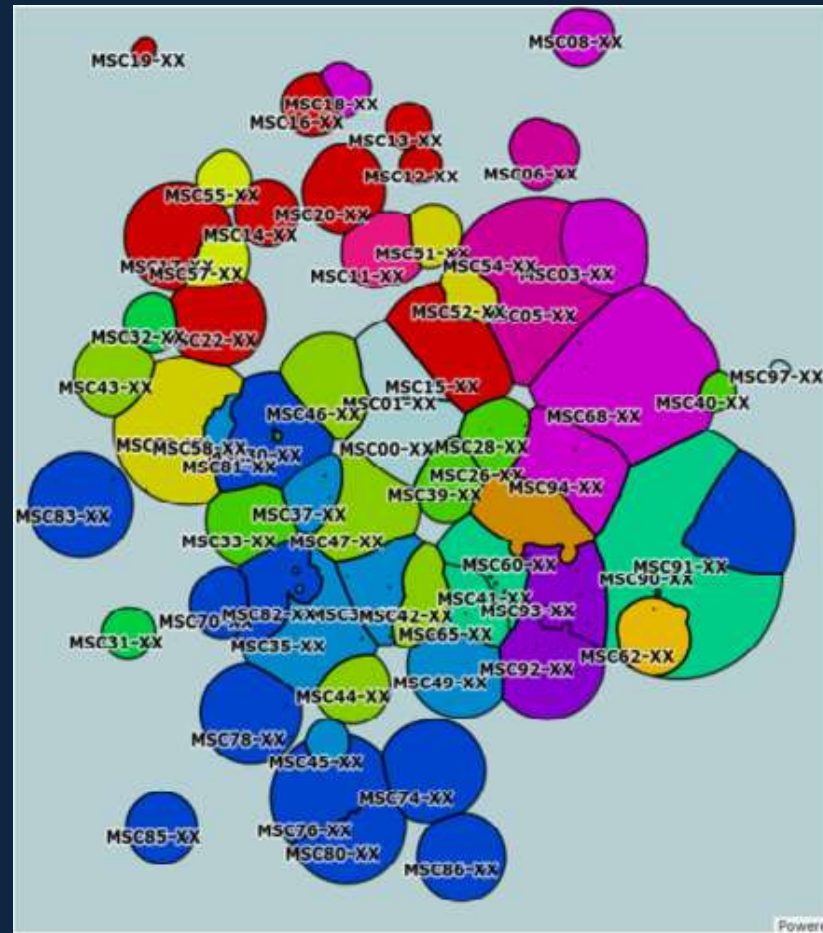
Review Format
☐ PDF ☒ HTML



Fakten und Statistik: 2,900,672 Gesamtpublikationen [Hilfe](#) [Benutzerhilfe per e-mail](#)

MathSciNet

Design for Mathematicians?



MSC Map

No-Go Questions

- **Which tools** are used by mathematicians for search?
- **What** do mathematicians search for?
- **How often** do mathematicians search?
- Which search engines are **preferred** by mathematicians?

The Question at Hand

What is
„mathematical search“
all about?

(If we understand what mathematical search is all about, then we should know better how to design math search interfaces.)

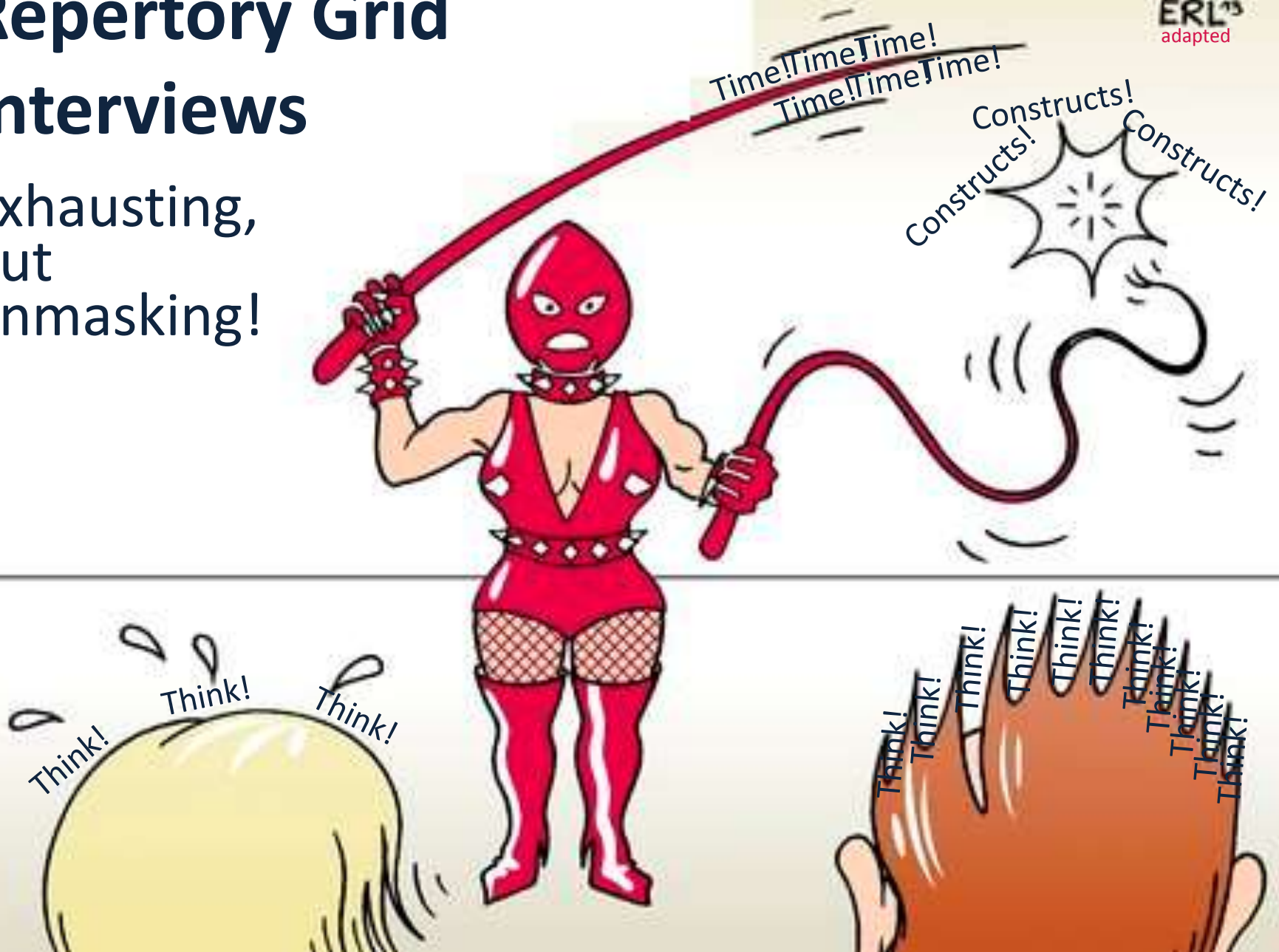
Methodology

- Quantitative Methods? No!
- Qualitative Methods:
 - Questionnaires?
 - Interviews?
 - Ethnographic field studies?
- Semi-Empirical Method:
 - Repertory Grid Interviews!

Repertory Grid Interviews

Exhausting,
but
unmasking!

ERL¹³
adapted



Repertory Grid Interviews = RGIs

„RGI Elements“



zbMathNew

zbMathOld

MathSciNet

Google-Scholar

Google

myOffice

TIB

vifamath

myLibrary

arXiv

ResearchGate

mathoverflow

myColleagues

MSC-Map

arXiv-Catchup

FormulaSearch

Bibliography

Repertory Grid Interviews = RGIs

Procedure

- i. The interviewee randomly chooses three RGI elements.
- ii. He declares which two of the three elements seem more similar.
- iii. He determines the aspect under which these two are more similar and the aspect under which the third one is different.



- iv. He evaluates all RGI elements with respect to this construct.

A Repertory Grid Example

[illegible]

The RGI Study

RGIs: 22

Total: 107 Constructs

Research Mathematicians	Info-Services- Mathematicians	Non- Mathematicians
11	5	6

50 Constructs

Average:

4,54

28 Constructs

Average:

5,6

29 Constructs

Average:

4,83

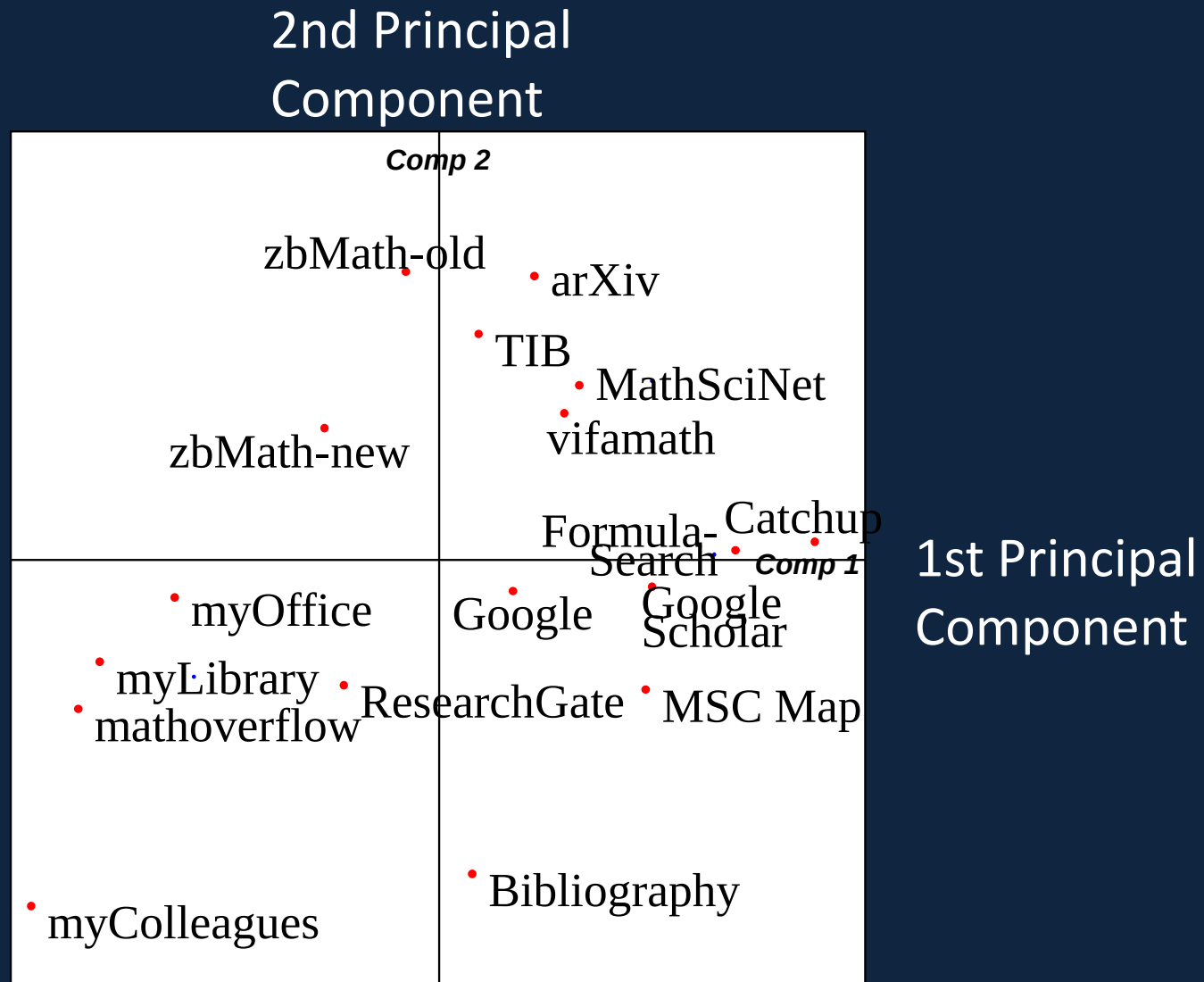
Repertory Grid Interviews = RGIs

Empirical Method

= General Procrustes Analysis

1. Find a consensus grid
(containing “abstract” constructs Con_1 – Con_n):
 - comparison of grids wrt the fixed set of RGI elements
2. Conduct a Principal Components Analysis on the consensus grid
 - find the dimensions that differentiate the most between the RGI elements

Interpretation Tool: Biplot of RGI Elements



Repertory Grid Interviews = RGIs

Empirical Method

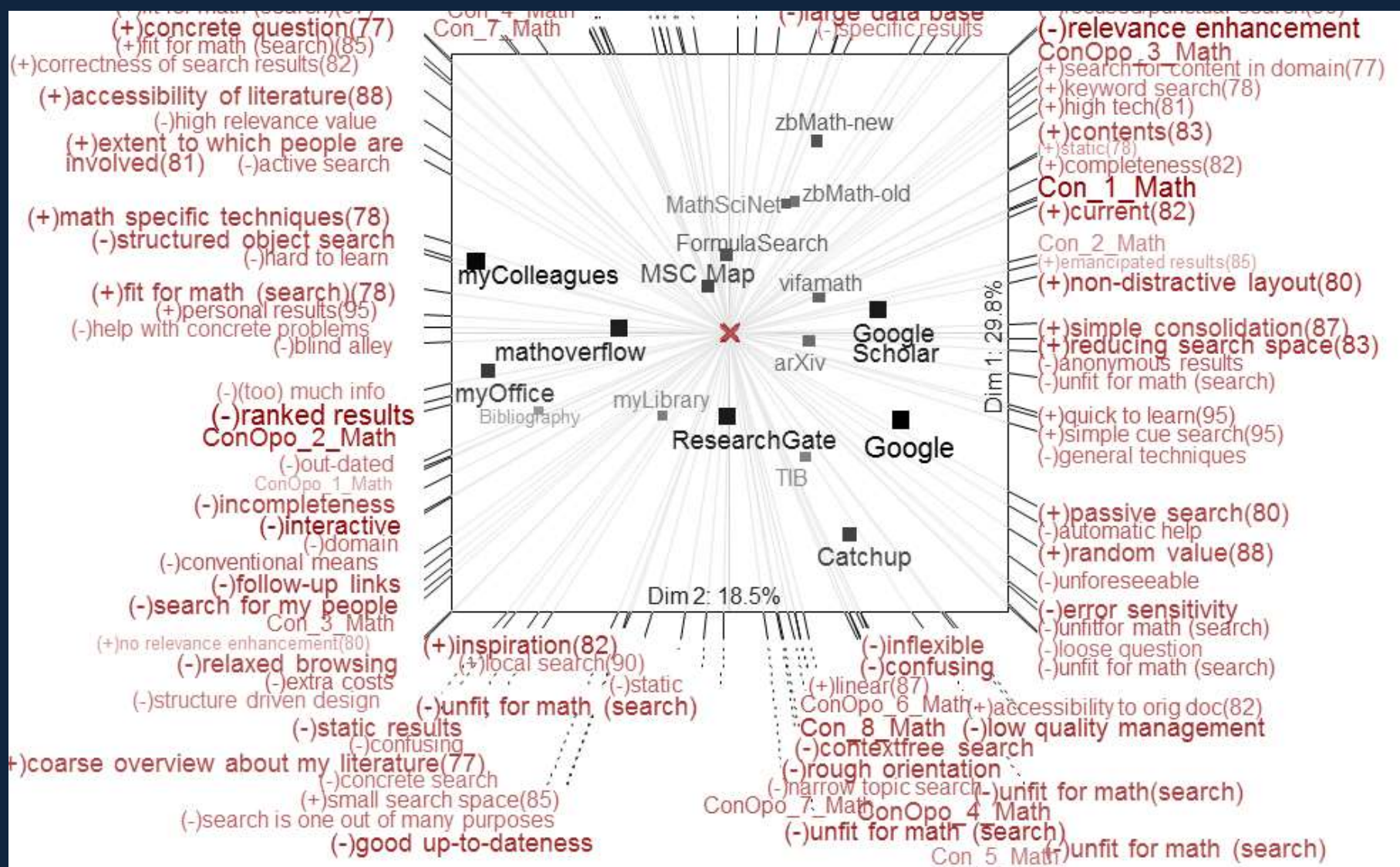
= General Procrustes Analysis

1. Find consensus grid ...
2. Find Principal Components ...
3. Do a Multiple Groups Components Analysis
 - Recompute relative location of real and abstract constructs and visualize them in the biplot

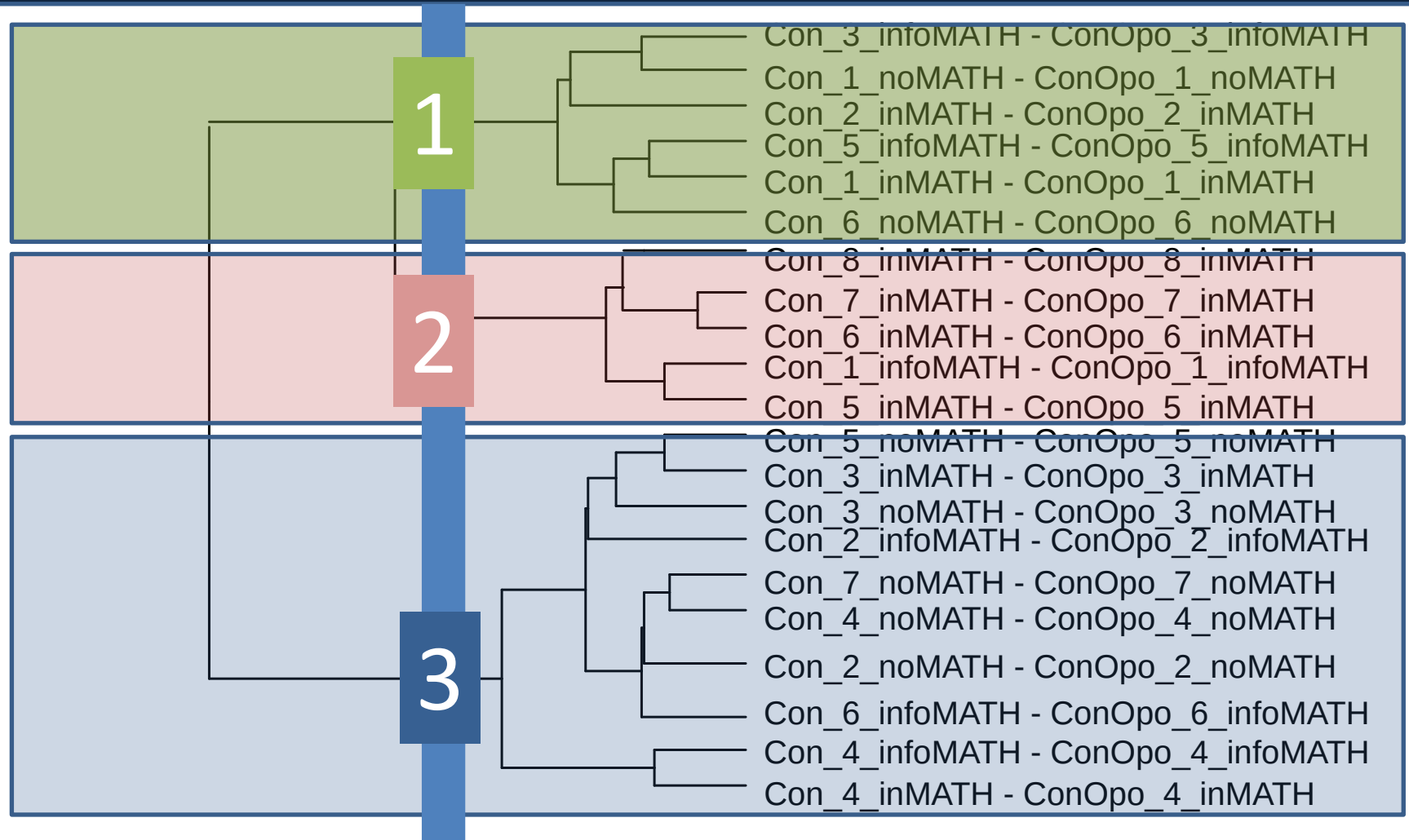
(+)high quality (+)fit for math (search)(77)
management(89)(+)fit for math (search)(91)

(+)poor up-to-dateness(81)

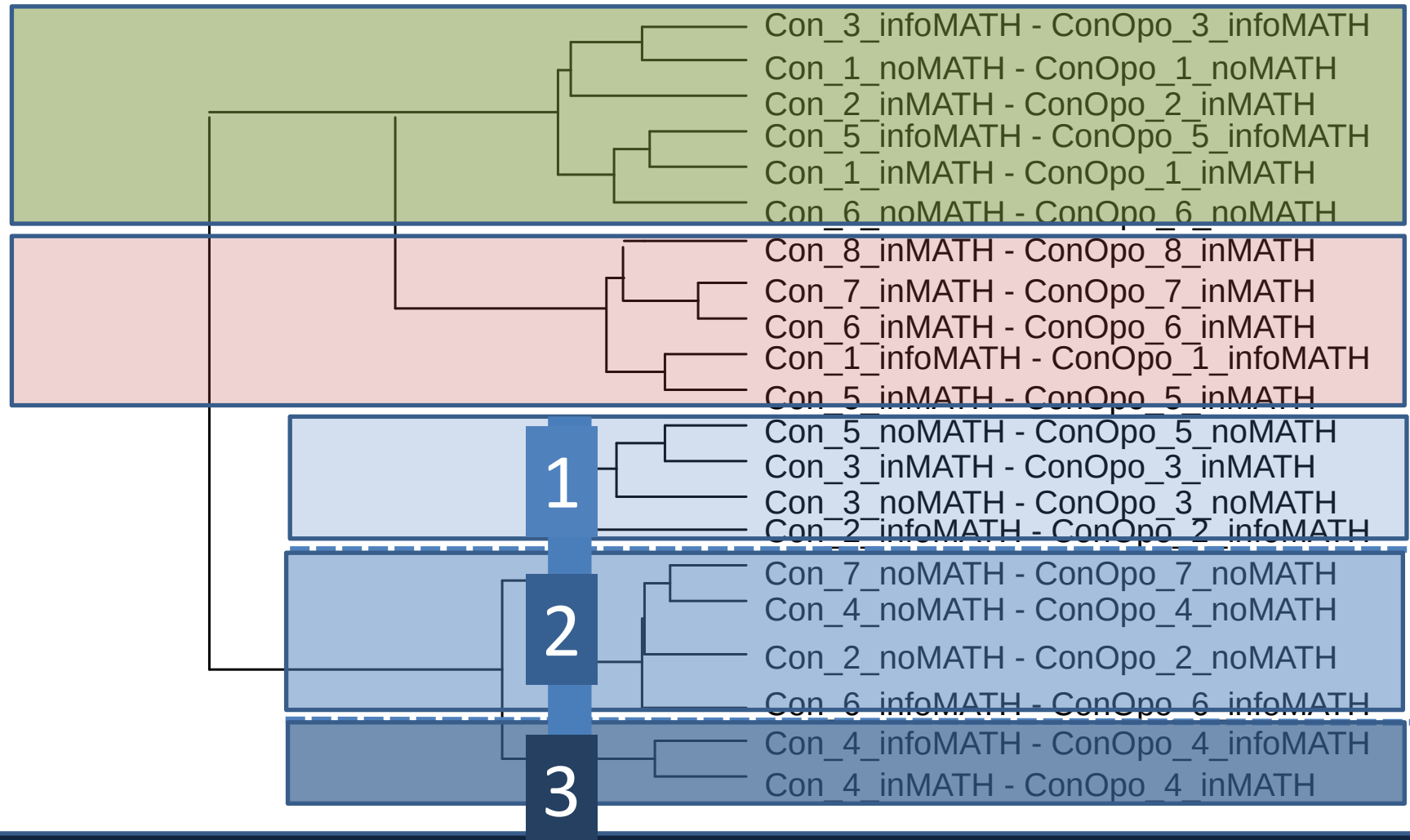
Interpretation Tool: 3D-Biplot of RGI Elements and -Constructs



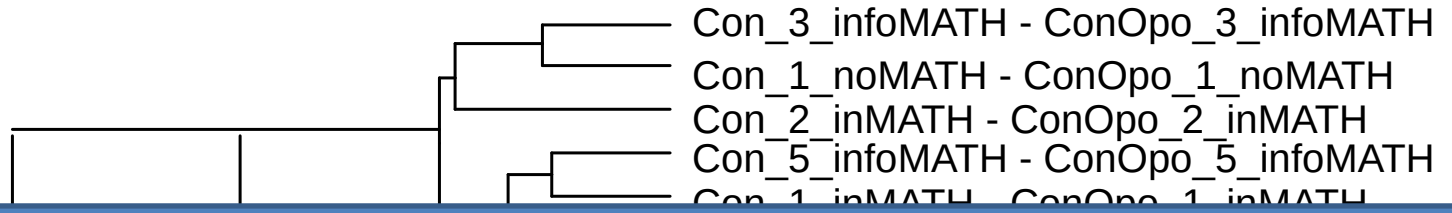
Interpretation Tool: Cluster Analysis in Form of Dendrogram



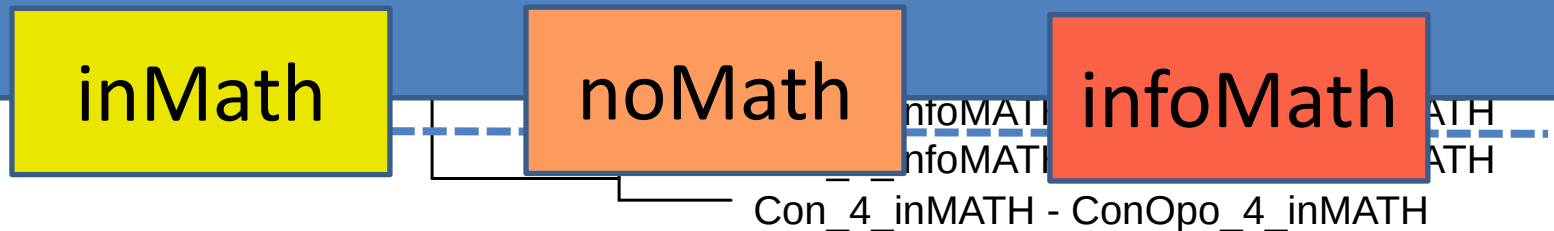
Interpretation Tool: Cluster Analysis in Form of Dendrogram



Cluster of what acc. to what?



Similarity of Constructs
acc. to Element Evaluation:
Cluster Analysis of constructs
of 3 consensus grids



Consensus Grids for 3 Groups

inMath

noMath

infoMath

shared
(2:2:2)

inMATH
(4:1:0)

almost
noMATH
(2:3:5)

shared
(1:1:2)

noMATH
(0:1:3)

no noMATH
(1:1:0)

Con_3_infoMATH - ConOpo_3_infoMATH

Con_1_noMATH - ConOpo_1_noMATH

Con_2_inMATH - ConOpo_2_inMATH

Con_5_infoMATH - ConOpo_5_infoMATH

Con_1_inMATH - ConOpo_1_inMATH

Con_6_noMATH - ConOpo_6_noMATH

Con_8_inMATH - ConOpo_8_inMATH

Con_7_inMATH - ConOpo_7_inMATH

Con_6_inMATH - ConOpo_6_inMATH

Con_1_infoMATH - ConOpo_1_infoMATH

Con_5_inMATH - ConOpo_5_inMATH

Con_5_noMATH - ConOpo_5_noMATH

Con_3_inMATH - ConOpo_3_inMATH

Con_3_noMATH - ConOpo_3_noMATH

Con_2_infoMATH - ConOpo_2_infoMATH

Con_7_noMATH - ConOpo_7_noMATH

Con_4_noMATH - ConOpo_4_noMATH

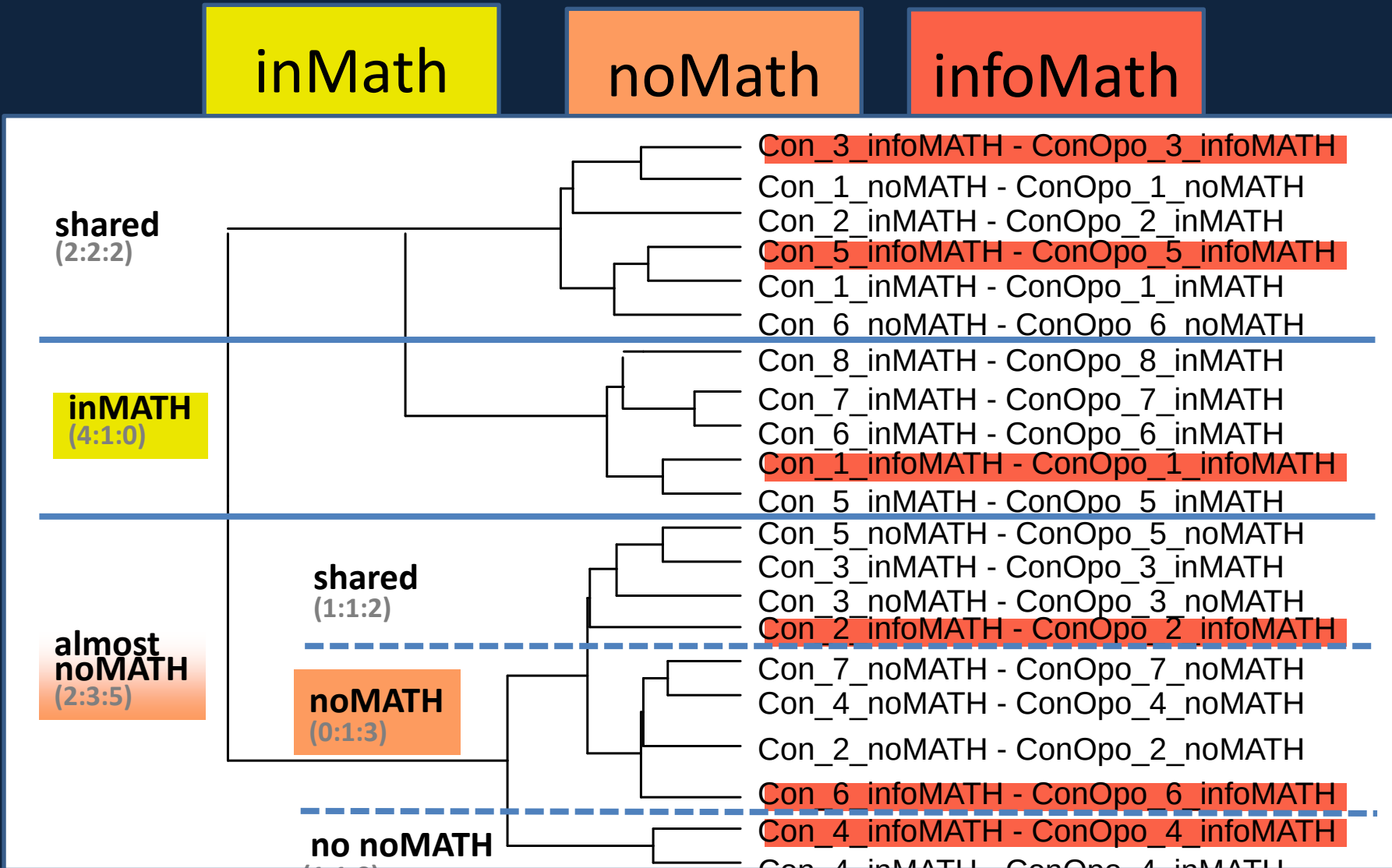
Con_2_noMATH - ConOpo_2_noMATH

Con_6_infoMATH - ConOpo_6_infoMATH

Con_4_infoMATH - ConOpo_4_infoMATH

Con_4_inMATH - ConOpo_4_inMATH

Result 1



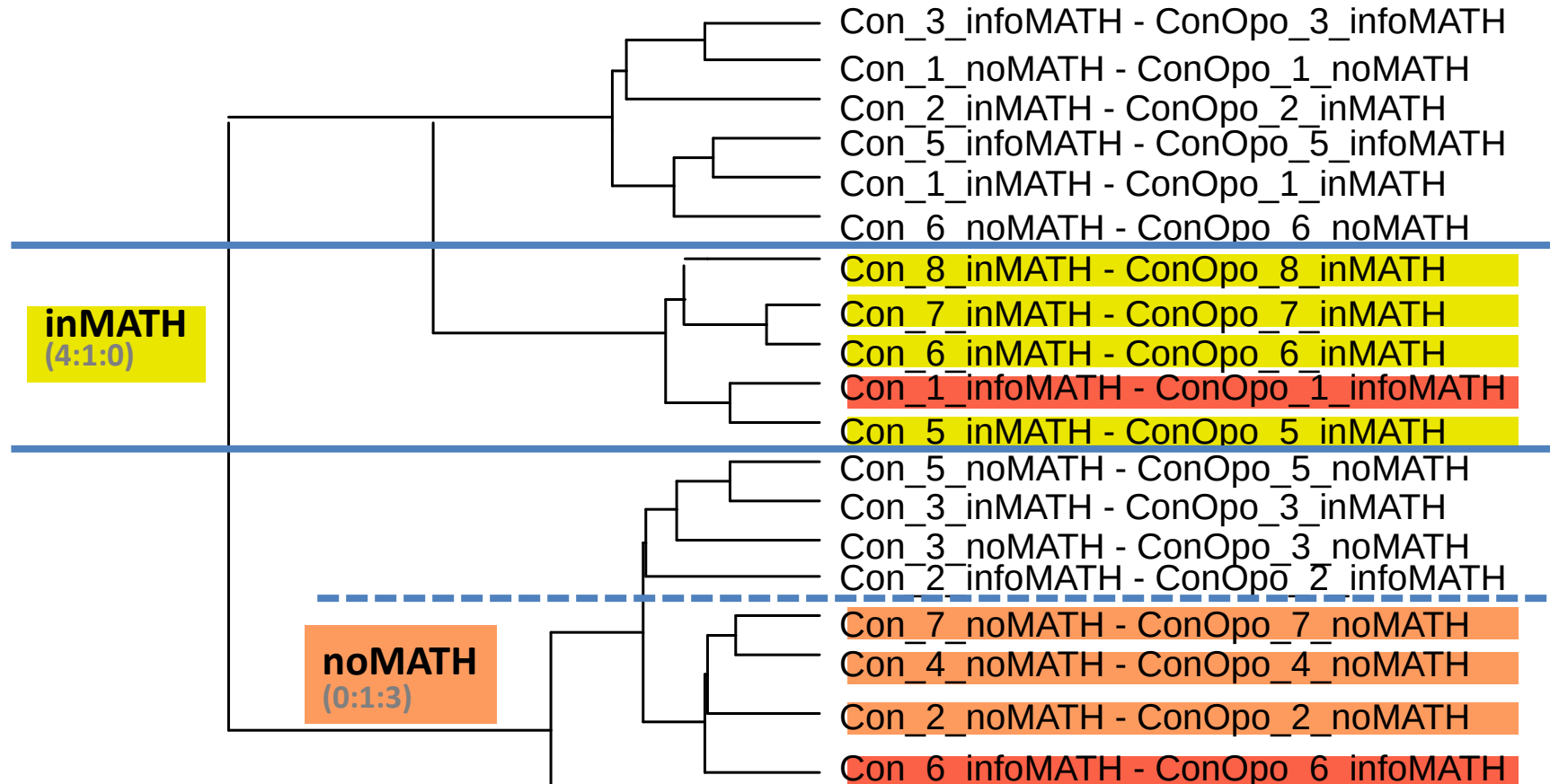
„Info-Service-Mathematicians are inbetween“

Result 2

inMath

noMath

infoMath



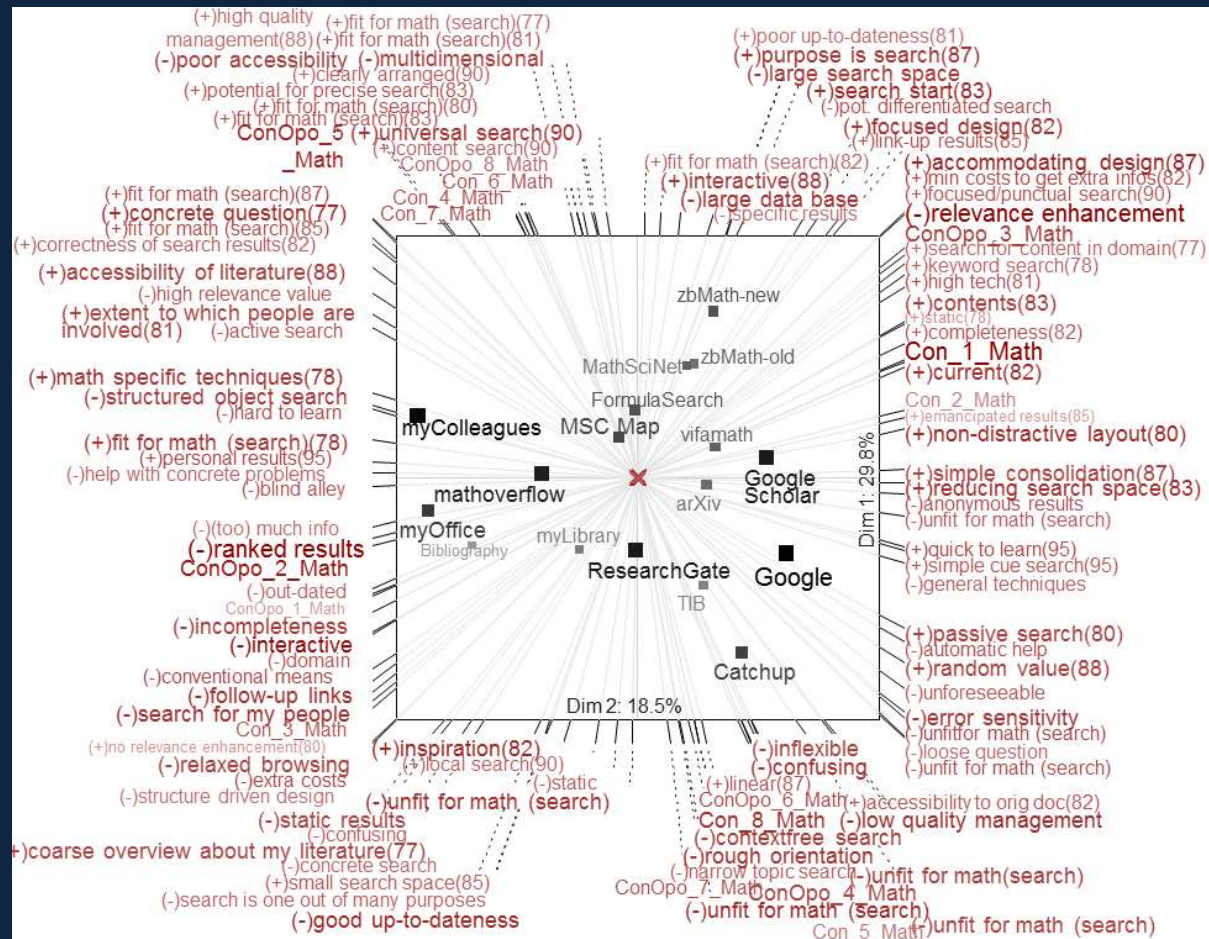
Validation of „Mathematicians are special“

Relevance Ranking

	PC_1	PC_2	PC_3	Length
Con_6_inMATH	-0.61	0.52	0.52	0.96
Con_7_inMATH	-0.72	0.09	0.63	0.96
Con_5_inMATH	-0.59	-0.61	-0.37	0.93
Con_1_inMATH	0.03	0.70	-0.59	0.92
Con_4_inMATH	-0.81	-0.20	-0.35	0.90
Con_3_inMATH	0.05	0.72	-0.03	0.72
Con_2_inMATH	-0.36	0.50	-0.34	0.70
Con_8_inMATH	0.34	-0.05	0.49	0.60

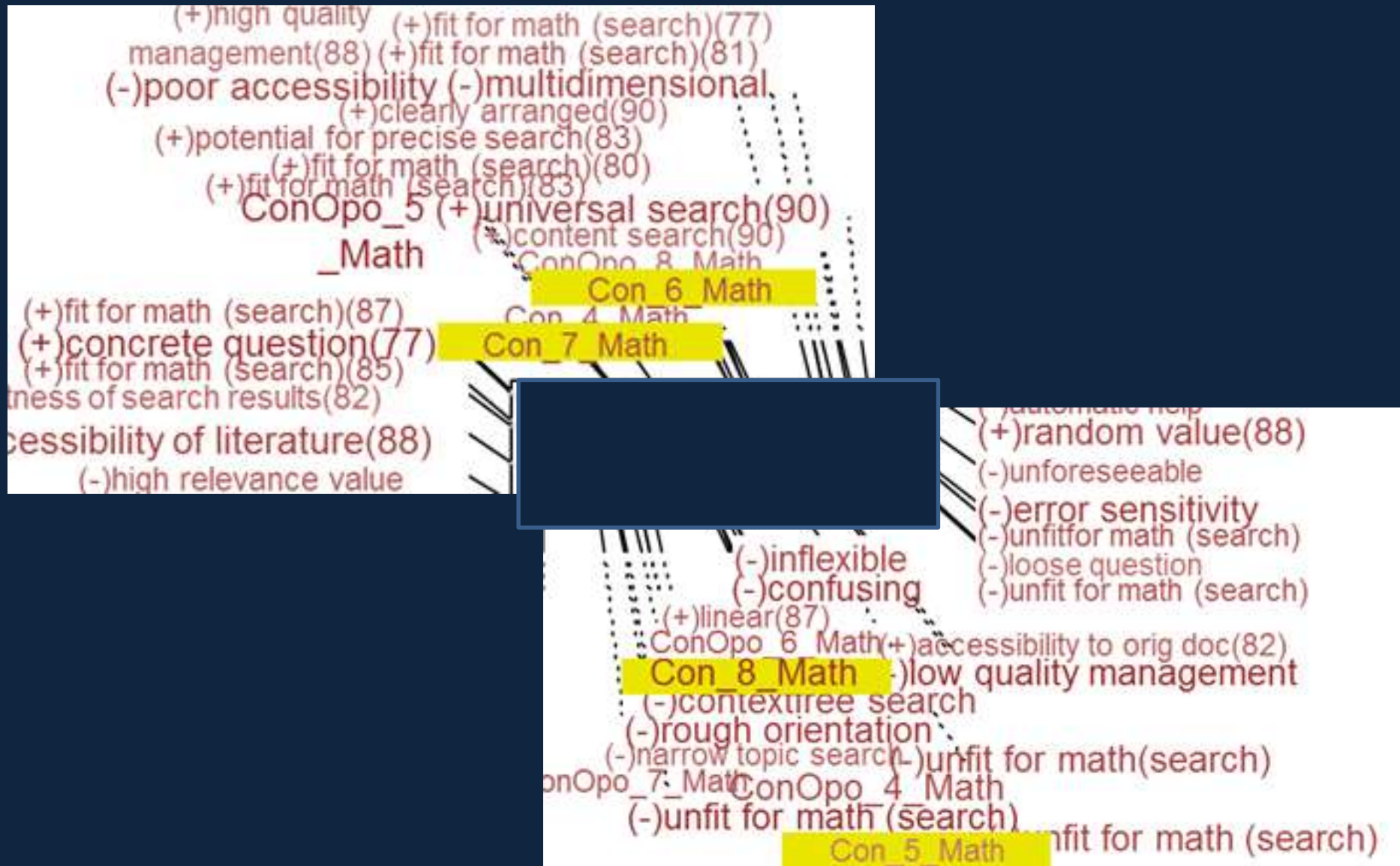
inMath-Specific Constructs

Relevance Ranking: Interpretation



3D-Biplot

Relevance Ranking: Interpretation



Result 3

Meaning

relev. of results: driven by user Con_6_inMATH

relev. of results: driven by data Con_7_inMATH

precision of input Con_5_inMATH

adequacy: search philosophy Con_1_inMATH

math specificity Con_4_inMATH

adequacy: trustfulness Con_3_inMATH

supportiveness: result Con_2_inMATH

preconditions for search Con_8_inMATH

Meaningful, math-specific evaluation schemes

More Cluster Analysis ...

Cluster analysis of all **elements** for

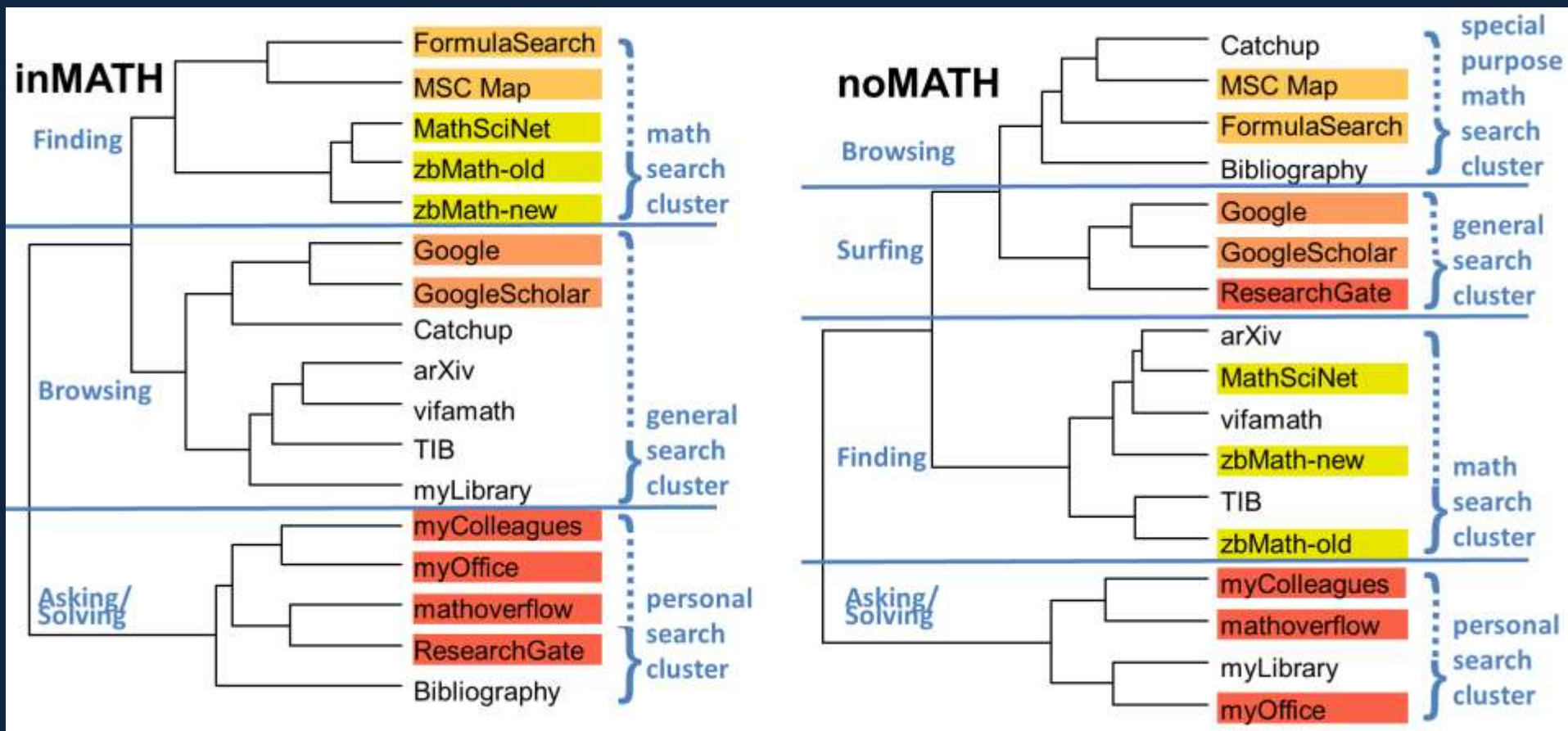
inMath

vs.

noMath

Which math search interfaces are
more similar than others?

Mathematicians vs. Non-Mathematicians



Element Clusters

More Cluster Analysis ...

Cluster analysis of all **constructs** for

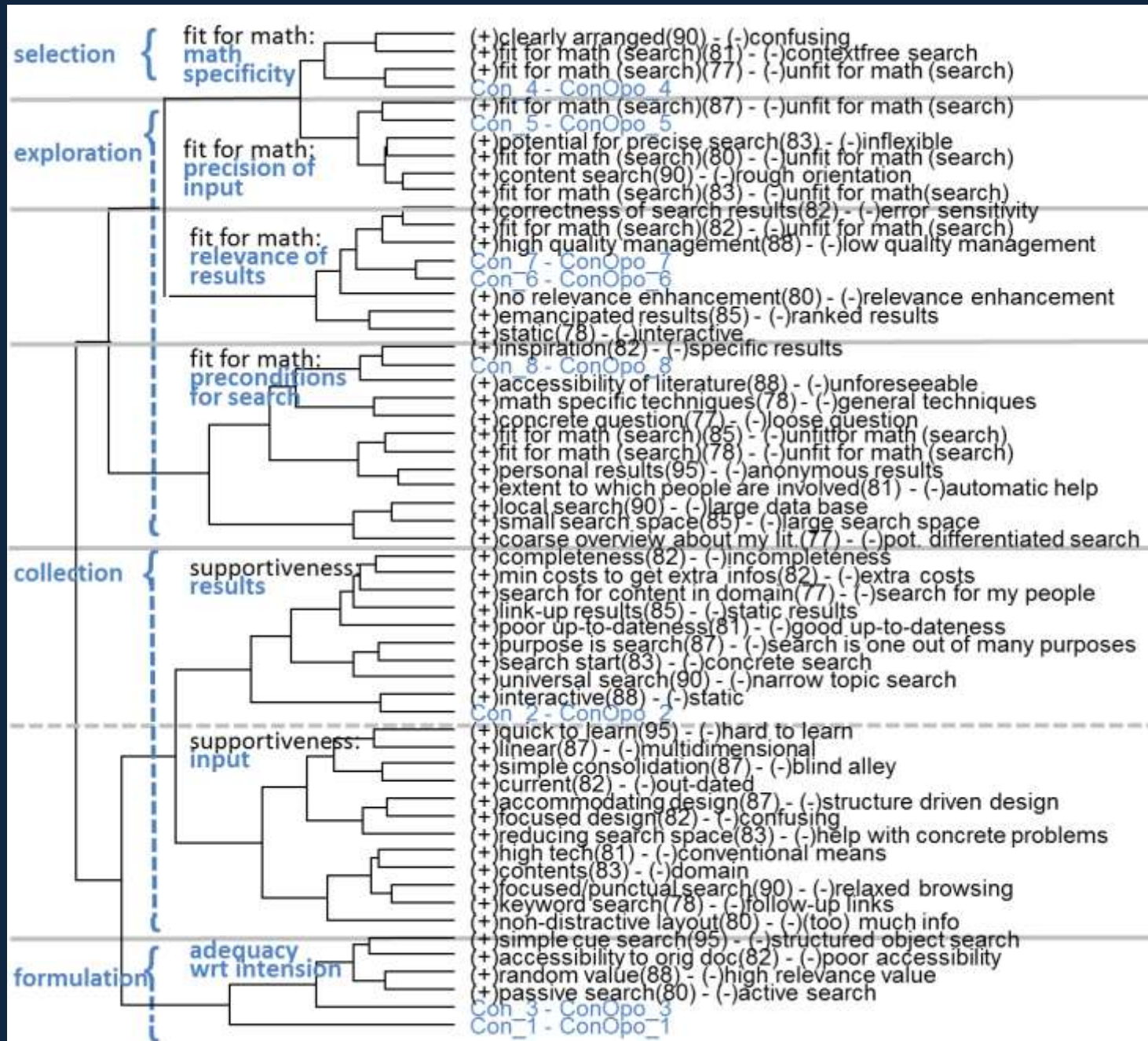
inMath

vs.

noMath

Which evaluation schemes are more similar than others?

inMATH Construct Clusters



→ Main Result: 10 Patterns

P 1 *“Mathematicians do not assess mSIs based on familiarity.”*

P 2 *“Mathematicians trust human and community resources.”*

P 3 *“Finding is the primary mathematical search task.”*

P 4 *“Mathematicians appreciate social interaction as a mathematical tool. In particular, it is a mathematical practice to collaborate and exchange feedback.”*

P 5 *“Mathematicians aim at adopting a search tool as a medium.”*

P 6 *“Mathematicians appreciate function over form.”*

P 7 *“Mathematicians care more for the outcome than the input.”*

P 8 *“Mathematicians want to be empowered in the search process.”*

P 9 *“Mathematicians base their information search process on transparency of the search result.”*

P 10 *“Mathematicians expect to find meaningful information in the search result.”*

Pattern (1/10)

„Familiarity“:

Mathematicians do not assess math search interfaces based on familiarity.



D. Bruff: „Stevenson Center 1210“

Pattern (2/10)

„Community“:

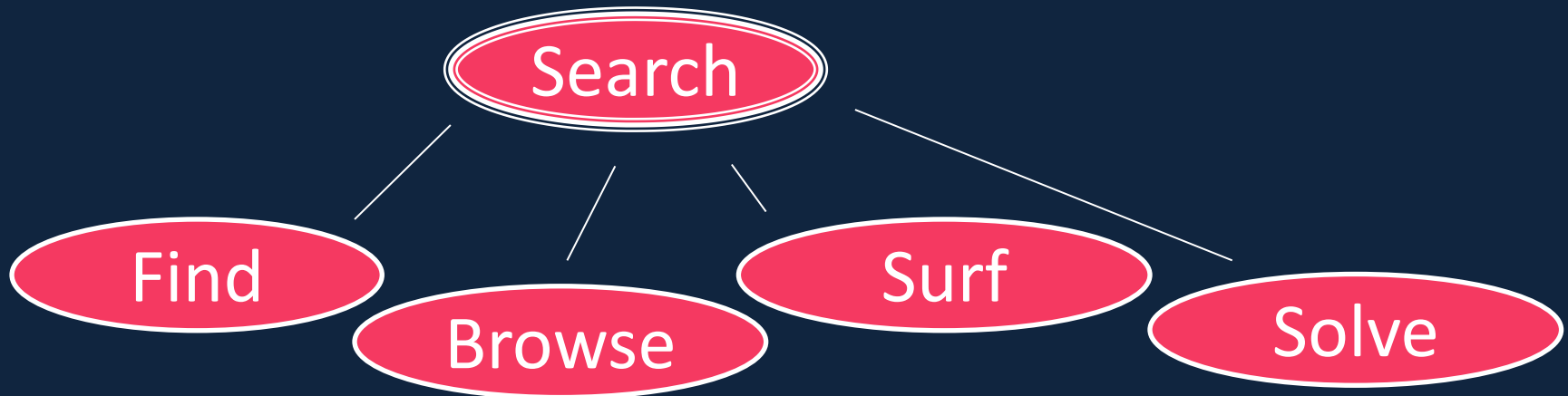
Mathematicians trust
human and community resources.

More so than other communities and
more so the older the mathematician.

Pattern (3/10)

„Finding“:

Finding is the primary mathematical search task.



Pattern (4/10)

„Social Interaction Tool“:

Mathematicians appreciate social interaction as a mathematical tool. In particular, it is a mathematical practice to collaborate and exchange feedback.

≠ „Mathematicians are social“!

yes:

The logo for mathoverflow, featuring the word "math" in a standard font and "overflow" in a bold, italicized font, with a stylized orange bracket graphic above the text.

no,

but maybe:

The logo for ResearchGate, with "Research" in white and "Gate" in green, set against a dark grey background.

Pattern (5/10)

„Medium“:

Mathematicians aim at adopting a search tool as a medium.



Medium
= „Extension of Man“

Pattern (6/10)

„Function“:

Mathematicians appreciate function over form.



Pattern (7/10)

„Outcome“:

Mathematicians care more for the outcome than the input.

$$|f_j(x) - f_j(y)| \leq |\mathbf{f}(x) - \mathbf{f}(y)| = \left\{ \sum_{i=1}^k |f_i(x) - f_i(y)|^2 \right\}^{\frac{1}{2}},$$

Pattern (8/10)

„Empowerment“:

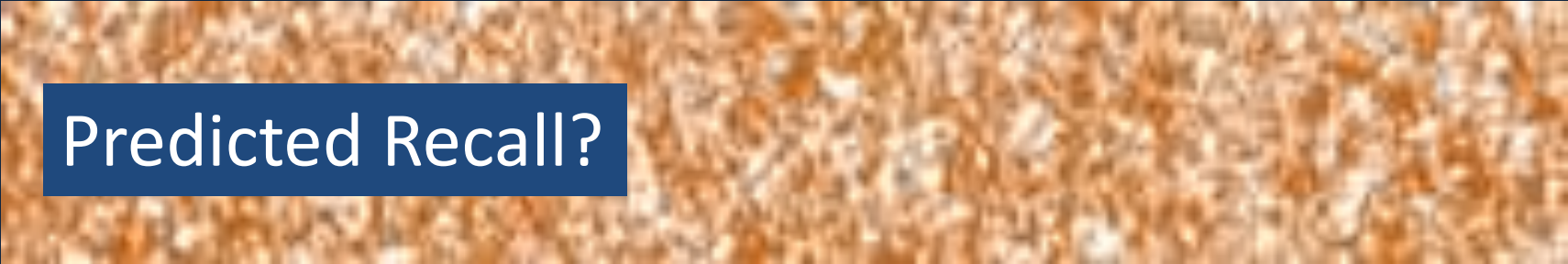
Mathematicians want to be empowered in the search process.



Pattern (9/10)

„Transparency“:

Mathematicians base their information search process on transparency of the search result.



Predicted Recall?

themarketingbit.com



Predicted Precision?

marlismatthias.blogspot.com

Pattern (10/10)

„Expectations“:

Mathematicians expect to find meaningful information in the search result.

≠ meaningful search result!



Summary

- P 1 *“Mathematicians do not assess mSIs based on familiarity.”*
- P 2 *“Mathematicians trust human and community resources.”*
- P 3 *“Finding is the primary mathematical search task.”*
- P 4 *“Mathematicians appreciate social interaction as a mathematical tool. In particular, it is a mathematical practice to collaborate and exchange feedback.”*
- P 5 *“Mathematicians aim at adopting a search tool as a medium.”*
- P 6 *“Mathematicians appreciate function over form.”*
- P 7 *“Mathematicians care more for the outcome than the input.”*
- P 8 *“Mathematicians want to be empowered in the search process.”*
- P 9 *“Mathematicians base their information search process on transparency of the search result.”*
- P 10 *“Mathematicians expect to find meaningful information in the search result.”*

Conclusion

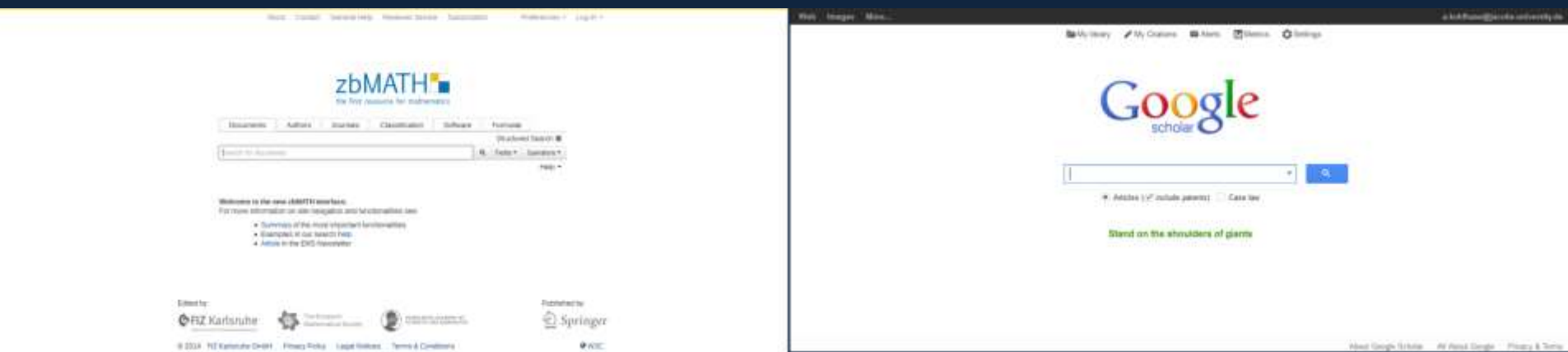
Mathematicians are special,
you are probably not any longer a mathematician,
make use of the patterns
when considering the pros and cons of a design!



Old zbMath website and wonderful Google

Conclusion

Mathematicians are special,
you are probably not any longer a mathematician,
make use of the patterns
when considering the pros and cons of a design!



New zbMath website: very similar to Google!

Conclusion

Mathematicians are special,
you are probably not any longer a mathematician,
make use of the patterns



Very noticeable difference!

Thank you!

Conclusion

Mathematicians are special,
you are probably not any longer a mathematician,
make use of the patterns



No noticeable difference for mathematicians
– “not really”!