

WHAT WE (DON'T) KNOW ABOUT SEARCH ENGINES

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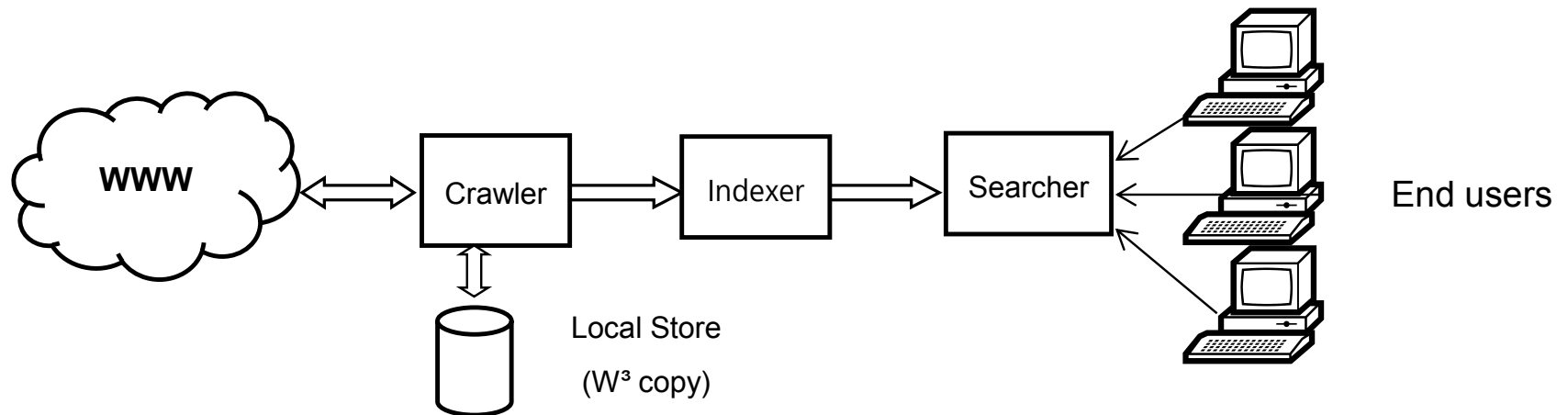
AGENDA

1. How search engines work
2. The field of search engine research
3. Research at the search studies research group

HOW SEARCH ENGINES WORK

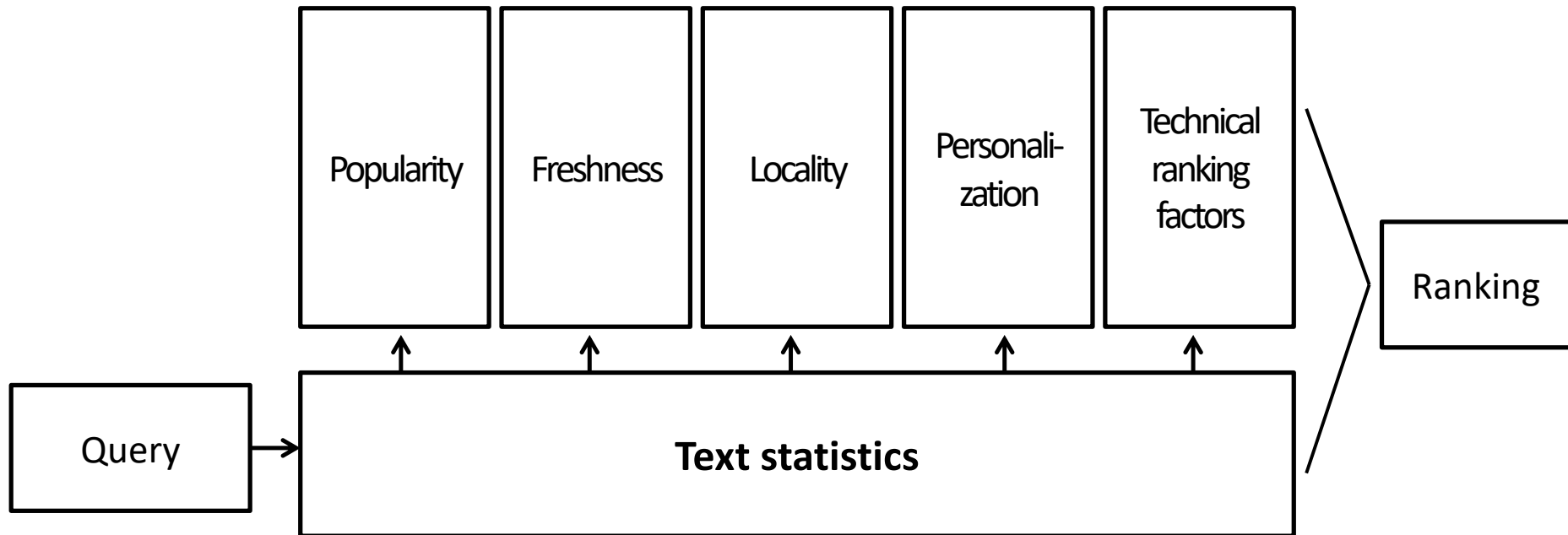
Introduction to the technical design of search engines

GENERAL SEARCH ENGINE ARCHITECTURE

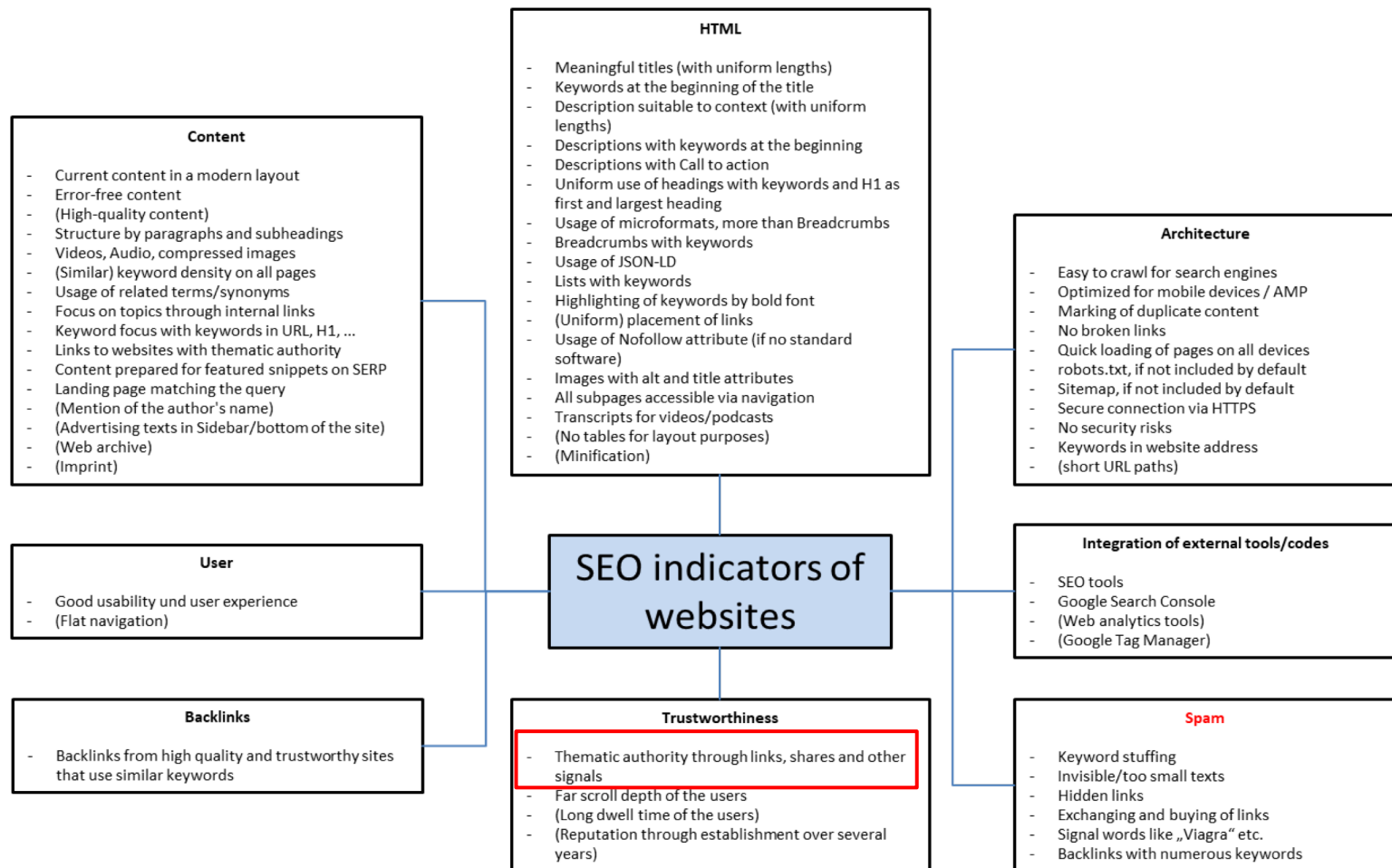


(Risvik & Michelsen, 2002)

SEARCH ENGINE RANKING (SIMPLIFIED)



RANKING FROM THE PERSPECTIVE OF SEARCH ENGINE OPTIMIZATION (SEO)



Explanation:
Indicators (or parts thereof) that are in brackets were controversial (agreement by one interviewee, rejection by another)

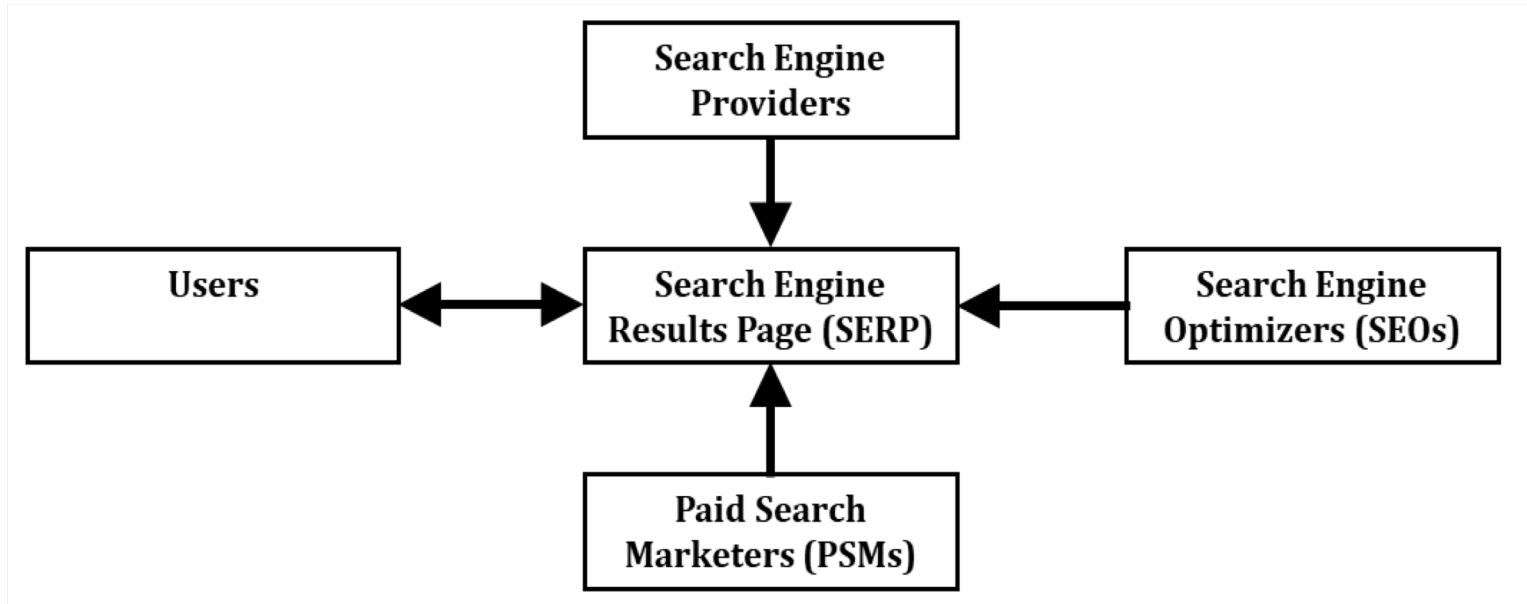
HOW DO SEARCH ENGINES MEASURE QUALITY?

Different types of “quality” signals

- Text-based signals (e.g., keyword density, text structure)
- Link-based signals (e.g., weighted number of in-links)
- Click-based signals (e.g., clicks on results, dwell time)
- User-based signals (personalization)
- Collection-based signals (e.g., belongs to the collection of news websites)

Measuring quality through these signals generally works well in practice.

INFLUENCES ON SEARCH RESULTS



SOME PROBLEMS RESULTING FROM THE “POPULARITY APPROACH” (1)

The screenshot shows a Google search interface with the query "did the holocaust happen". The search results are displayed under the "All" tab. The first result is an advertisement from ushmm.org titled "Did The Holocaust Happen? - Learn More - ushmm.org". The second result, highlighted with a red border, is from stormfront.org titled "Top 10 reasons why the holocaust didn't happen. - Stormfront". The third result is from Wikipedia titled "Holocaust denial - Wikipedia".

Google

did the holocaust happen

All Videos News Images Shopping More Settings Tools

About 14,200,000 results (0.36 seconds)

Did The Holocaust Happen? - Learn More - ushmm.org
Ad www.ushmm.org/ ▼
Learn why people deny the **Holocaust** and the importance of confronting denial.

Top 10 reasons why the holocaust didn't happen. - Stormfront
<https://www.stormfront.org> › General › History & Revisionism ▼
Dec 19, 2008 - 10 posts - 8 authors
The **Holocaust** Lie more than anything else keeps us down. The twin ... You can believe what you want, but i believe the **holocaust did happen**.

Common Questions about the Holocaust – United States Holocaust ...
<https://www.ushmm.org/educators/...about...holocaust/common-question...> ▼
Hitler **did** not make the **Holocaust happen** by himself. Many Germans and non-Germans contributed to/or benefited from the so-called "Final Solution" (the term ...

Holocaust denial - Wikipedia
https://en.wikipedia.org/wiki/Holocaust_denial ▼
Holocaust denial is the act of denying the genocide of Jews and other groups in the **Holocaust** false claims made about World War II, namely that Germany started the war in 1939, and the **Holocaust**, which Barnes claimed **did not happen**.
Laws against Holocaust denial · Order of magnitude · Criticism

(2016)

<https://searchengineland.com/googles-results-no-longer-in-denial-over-holocaust-265832>

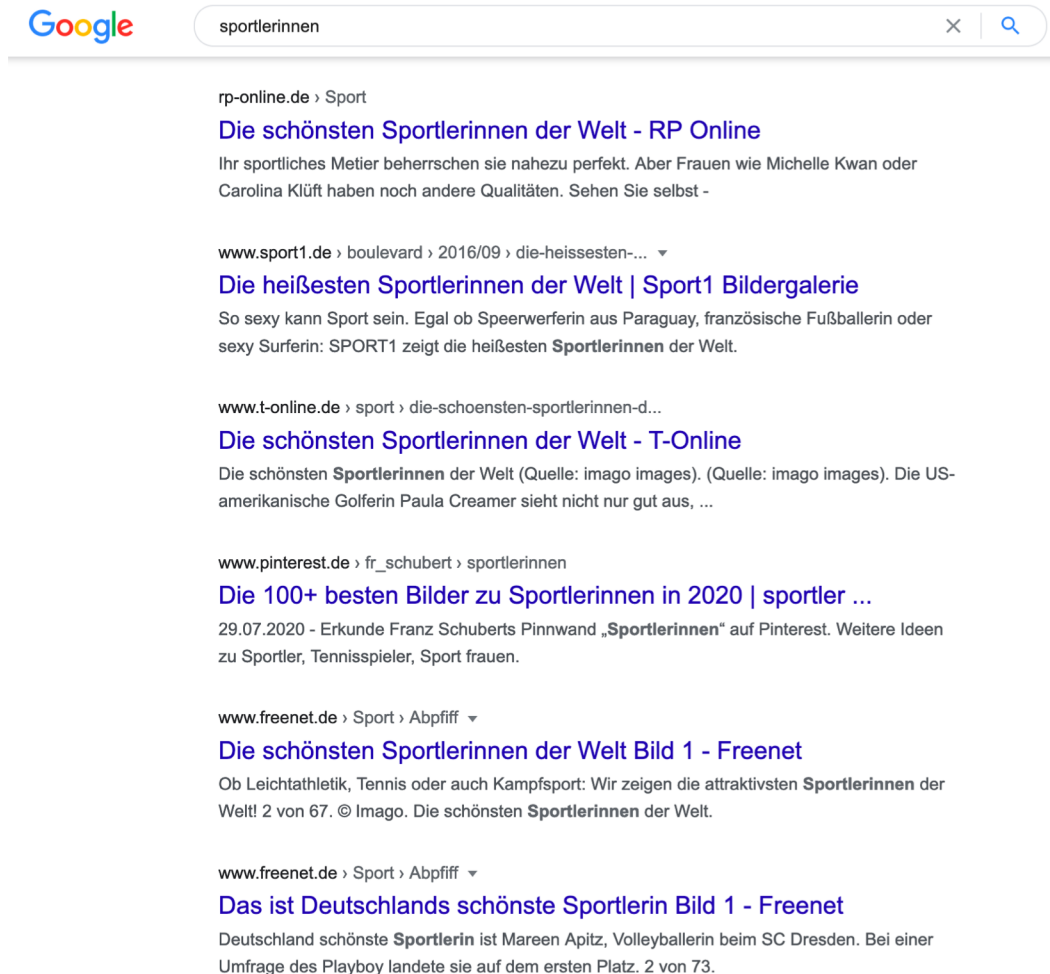
"Search is a reflection of the content that exists on the web. The fact that hate sites appear in search results in no way means that Google endorses these views."

(Google 2016)

SOME PROBLEMS RESULTING FROM THE “POPULARITY APPROACH” (2)

Query: Sportlerinnen
[female athletes]

Web results only



The screenshot shows a Google search for 'sportlerinnen'. The search bar at the top contains the text 'sportlerinnen' with a magnifying glass icon to the right. Below the search bar, the first result is from 'rp-online.de' with the title 'Die schönsten Sportlerinnen der Welt - RP Online'. The snippet below the title reads: 'Ihr sportliches Metier beherrschen sie nahezu perfekt. Aber Frauen wie Michelle Kwan oder Carolina Klüft haben noch andere Qualitäten. Sehen Sie selbst -'. The second result is from 'www.sport1.de' with the title 'Die heißesten Sportlerinnen der Welt | Sport1 Bildergalerie'. The snippet reads: 'So sexy kann Sport sein. Egal ob Speerwerferin aus Paraguay, französische Fußballerin oder sexy Surferin: SPORT1 zeigt die heißesten Sportlerinnen der Welt.'. The third result is from 'www.t-online.de' with the title 'Die schönsten Sportlerinnen der Welt - T-Online'. The snippet reads: 'Die schönsten Sportlerinnen der Welt (Quelle: imago images). (Quelle: imago images). Die US-amerikanische Golferin Paula Creamer sieht nicht nur gut aus, ...'. The fourth result is from 'www.pinterest.de' with the title 'Die 100+ besten Bilder zu Sportlerinnen in 2020 | sportler ...'. The snippet reads: '29.07.2020 - Erkunde Franz Schuberts Pinnwand „Sportlerinnen“ auf Pinterest. Weitere Ideen zu Sportler, Tennisspieler, Sport frauen.'. The fifth result is from 'www.freenet.de' with the title 'Die schönsten Sportlerinnen der Welt Bild 1 - Freenet'. The snippet reads: 'Ob Leichtathletik, Tennis oder auch Kampfsport: Wir zeigen die attraktivsten Sportlerinnen der Welt! 2 von 67. © Imago. Die schönsten Sportlerinnen der Welt.'. The sixth result is also from 'www.freenet.de' with the title 'Das ist Deutschlands schönste Sportlerin Bild 1 - Freenet'. The snippet reads: 'Deutschland schönste Sportlerin ist Mareen Apitz, Volleyballerin beim SC Dresden. Bei einer Umfrage des Playboy landete sie auf dem ersten Platz. 2 von 73.'.

rp-online.de › Sport
Die schönsten Sportlerinnen der Welt - RP Online
Ihr sportliches Metier beherrschen sie nahezu perfekt. Aber Frauen wie Michelle Kwan oder Carolina Klüft haben noch andere Qualitäten. Sehen Sie selbst -

www.sport1.de › boulevard › 2016/09 › die-heissesten-...
Die heißesten Sportlerinnen der Welt | Sport1 Bildergalerie
So sexy kann Sport sein. Egal ob Speerwerferin aus Paraguay, französische Fußballerin oder sexy Surferin: SPORT1 zeigt die heißesten **Sportlerinnen** der Welt.

www.t-online.de › sport › die-schoensten-sportlerinnen-d...
Die schönsten Sportlerinnen der Welt - T-Online
Die schönsten **Sportlerinnen** der Welt (Quelle: imago images). (Quelle: imago images). Die US-amerikanische Golferin Paula Creamer sieht nicht nur gut aus, ...

www.pinterest.de › fr_schubert › sportlerinnen
Die 100+ besten Bilder zu Sportlerinnen in 2020 | sportler ...
29.07.2020 - Erkunde Franz Schuberts Pinnwand „**Sportlerinnen**“ auf Pinterest. Weitere Ideen zu Sportler, Tennisspieler, Sport frauen.

www.freenet.de › Sport › Abpiff
Die schönsten Sportlerinnen der Welt Bild 1 - Freenet
Ob Leichtathletik, Tennis oder auch Kampfsport: Wir zeigen die attraktivsten **Sportlerinnen** der Welt! 2 von 67. © Imago. Die schönsten **Sportlerinnen** der Welt.

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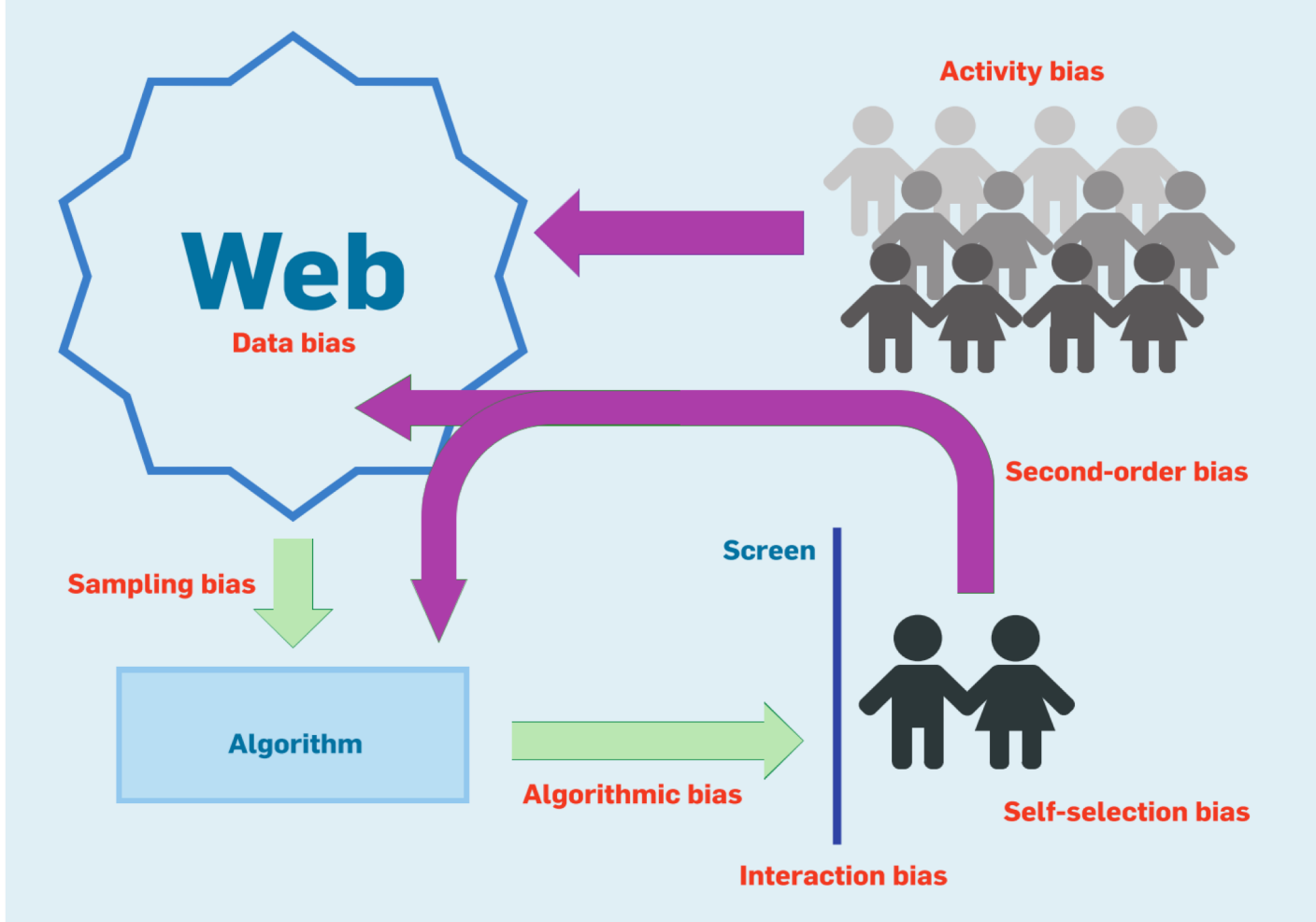
BIAS IN ORGANIC RESULTS IS JUST THE TIP OF THE ICEBERG

Facets of search engine bias

1. **Search engine (engineering)** – Ranking
2. **Users** – Cognitive biases
3. **Search engine providers' self-interests** – Design of search engine result pages
4. **External influences** – Search Engine Optimization (SEO)

BIAS ON THE WEB

Figure 1. The vicious cycle of bias on the Web.



(Baeza-Yates, 2018)

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FURTHER READING: SEARCH ENGINE BASICS

Croft, W. B., Metzler, D., & Strohman, T. (2015). *Search Engines: Information retrieval in practice*. Boston, MA: Pearson.

Good introduction to information retrieval.

Manning, C. D., Raghavan, P., & Schütze, H. (2008). *Introduction to Information Retrieval*. Cambridge: Cambridge University Press.

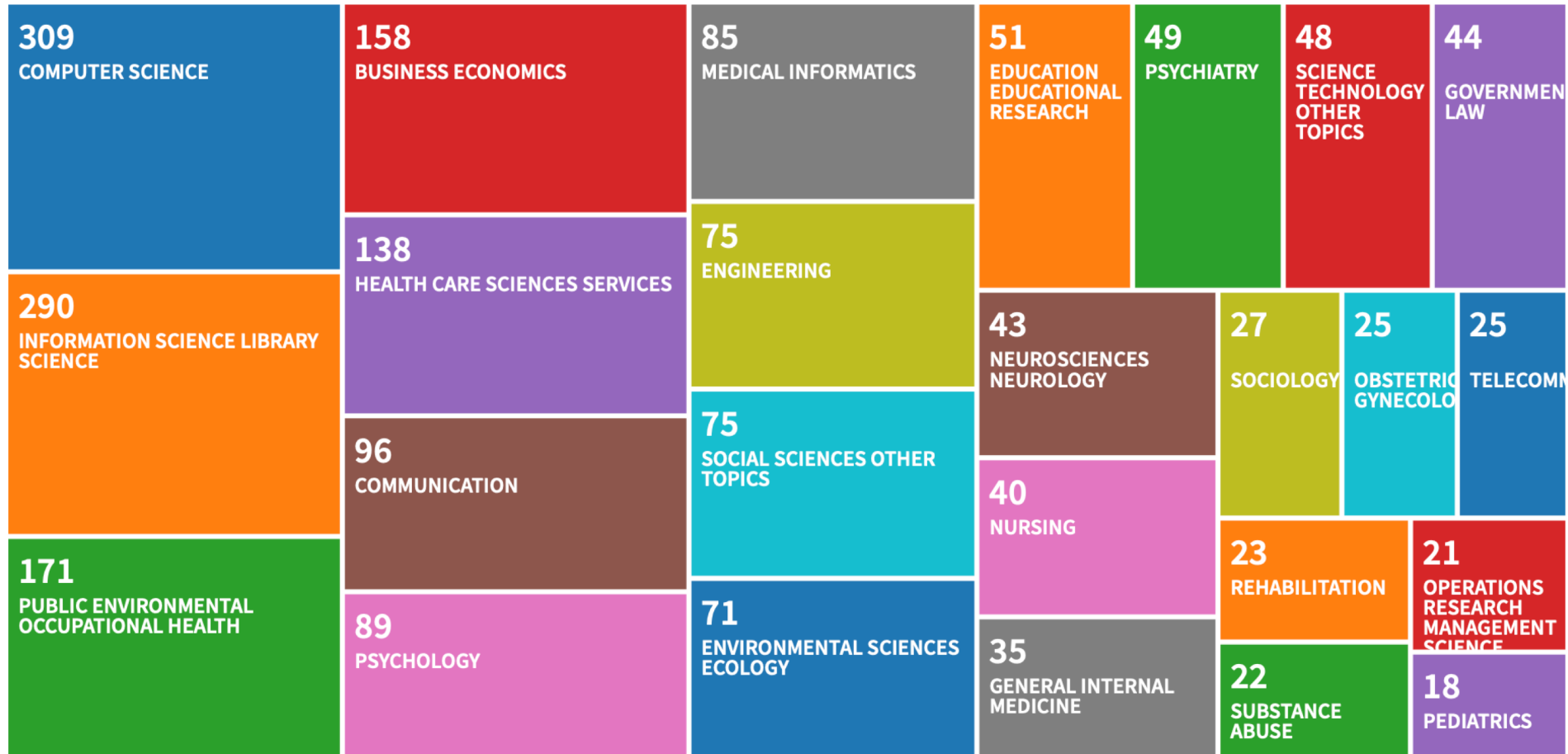
Good introduction to information retrieval. Goes a bit deeper than Croft et al.

White, R. W. (2016). *Interactions with Search Systems*. New York: Cambridge University Press.

Good overview of interactive information retrieval research. Complete overview of the research literature in the field.

THE FIELD OF SEARCH ENGINE RESEARCH

A QUICK OVERVIEW OF SEARCH ENGINE RESEARCH (2016-2020)



(Data from Web of Science; topic “search engine*”)

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THE FIELD OF SEARCH ENGINE RESEARCH

General characteristics

- Multidisciplinary field
- Output is growing but not very fast
- Research focussing on commercial search engines vs. research and development in the field of information retrieval more generally

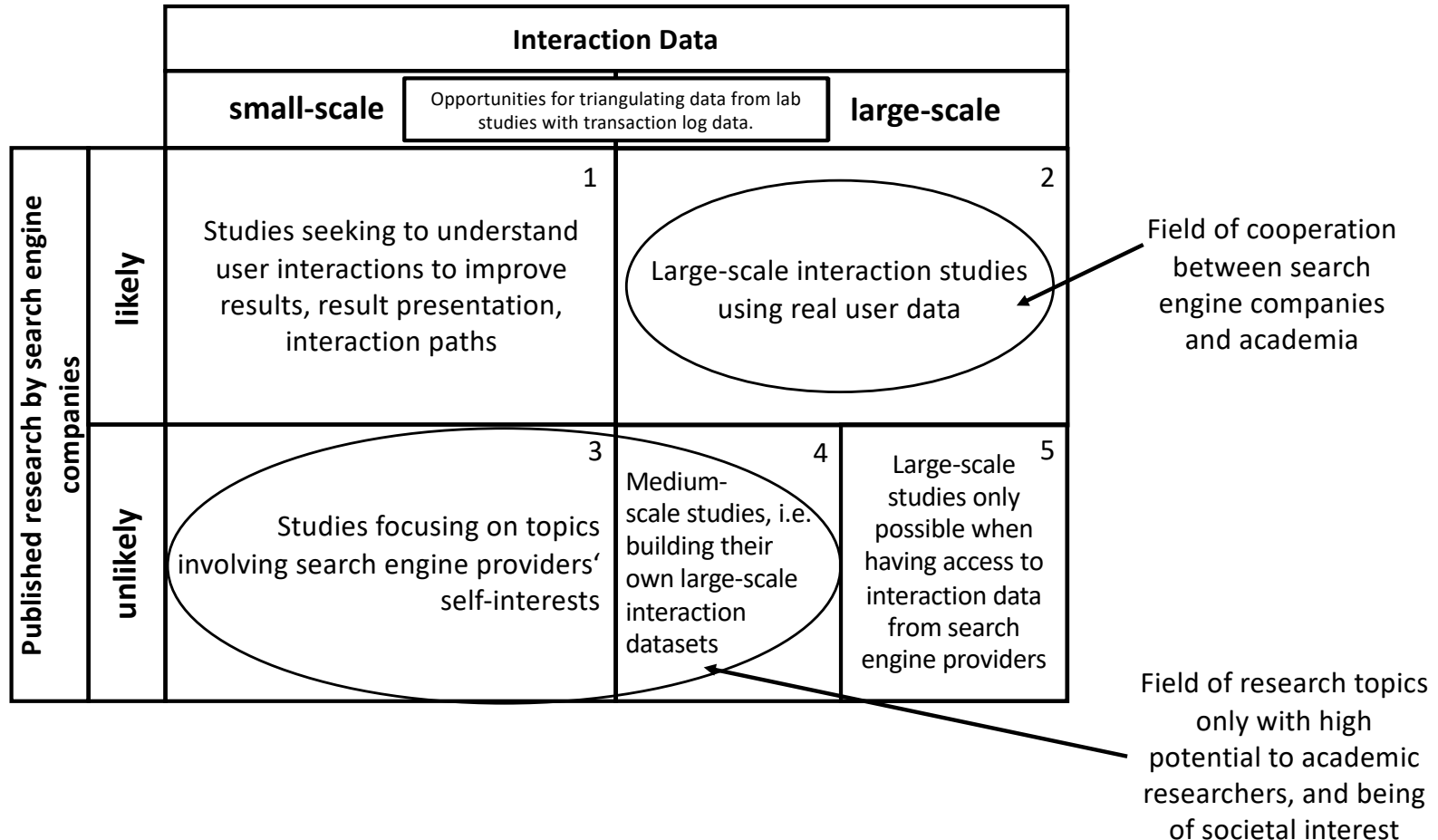
“Data problems”

- Lack of query data (real queries from real users)
- Very limited access to search results data (Bing API)
- Data access through cooperation with search engine companies

TOPICAL CLUSTERS (NOT SYSTEMATIC)

- Using Google Trends to predict real-world events (stock prices, illnesses, etc.)
- Lots of computer science research focusing on developing search engine components
- Improving the effectiveness of search engine advertising
- Search engine user behaviour
- Search engine bias
- Evaluating the quality of Web search engines
- Search engine optimization (SEO)
- Search engines and information literacy
- Search engine market and regulation
- ...

RESEARCH TOPICS AND THE EVIDENTIAL VALUE OF USER STUDIES



(Lewandowski, Sünkler & Schultheiß, 2020)

BOOKS ON SEARCH ENGINES 2016-2020

White, R. W. (2016). *Interactions with Search Systems*. New York: Cambridge University Press.

Good overview of interactive information retrieval research. Complete overview of the research literature in the field.

Noble, S. U. (2018). *Algorithms of Oppression: How Search Engines Reinforce Racism*. New York, USA: New York University Press.

Illustrates the problem of search engine bias but many of the examples are hopelessly outdated.

Halavais, A. (2018). *Search Engine Society (Second edition)*. Cambridge, UK: Polity.

Good starting point as the author discusses a lot of aspects relevant to search engine research. A bit weak on the technical side.

Haider, J., and O. Sundin (2019), *Invisible Search and Online Search Engines*. Oxford, New York: Routledge.

RESEARCH AT THE SEARCH STUDIES RESEARCH GROUP

TWO PILLARS

User studies

- Task-based surveys, lab studies (incl. eye tracking)
- Focus on representative samples (surveys), diverse samples (lab studies)

Search engine data analysis

- Automatic data collection (screen scraping SERPs)
- (Semi-)automatic analysis of URLs and result documents
- Software development

CURRENT RESEARCH PROJECTS

1. Contextual advertising

How well do users understand advertising on search engine result pages?

What effect do ads have on users' selection behaviour?

2. Search result analysis

What is actually shown on SERPs?

3. SEO-Effekt: Influence of search engine optimization on the search results

SEO from the perspective of optimizers and users

Software for identifying optimized documents in search results

1. CONTEXTUAL ADVERTISING

APPROACH

Two large-scale studies representative of the German online population (data from 2014, 2020)

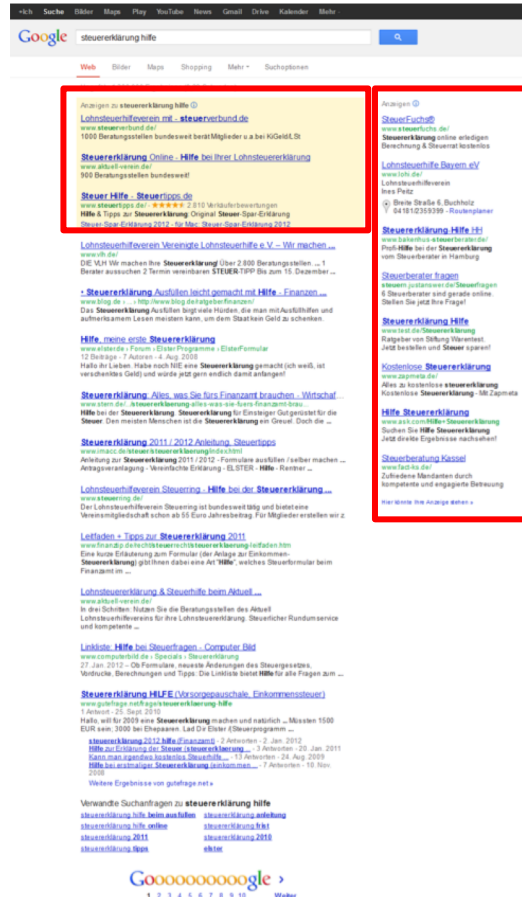
1. Users' knowledge on Google's business model
2. Four tasks where users had to mark all ads on SERPs
3. Experiment with manipulated SERPs (2014 only)

→ Results from the 2020 study (as yet unpublished) confirm the older results.

Eye-tracking study (data from 2019)

SAMPLE TASK: MARK ALL THE ADVERTISEMENTS ON THIS SEARCH ENGINE RESULTS PAGE

N=1,000



35% marked all ads correctly.

18% marked at least some organic results as ads.

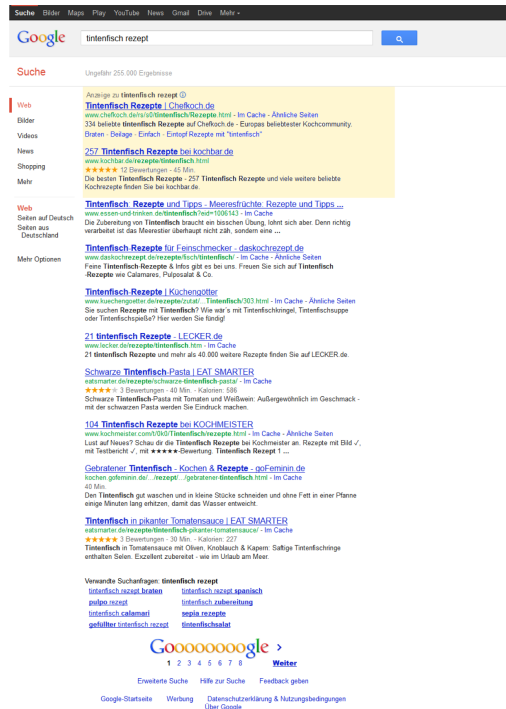
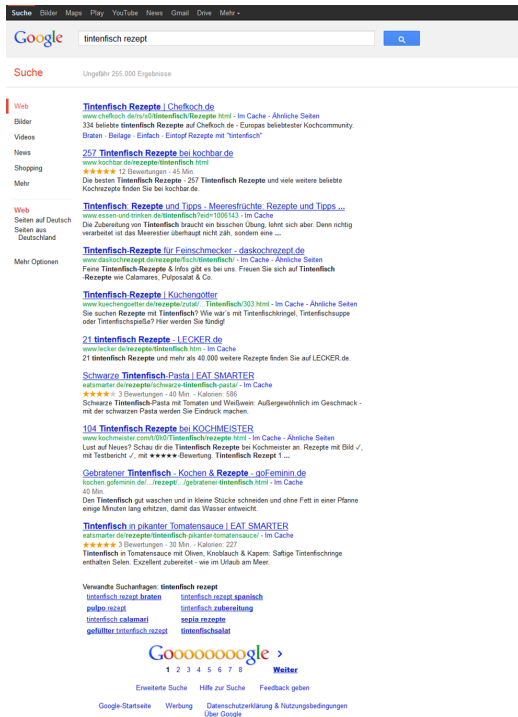
Still, more than 90% of users regard themselves as competent when it comes to using search engines.

Lewandowski, D., Kerkmann, F., Rümmele, S., & Sünkler, S. (2018). An empirical investigation on search engine ad disclosure. *Journal of the Association for Information Science and Technology*, 69(3), 420–437. <https://doi.org/10.1002/asi.23963>

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RESULTS FROM THE EXPERIMENT

N=1,000



Users not able to distinguish ads from organic results clicked on the first ad about twice as often (40.3% vs. 21.6%).

Lewandowski, D. (2017). Users' Understanding of Search Engine Advertisements. *Journal of Information Science Theory and Practice*, 5(4), 6–25. <https://doi.org/10.1633/JISTaP.2017.5.4.1>

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UNDERSTANDING OF ADS INFLUENCES USERS' VISUAL BEHAVIOUR

N=100

Participants with a low level of knowledge on search advertising are more likely to click on ads than subjects with a high level of knowledge.

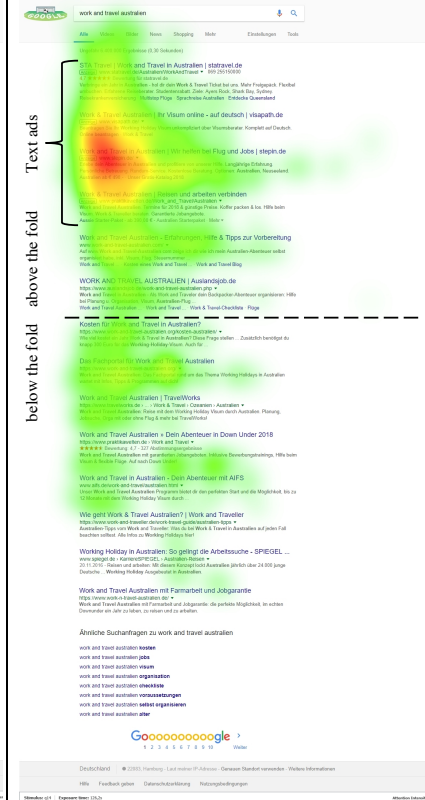
Subjects with little knowledge show less willingness to scroll down to organic results.

Larger effect on the mobile device

little knowledge of ads



comprehensive knowledge of ads



(Schultheiß & Lewandowski, 2020)

2. SEARCH RESULT ANALYSIS

TOOLS FOR COLLECTING AND ANALYSING RESULTS FROM COMMERCIAL SEARCH ENGINES

Relevance Assessment Tool (RAT; Lewandowski & Sünkler, 2013)

- Screen-scraping SERPs: Collecting URLs, downloading result documents
- Test-design interface
- Juror interface for collecting (relevance) assessments

Some tools for analysing search results developed in different projects

- Online shop identification, grocery shop identification
- Imprint data
- Indicators for search engine optimization

STUDIES USING SCREEN SCRAPING AND RESULT ANALYSIS (1/2)

German Federal Elections 2017

Use of info boxes (principles and priorities) by political candidates

Those who are more established make more considerable efforts to achieve visibility on the result pages.

The content analysis shows different degrees of internal pluralism of parties

The screenshot shows a Google search for "Martin Schulz". The top navigation bar includes "Alle", "News", "Bilder", "Videos", "Maps", "Mehr", "Einstellungen", and "Tools". Below the search bar, it indicates "Ungefähr 47.600.000 Ergebnisse (0,49 Sekunden)".

The main content area displays several news snippets under the heading "Schlagzeilen":

- Nach TV-Duell: Merkel laut Umfragen Siegerin: Überraschung** (Spiegel - vor 4 Stunden)
- TV-Duell: Zuschauer sehen Merkel vorne - Schulz besser als erwartet** (Focus - vor 4 Stunden)
- TV-Duell: Pitbull Schulz: Sieben Angriffe des Kanzlerkandidaten – und wie Merkel parierte** (Focus - vor 23 Minuten)

Below these are links to "Mehr zu Martin Schulz" and a list of related articles:

- Martin Schulz – Wikipedia**: https://de.wikipedia.org/wiki/Martin_Schulz. Martin Schulz (* 20. Dezember 1955 in Hehlrath, heute Eschweiler) ist ein deutscher Politiker (SPD). Von 1987 bis 1998 war Schulz Bürgermeister von ... Herkunft und ... · SPD-Politiker (1975 bis ... · Politische Positionen · Kontroversen
- Martin Schulz | martinschulz.de**: https://martinschulz.de/. Erfahre mehr über den SPD-Kanzlerkandidaten Martin Schulz. Es ist Zeit für mehr Gerechtigkeit. Zeit für Martin Schulz. Unterstütze ihn dabei.
- Martin Schulz (@MartinSchulz) | Twitter**: https://twitter.com/martinschulz/angende. 4396 tweets · 425 photos/videos · 502K followers. Check out the latest Tweets from Martin Schulz (@MartinSchulz)
- Martin Schulz - Startseite | Facebook**: https://de-de.facebook.com/martinschulz/. Martin Schulz. Gefällt 394.066 Mal. Kanzlerkandidat und Vorsitzender der SPD. Glühender Sozialdemokrat.
- Martin Schulz aktuell: News der FAZ zum Kanzlerkandidaten - Faz.net**: www.faz.net/aktuell/politik/themamartin-schulz. Aktuelle Nachrichten zu Martin Schulz im Überblick: Lesen Sie hier alle Informationen der FAZ rund um die Kanzlerkandidatur des SPD-Spitzenpolitikers.
- Martin Schulz - SPIEGEL ONLINE**: www.spiegel.de > Politik > Deutschland. Flüchtlinge, Türkei, Diesel, Nordkorea: Wie haben sich Angela Merkel und Martin Schulz im TV-Duell positioniert? Die wichtigsten Streitpunkte im Überblick.

On the right side, there is a detailed profile for **Martin Schulz**, Ehemaliger Präsident des Europäischen Parlaments. It includes a photo gallery, a bio, and a list of "Grundsatz" (Principles) and "Prioritäten" (Priorities).

Grundsatz

- Martin Schulz**
Persönlich verfasste Standpunkte

Es ist Zeit für mehr Gerechtigkeit. Wir wollen, dass alle in unserem Land die Chance auf ein gutes Leben haben. Deshalb wollen wir investieren – hier und jetzt und in die Zukunft unserer Kinder. Frieden und Wohlstand sichern wir nur gemeinsam – durch ein starkes Europa. Lasst uns unser Land gerechter machen, mutig die Zukunft gestalten und für ein besseres Europa kämpfen!

Prioritäten

- Martin Schulz**
Persönlich verfasste Standpunkte

- Mehr Gerechtigkeit: Jeder soll die gleichen Chancen auf beste Bildung und Ausbildung, gute Jobs und ein würdevolles Leben im Alter haben.
- Mutige Investitionen in die Zukunft: in bessere Straßen, in bezahlbare Wohnungen, schnelles Internet und beste Bildung – in Stadt und Land.
- Ein einiges und starkes Europa: gemeinsamer Kampf gegen Steuerbetrug und eine gerechte Verteilung der Flüchtlinge.

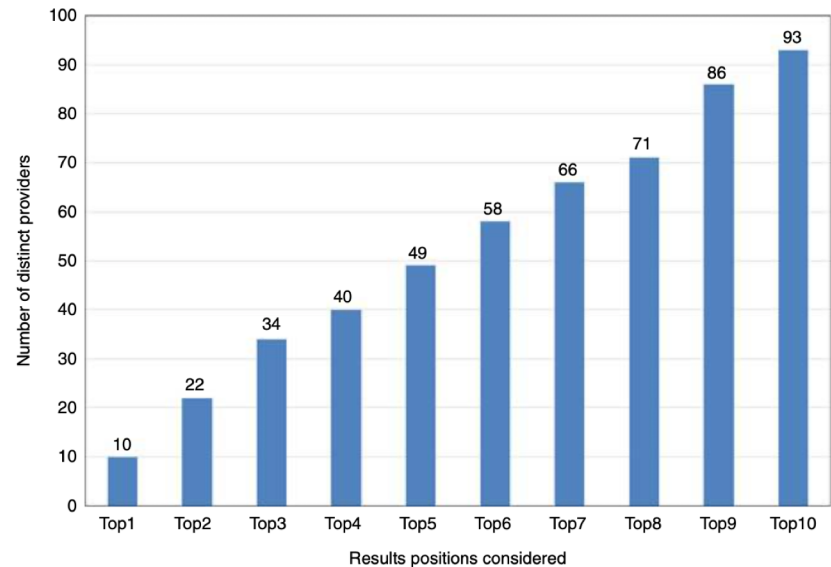
(Hinz, Sünkler & Lewandowski, 2020)

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STUDIES USING SCREEN SCRAPING AND RESULT ANALYSIS (2/2)

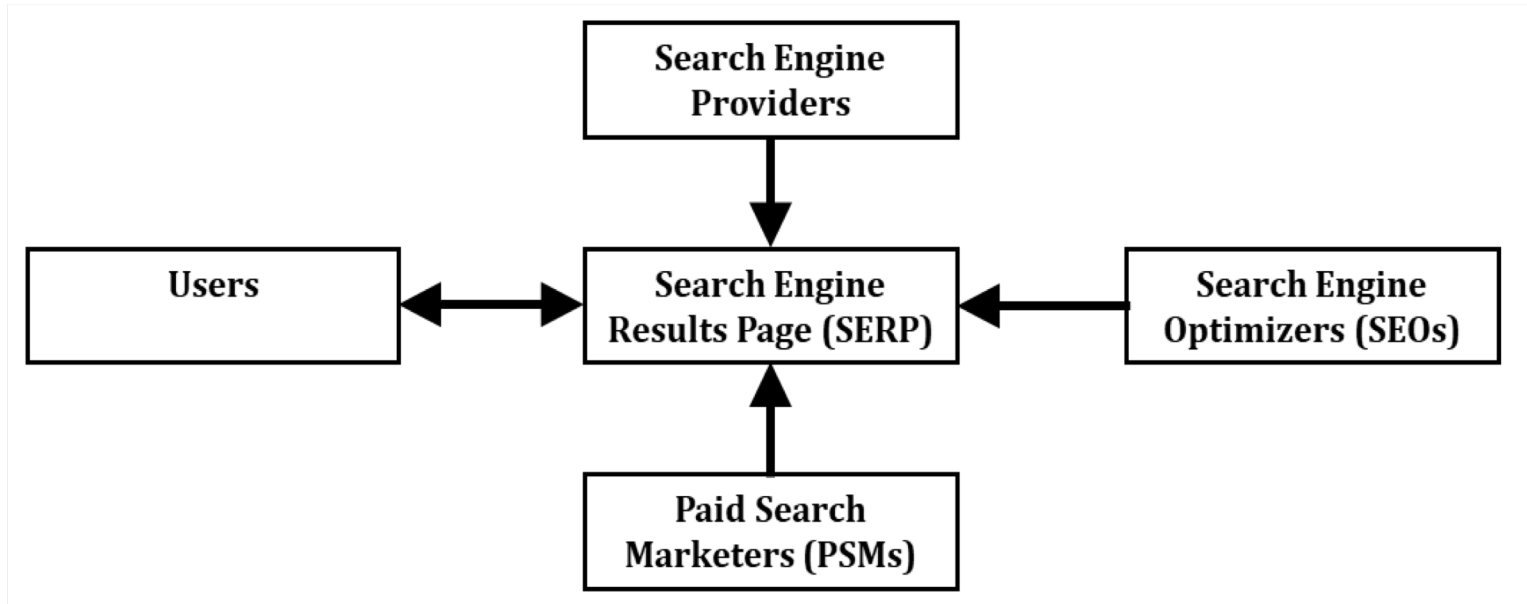
Insurance offering

- Set of 121 queries containing "insurance" and "comparison", e.g., "car insurance comparison sites", "buildings insurance comparison".
- Shows a high concentration of some commercial domains within the top search results (not necessarily providing fair and unbiased insurance comparisons)



(Lewandowski & Sünkler, 2019)

SEO-EFFEKT: INFLUENCE OF SEARCH ENGINE OPTIMIZATION ON THE SEARCH RESULTS



SEO-EFFEKT: SOME FINDINGS

Expert interviews (Schultheiß & Lewandowski, submitted)

- Search engine optimizers regard SEO as a means to providing users with better results.
- SEO is considered necessary for content providers to ensure visibility.

Representative user study (publication in preparation)

- Users have a very limited understanding of SEO.

Trust in Google (results from representative user study; submitted)

- Users with little search engine knowledge are more likely to trust and use Google than users with more knowledge.

Data analysis (publication in preparation)

- Tool used to extract information from HTML code, e.g., use of specialized SEO tools, analytics tools + URL classification (pre-defined sets) [+machine learning].
- Demo tool: <http://5.189.155.20:5000>

DEMO TOOL RESULTS

Results for <https://www2.bui.haw-hamburg.de/pers/ulrike.spree/>

Tools & Plugins

SEO Tools: ✗
Analytics Tools: ✗

URL Classification

Online Marketing Customer: ✗
News Service: ✗
Ads on Website: ✗
Company Website: ✗
Online Shop: ✗
Not optimized: ✗

Indicators for SEO

https: ✓
Description: ✗
Title: ✓
robots.txt: ✗
Sitemap: ✗
nofollow: ✗
speed: ✓
canonical: ✗
viewport: ✗
Micros: ✗

SEO Assessment

Most probably: ✗
Most probably not: ✗
Probably: ✗
Likely not optimized: ✓
Uncertain: ✓

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Projekte | Auslandspraktikum | Studienberatung / BAföG-Dozentin |



Prof. Dr. Ulrike Spree

Lehrgebiete:

Hochschule für Angewandte Wissenschaften Hamburg
Fakultät Design Medien Information
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Medien-campus Finkenau
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22081 Hamburg

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Wissensorganisation und Records Management
Information Research

Telefon: 040/42875/3607
Mail: ulrike.spree@haw-hamburg.de

Sprechstunde:
mittwochs 15:00 bis 16:30
Am 03.12.2014 muss die Sprechstunde leider ausfallen, da ich dienstlich unterwegs bin.

Aktuelle Informationen:
Kurse in Moodle
Themenvorschläge Bachelor- und Masterarbeiten
Infos zum BAföG-Antrag

Aktuelle Veröffentlichungen und Vorträge:
• Alexander, Fran; Spree, Ulrike (Hgg.): *Aslib Journal of Information Management*. Special Issue: Semantic Search. Vol. 66, 2014, Nr. 5 (Beginn ab S.473) <http://www.emeraldinsight.com/toc/ajim/66/5>
• Spree, Ulrike: How Readers Shape the Content of an Encyclopedia: A Case Study Comparing the German Meyers Konversationslexikon (1885-1890) with Wikipedia (2002-2013). In: *Culture Unbound : Journal of Current Cultural Research*; Vol. 6, Article 29, 2014 <http://www.cultureunbound.ep.liu.se/v6/a29/cu14v6a29.pdf>
• Spree, Ulrike: Kulturelle Teilhabe ermöglichen : Möglichkeiten und Grenzen zielgruppenorientierter Bibliotheksarbeit für Menschen mit Demenz. In: *Medien & Altern* 2013; 3. S. 77-93 [preprint]
• Spree, Ulrike: Wörterbücher und Enzyklopädien. In: *Grundlagen der praktischen Information und Dokumentation* / hrsg. von Kühlen, Rainer. 6., völlig neu gefasste Ausgabe. - Berlin, Boston, Mass. : De Gruyter Saur, 2012, S. 550-559. [preprint]
• Ulrike Spree: *Mutually dependent : Encyclopedias and their audiences*. Vortrag gehalten am 09.11.2012 auf der Konferenz "Encyclopedias and beyond" in der National Library Oslo
• Ulrike Spree; Jutta Lindenthal; Andje Knaack: *Wortnetz Kultur - ein Thesaurusprojekt zur kollaborativen Erschließung von Fachinformationen des kulturellen Erbes*. In: *Information, Wissenschaft & Praxis* 2012; 63(1). S.23-36. [preprint]

... weitere Publikationen

Mein Motto:
When action grows unprofitable, gather information; when information grows unprofitable, sleep.

SUMMARY OF RESEARCH PROJECTS

- Combining social science and computer science methods provides a fruitful basis for conducting research on commercial search engines.
- Collecting data from commercial search engines is cumbersome but is the only way forward given that search engine companies will only provide data for research projects they endorse.

THANK YOU

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- Lewandowski, D., & Sünkler, S. (2019). What does Google recommend when you want to compare insurance offerings? *Aslib Journal of Information Management*, 71(3), 310–324. <https://doi.org/10.1108/AJIM-07-2018-0172>
- Lewandowski, D., Sünkler, S., & Schultheiß, S. (2020). Studies on Search: Designing Meaningful IIR Studies on Commercial Search Engines. *Datenbank-Spektrum*, 20(1), 5–15. <https://doi.org/10.1007/s13222-020-00331-1>
- Manning, C. D., Raghavan, P., & Schütze, H. (2008). *Introduction to Information Retrieval*. Cambridge: Cambridge University Press.
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