

Evaluation of Contextualization and Diversification Approaches in Aggregated Search

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TIR 2017



OUTLINE

1. Introduction
2. System
3. Evaluation

INTRODUCTION





Starting Point & Goals

- Provide & research ways to include **diversity** and **serendipity** into **result aggregation**
 - ... specific for our search scenario
 - ... for a better understanding of how users perceive such result aggregation techniques



Diversity

- Diversity could be described as a “**strategy to resolve the ambiguity of a query**”
- Usual approach:
 1. Capture the different meanings of a query
 2. Produce results that respond to each of the different meanings

C. L. Clarke, M. Kolla, G. V. Cormack, O. Vechtomova, A. Ashkan, S. Büttcher, and I. MacKinnon, “Novelty and diversity in information retrieval evaluation,” in Proceedings of the 31st annual International ACM SIGIR Conference on Research and Development in Information Retrieval. ACM, 2008, pp. 659–666.

R. Agrawal, S. Gollapudi, A. Halverson, and S. Jeong, “Diversifying search results,” in Proceedings of the Second ACM International Conference on Web Search and Data Mining. ACM, 2009, pp. 5–14



Serendipity

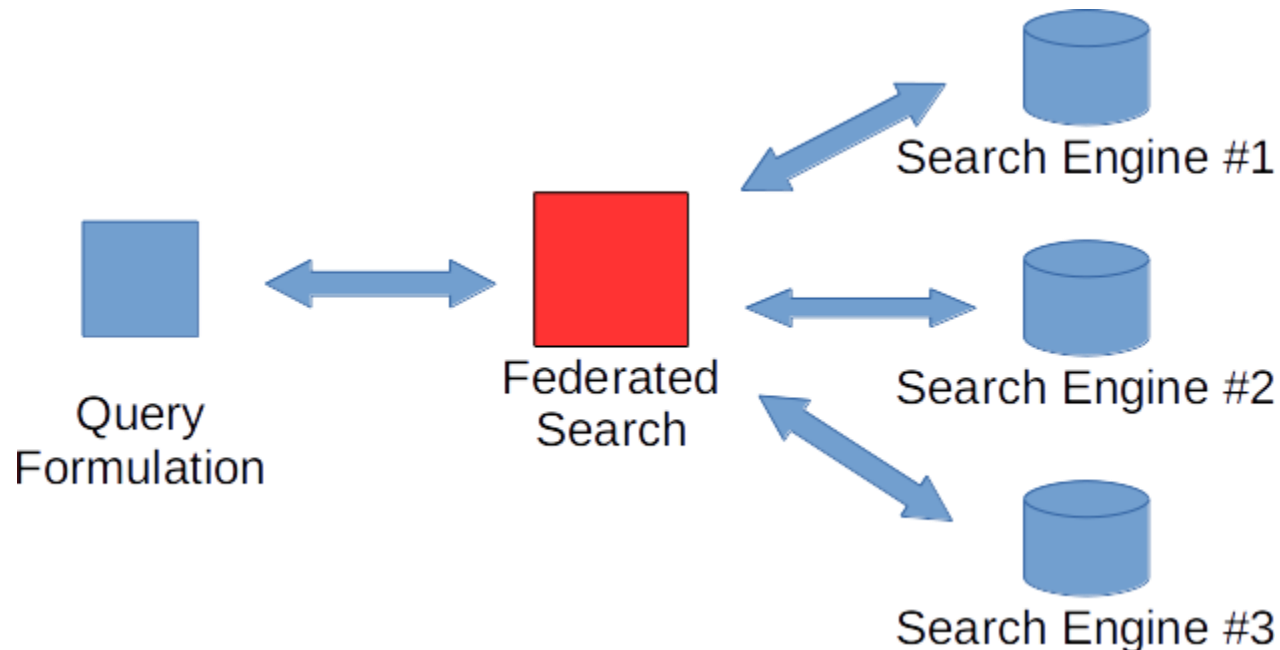
- “Serendipitous information retrieval is the occurrence of a user interacting with an information node with **no prior intentions to do so**”
- Pleasantly surprising results
 - Support a creative process

E. G. Toms, “Serendipitous information retrieval.” in DELOS Workshop: Information Seeking, Searching and Querying in Digital Libraries. Zurich, 2000.



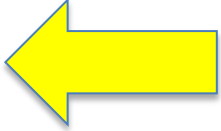
Cross Vertical Aggregated Search

- Federated Search consisting of heterogeneous sources
 - E.g. text, images, videos, ...





Cross Vertical Aggregated Search

- Main challenges
 - Collection representation
 - Collection selection
 - **Result merging** 
 - How to aggregate results from multiple sources & queries

M. Shokouhi and L. Si, "Federated search," *Foundations and Trends in Information Retrieval*, vol. 5, no. 1, pp. 1–102, 2011.

J. Lu and J. Callan, "Federated search of text-based digital libraries in hierarchical peer-to-peer networks," in *Advances in Information Retrieval*. Springer, 2005, pp. 52–66.



Scenario

- Cultural Heritage

Information Need

- Users are assumed to be in a state of a creative process
- Users have different background & knowledge

Query Formulation

- Queries are automatically generated by the user context
- “Just-in-time Information Retrieval”

J. Schlotterer, C. Seifert, and M. Granitzer, “Web-based -in-time retrieval for cultural content,” PATCH14: Proceedings of the 7th International ACMWorkshop on Personalized Access to Cultural Heritage, 2014.

SYSTEM





EEXCESS System

- Technological base for our adaptations
- **Federated recommender system**
 - ... developed for the cultural heritage domain
- Provides components for
 - E.g. query generation, federated search, result aggregation, de-duplication...
- Provides many search engines
 - E.g. Europeana, Mendeley, EconBiz, ...
- Open source
 - <https://github.com/EEXCESS>



SYSTEM

Example Screenshot of the EEXCESS System

The screenshot displays the EEXCESS system interface overlaid on a Wikipedia page about Ada Lovelace. The interface includes several key components:

- Focus Paragraph:** A red box highlights a paragraph in the article, with an arrow pointing to it labeled "focus paragraph".
- Search Results:** A red box highlights a search results panel at the bottom, with an arrow pointing to it labeled "search results".
- Sort and Filter Options:** A red box highlights the "Sort and Filter Options" section, with an arrow pointing to it labeled "sort and filter options".
- Main Topic:** A red box highlights the "main topic" section, with an arrow pointing to it labeled "main topic".
- Keywords:** A red box highlights the "KEYWORDS" section, with an arrow pointing to it labeled "KEYWORDS".
- Search Options:** A red box highlights the "search options" section, with an arrow pointing to it labeled "search options".
- Visual Query History:** A red box highlights the "visual query history" section, with an arrow pointing to it labeled "visual query history".
- Setup Layer Control:** A red box highlights the "setup layer control" section, with an arrow pointing to it labeled "setup layer control".
- Result Indicator:** A red box highlights the "result indicator" section, with an arrow pointing to it labeled "result indicator".

The background shows the Wikipedia article text, including the "Work" section and a portrait of Ada Lovelace.



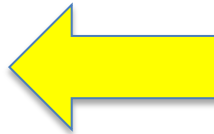
Approach

1. **Extend** the EEXCESS system to **use different methods** of including diversity and serendipity into the result aggregation
2. **Measure** the how well the different results aggregation methods are perceived



Three main approaches for result aggregation

- Non blended
 - Individual result lists
- Blended
 - **One integrated result list**
- Composite retrieval
 - Mixture of both



S. Sushmita, H. Joho, M. Lalmas, and R. Villa, "Factors affecting click-through behavior in aggregated search interfaces," in Proceedings of the 19th ACM International Conference on Information and knowledge management. ACM, 2010, pp. 519–528.

H. Bota, K. Zhou, J. M. Jose, and M. Lalmas, "Composite retrieval of heterogeneous web search," in Proceedings of the 23rd International Conference on World Wide Web. ACM, 2014, pp. 119–130.



Diversity

- Query expansion
- Pseudo-relevance feedback via external source
- Disjunction query

Serendipity

- Query expansion
- Keyword extraction from user browsing history
- Conjunction query

H. Ziak and R. Kern, "Evaluation of pseudo relevance feedback techniques for cross vertical aggregated search," in *Experimental IR Meets Multilinguality, Multimodality, and Interaction*. Springer, 2015, pp. 91–102.

R. Rubien, H. Ziak, and R. Kern, "Efficient Search Result Diversification via Query Expansion Using Knowledge Bases," in *Proceedings of 12th International Workshop on Text-based Information Retrieval (TIR)*, 2015.



Comparison of Search Results from Wikipedia

Q einstein OR (albert OR bose OR relativity OR nuclear)

[Content pages](#) [Multimedia](#) [Everything](#) [Advanced](#)

Albert Einstein

Albert Einstein (14 March 1879 – 18 April 1955) was a German-born theoretical physicist.

Einstein developed the theory of **relativity**, one of the two pillars

141 KB (15,113 words) - 20:43, 25 August 2017

List of scientific publications by Albert Einstein

Albert Einstein (1879–1955) was a renowned theoretical physicist of the 20th century, best known for his theories of special **relativity** and general relativity

161 KB (4,081 words) - 18:56, 31 July 2017

Albert Einstein Science Park

the park are the **Einstein** Tower, an astrophysical observatory that was built to perform checks of **Einstein's** theory of General **Relativity**; and the Great

2 KB (206 words) - 20:59, 30 November 2016

Albert Einstein House

The **Albert Einstein** House at 112 Mercer Street in Princeton, Mercer County, New Jersey, United States was the home of **Albert Einstein** from 1935 until

6 KB (502 words) - 00:26, 30 June 2017

Satyendra Nath Bose

Saha, **Bose** prepared the first book in English based on German and French translations of original papers on **Einstein's** special and general **relativity** in

28 KB (2,810 words) - 18:14, 16 August 2017

Q einstein AND (music OR sports)

[Content pages](#) [Multimedia](#) [Everything](#) [Advanced](#)

Albert Einstein

Albert Einstein (14 March 1879 – 18 April 1955) was a German-born theoretical physicist.

Einstein developed the theory of relativity, one of the two pillars

141 KB (15,113 words) - 20:43, 25 August 2017

Arik Einstein

pioneer of Israeli rock **music** and was named "the voice of Israel". Through both high public and critical acclamation, **Einstein** is regarded as the greatest

24 KB (2,931 words) - 19:32, 2 August 2017

Satyendra Nath Bose (section Bose–Einstein statistics)

early 1920s, providing the foundation for Bose–**Einstein** statistics and the theory of the Bose–**Einstein** condensate. A Fellow of the Royal Society, he was

28 KB (2,810 words) - 18:14, 16 August 2017

Baby Einstein

they named Baby **Einstein** and later sold as Language Nursery. The original video shows a variety of toys and visuals interspersed with **music**, stories, numbers

19 KB (2,120 words) - 14:00, 24 August 2017

Albert Einstein in popular culture

Albert Einstein has been the subject of or inspiration for many works of popular culture.

On **Einstein's** 72nd birthday on March 14, 1951, United Press photographer

23 KB (2,349 words) - 23:41, 23 August 2017



Three types of results

- Results from the **original query**



- Results from the **diversity query**



- Results from the **serendipity query**



Note: all result lists are filtered for (near) duplicates



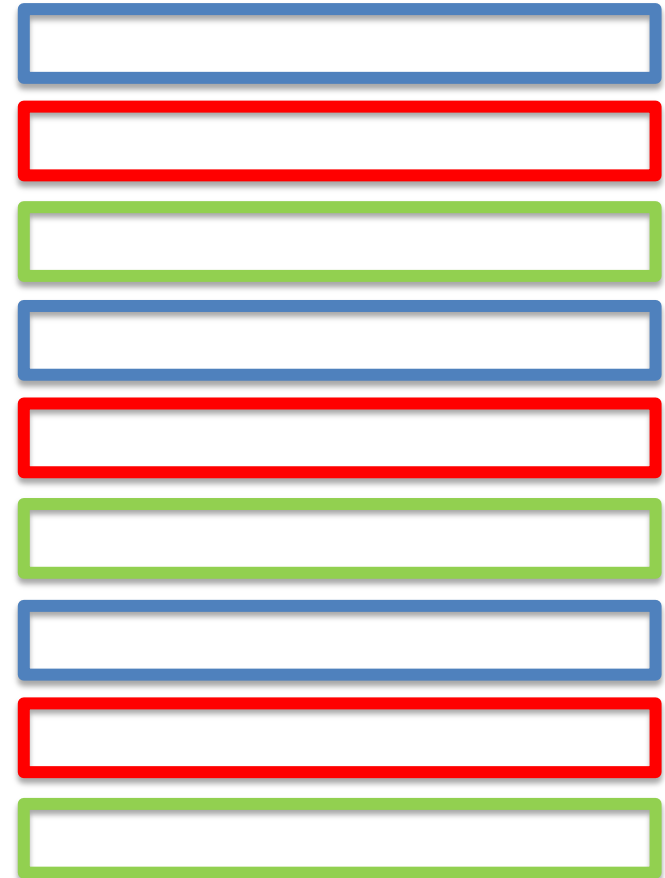
5 types of result aggregation

- **Baseline**
- Interleaved
- Three blocks
- Two blocks (diversity)
- Two blocks (serendipity)



5 types of result aggregation

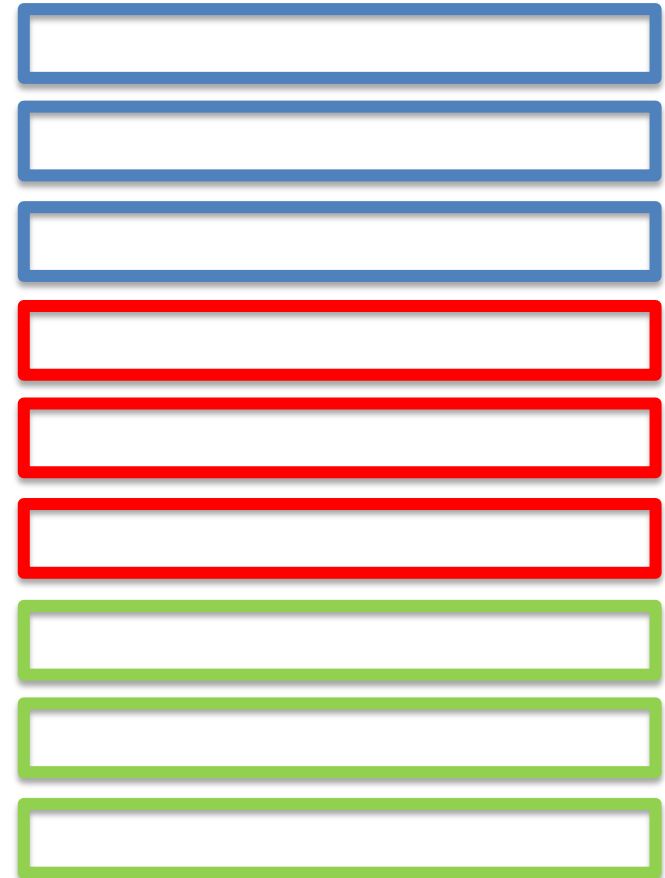
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5 types of result aggregation

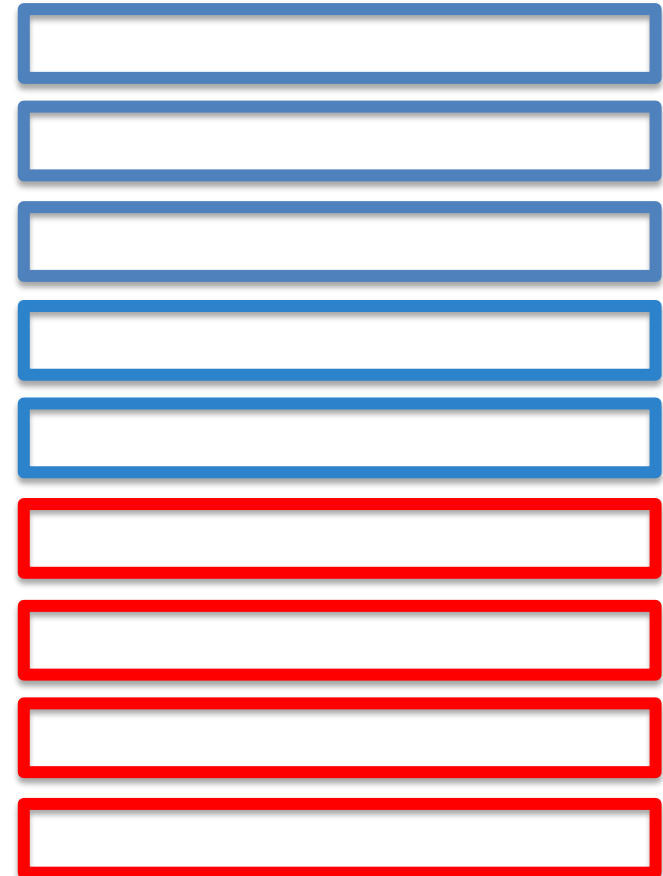
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5 types of result aggregation

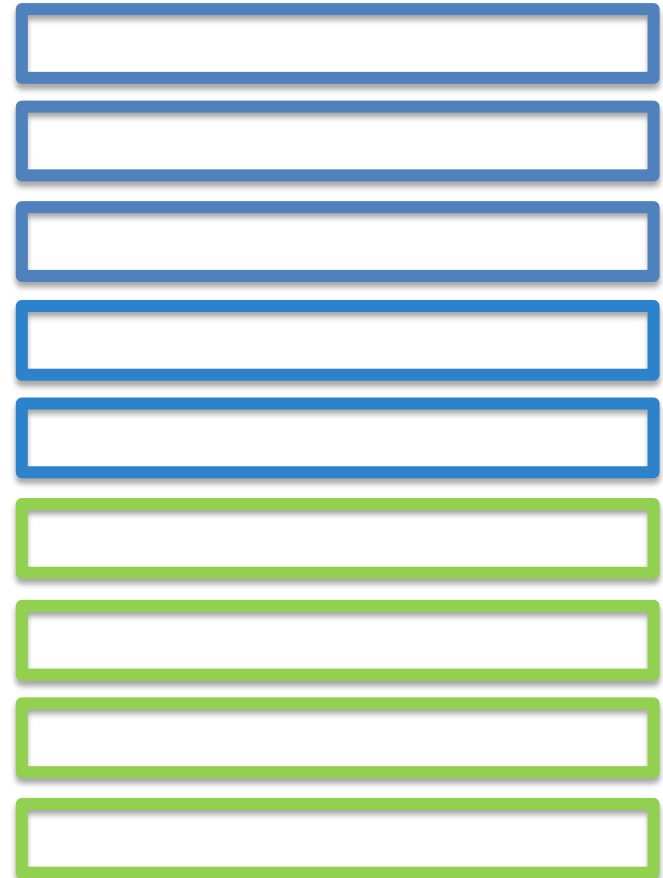
- Baseline
- Interleaved
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- Two blocks (serendipity)





5 types of result aggregation

- Baseline
- Interleaved
- Three blocks
- Two blocks (diversity)
- **Two blocks (serendipity)**



EVALUATION





How to measure?


- “Cranfield paradigm” does not appear to be applicable
 - E.g. MAP, NDCG
 - ... only focus on relevancy
- Measures to estimate the diversity exist
 - E.g. NDCG-IA, α -NDCG
- ...still, not clear how to create the ground truth

E. M. Voorhees, “The philosophy of information retrieval evaluation,” in *Evaluation of cross-language Information Retrieval Systems*. Springer, 2002, pp. 355–370.

R. Agrawal, S. Gollapudi, A. Halverson, and S. Jeong, “Diversifying search results,” in *Proceedings of the Second ACM International Conference on Web Search and Data Mining*. ACM, 2009, pp. 5–14.



Crowd Sourcing

- Platform:  CrowdFlower
- Human workers were given tasks to assess
 - Over 300 workers
 - Over 1500 judgments
- Queries generated out of a query log
 - Total of 52 queries (from the cultural heritage domain)
- Evaluation corpus: Wikipedia

C. Seifert, J. Schlötterer, and M. Granitzer, "Towards a feature-rich data set for personalized access to long-tail content," in Proceedings of the 30th Annual ACM Symposium on Applied Computing. ACM, 2015, pp. 1031–1038.



EVALUATION

Have a look at the query and the description

Search Query:
march to Versailles

Google the Keyword

Query Description:

The Women's March on Versailles was one of the earliest and most significant events of the French Revolution.

- Tasks consisted of comparing two result lists
 - Vote for the preferred result list
 - Background given for each query
 - Plus a Web search link
 - Each task conducted at least by 6 workers
 - Left/right swapped
 - Static result lists (canned results)
 - Methods to detected “cheaters”

Left Search Results

Palace of Versailles - 4b57r4c7
For the city of Versailles see Versailles (city). For other uses see Versailles (disambiguation) The Palace of Versailles (or ; or simply Versailles is a royal château in Versailles in the Île-de-France region of France. In French it is known as the Château de Versailles . When the château was built Versailles was a country village; today however it is a wealthy suburb of Paris some

Remilitarization of the Rhineland - 4b57r4c7
The remilitarization of the Rhineland by the German Army took place on 7 March 1936 when German military forces entered the Rhineland . This was significant because it violated the terms of the Treaty of Versailles and the Locarno Treaties marking the first time since the end of World War I that German troops had been in this region. The remilitarization was hugely important as it changed the balance of power in Europe from France towards Germany and made it possible for Germany to pursue a pol..."

Hubert Gough - 4b57r4c7
General Sir Hubert de la Poer Gough GCB GCMG KCVO (12 August 1870 – 18 March 1963) was a senior officer in the British Army in the First World War . A favourite of the British Commander-in-Chief General Sir Douglas Haig he experienced a meteoric rise through the ranks during the war and commanded the British Fifth Army from 1916 to 1918 during the war. Early life Family background The Gough family (the name probably derives from the Welsh coch meaning red) were originally clerics and clerks..."

History of Germany - 4b57r4c7
The concept of Germany as a distinct region in central Europe can be traced to Roman commander Julius Caesar who referred to the unconquered area east of the Rhine as Germania thus distinguishing it from Gaul (France) which he had conquered. The victory of the Germanic tribes in the Battle of the Teutoburg Forest (9 AD) prevented

Right Search Results

Palace of Versailles - 4b57r4c7
For the city of Versailles see Versailles (city). For other uses see Versailles (disambiguation) The Palace of Versailles (or ; or simply Versailles is a royal château in Versailles in the Île-de-France region of France. In French it is known as the Château de Versailles . When the château was built Versailles was a country village; today however it is a wealthy suburb of Paris some

Treaty of Versailles - 4b57r4c7
The Treaty of Versailles (French: Traité de Versailles) was one of the peace treaties at the end of World War I. It ended the state of war between Germany and the Allied Powers . It was signed on 28 June 1919 exactly five years after the assassination of Archduke Franz Ferdinand . The other Central Powers on the German side of World

Women's March on Versailles - 4b57r4c7
The Women's March on Versailles also known as The October March The October Days or simply The March on Versailles was one of the earliest and most significant events of the French Revolution . The march began among women in the marketplaces of Paris who on the morning of 5 October 1789 were near rioting over the high price and scarcity of bread. Their demonstrations quickly became intertwined with the activities of revolutionaries who were seeking liberal political reforms and a constitutio..."

Versailles (band) - 4b57r4c7
Versailles (known as Versailles - Philharmonic Quintet - in the United States) was a Japanese visual kei metal band formed in 2007 by vocalist Kamijo and guitarist Hizaki . After recruiting bassist Jasmine You drummer Yuki and guitarist Teru they performed their first show on June 23. Their key characteristics are their Rococo -esque costumes dueling guitars and heavy but melodic arrangements. The group gained a significant worldwide following soon after forming as their debut EP Lyrical Sympath..."

Select which list fitted the users query better

Left Result List

Right Result List

How confident are you with your decision:

Very confident

confident

Hard to decide



Evaluation scenarios

- Scenario #1
 - Baseline vs. interleaved | blocked
- Scenario #2
 - Baseline vs. two blocks (diversity | serendipity)
- Scenario #3
 - Interleaved vs. blocked

Measures

- Agreement on task level
- Ratio of “wins”



EVALUATION

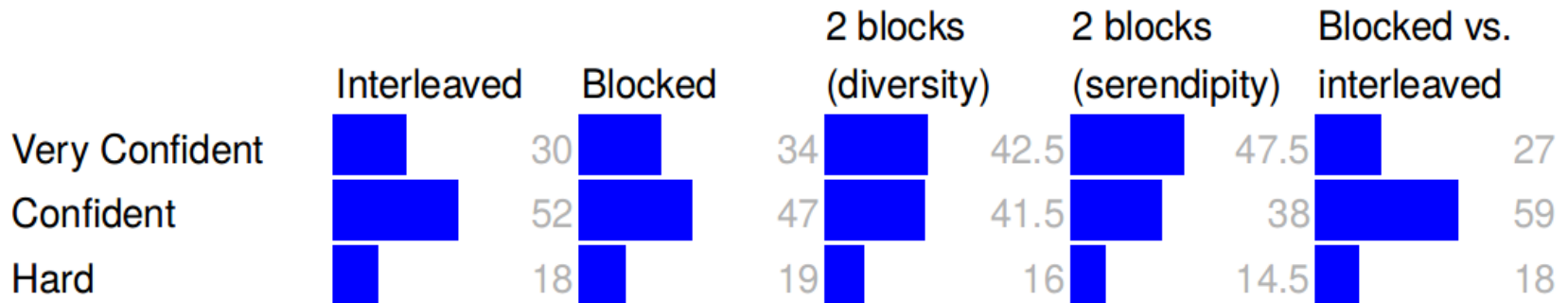
Scenario #1	Agreement	Wins
Interleaved	69%	64%
Blocked	72%	64%

Scenario #2	Agreement	Wins
2 blocks (diversity)	77%	69%
2 blocks (serendipity)	75%	69%

Scenario #3	Agreement	Wins
Blocked vs. interleaved	65%	47%



How confident were the workers?





Insights

- Each configuration better than the baseline
- Diversity and serendipity similar
 - Depends on the query, which is preferred
- Two blocks preferred over three blocks
- Need to take the background of the user into account
 - Web search were often used



CONCLUSIONS

- Either use diversity or serendipity
 - ... depending on the query
 - ... and (potentially) the user

- More research on serendipity is needed
 - ... especially improved evaluation scenarios

- Results & data set available on Github
 - <https://git.io/vQTLT>

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gefördert durch das Programm COMET (Competence Centers for Excellent Technologies), wir danken unseren Fördergebern:

