What Happens when Laypersons Search Scientific Articles?

Jaap Kamps
University of Amsterdam

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Motivation

Misinfo /Disinfo / Fake News

- Everyone agrees on the importance of **objective** and **reliable** information
- Citizens avoid scientific information as they assume it is **too complex**
- Can we better understand **barriers to access**? even remove them?

What Happens When Laypersons Search Scientific Articles?

- Analysis of **Corpus** and **Popular Science**
  - *How Complex is Science?*
  - *Do Search Engines Use Complexity?*
- **Search** Experiments
  - *Can we Avoid Complexity?*
- **Text Simplification** Experiments
  - *Can we Simplify Scientific Text?*

How Complex is Science?

Analysis #1

Scientific Text Complexity

Grade Level	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
School	*Elementary*						*Jr. High*			*High School*			*Undergrad.*				*Grad.*	*PhD*		
	Primary						*Secondary*						*University*					*PhD*		
	Compulsory												*Higher Edu.*							
Age	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

- Analyze Scientific abstracts, Popular science News articles, and Top 100 results
  - Using standard readability level measures (Flesch-Kincaid Grade Levels)
  - Target level is ~ 12 (high school diploma, exit compulsory education)

Corpus, Context, and Requests

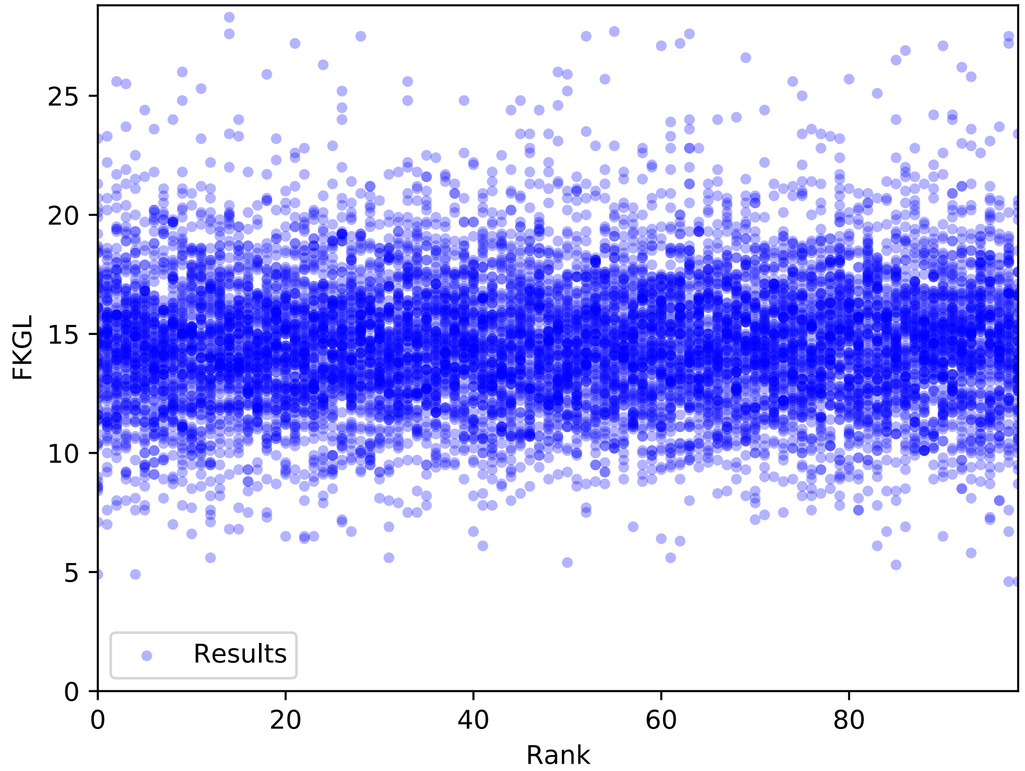
Data	Sample Size	Length		FKGL	
		Mean	Median	Mean	Median
Corpus (scientific abstracts)	8,513	951	905	14.55	14.40
News (popular science)	40	5,504	5,540	12.53	12.70
Retrieved results (top 100)	11,400	948	928	13.79	14.40

- Corpus is too complex, corresponding to university level education
- Popular science news is indeed the target level of 12!
- In response to a general query, the top 100 is as complex as the corpus...

Do Search Engines Use Complexity?

Analysis #2

Text Complexity per Rank of Retrieval



- There is no correlation between rank of retrieval and readability level!

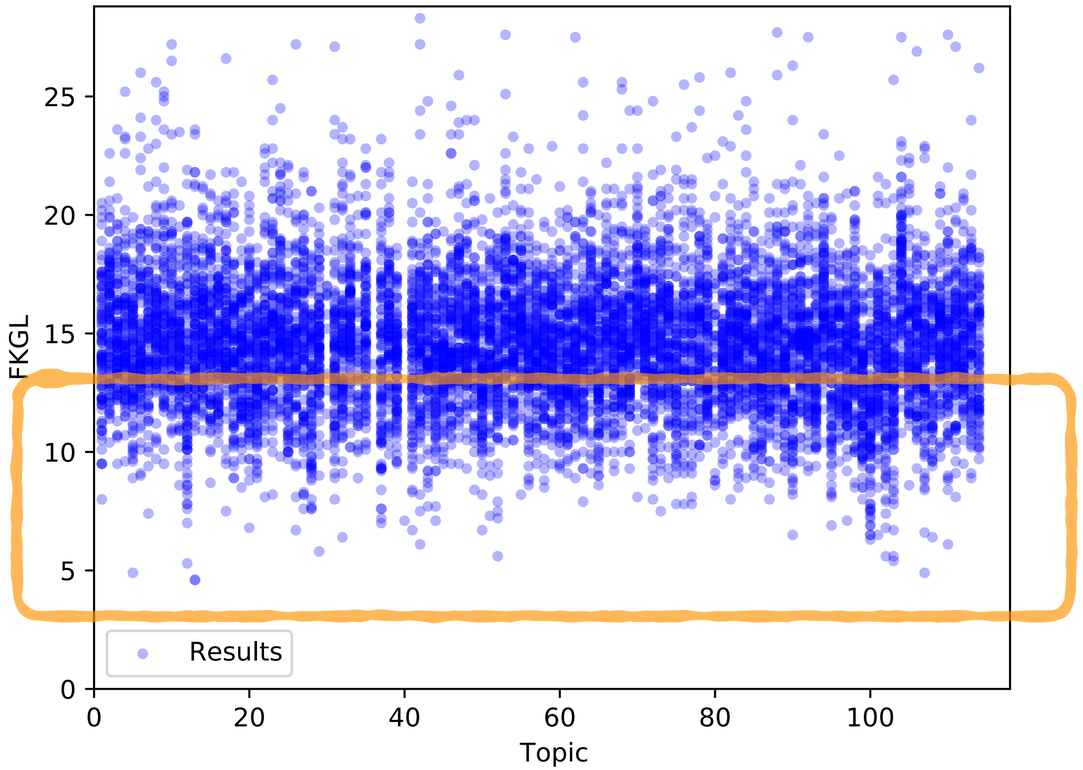
#1 Scientific texts are too complex
#2 Ranking ignores text complexity

Negative findings explaining why laypersons avoid science...

Can we Avoid Complexity?

Strategy #1

Complexity Variation per Topic



- For every request there are abstracts with the desirable readability level!

Relevant+Simple: Complexity-Aware Ranking!

Run	Top.	NDCG			FKGL	
		5	10	20	Mean	Median
Elastic	72	0.4053	0.4334	0.4438	13.79	14.40
Automatic	72	0.3531	0.3776	0.4073	11.70	12.80

- Per topic, we only keep the easier 1/2 of the abstracts retrieved by Elastic
  - Small loss of precision (-13% NCDG@10)
    - Positive? avoids too complex (but judged relevant) abstracts!
  - **Relevant+Simple** leads to desired readability level of 12!

#3 Per topic also readable abstracts
#4 We can filter on readability levels

We can avoid abstracts with high text complexity!

Can we Simplify Scientific Text?

Strategy #2

Zero-shot Text Simplification

Model	Task	Evaluated	SARI	Bleu	Precision			
					1-gram	2-gram	3-gram	4-gram
No change	Train	648	0.5571	0.4204	0.6010	0.4531	0.3712	0.3089
KiS Model	Train	648	0.3984	0.2809	0.4881	0.3176	0.2319	0.1733

- Off-the-shelf Text Simplification model:
  - "Keep it Simple" (ACL/IJCNLP'21)
  - Used zero-shot, but can be trained *unsupervised* for scientific text
- Evaluation against human simplifications (train corpus)
  - BLEU 28% and SARI 40% (cmp. SARI on Wikipedia ~ 26-43%)

Text Simplification: Readability Level

Run	Task	Sentences	FKGL			Compression	
			Mean	Median	Ratio	Mean	Median
No change	Train	648	15.46	15.4	0.00	1.00	1.00
KiS Model	Train	648	12.78	12.7	0.81	1.15	0.99
No change	Test	116,763	14.85	14.7	0.00	1.00	1.00
KiS Model	Test	116,763	12.06	11.9	0.79	1.33	1.01

- Evaluation must consider how much rewriting
  - No change has 15 FKGL (!)
  - Rewriting improves readability levels for 80% of the sentences
  - **Zero-shot model** leads to desired readability level of 12!

Text Simplification: Examples

1 Results

1.1 G01.1

2463945949 DIANE is a digital assistant system that aims to fasten allows the doctor a faster access to various informations at the patient and hospital such as health care facility , medical records , and also human resource data information . The fasten access This could be achieved by implementing done with face recognition and live streaming as part of the digital assistant system .

2797641221 Digital assistants are emerging to become more prevalent becoming popular in our daily lives . In interacting with these assistants , It will allow users may engage in to do multiple tasks within in a short period of time faster way .

1.2 G01.2

1448624402 As extensive experimental research has shown individuals Research showed that people suffer from diverse biases (disproportionate weight in favor of or against an idea) in decision-making . In our paper we analyze We analyzed the effects of decision-making biases of managers in collaborative decision processes on organizational performance . In the simulations , managerial managers decisions which are based on different levels of organizational complexity skills and different incentive systems rules , suffer from several known biases known from descriptive decision theory . The results illustrate how combined biases in combination with each other and in different organizational contexts affect organizational performance . We find that , contrary Contrary to intuition expectations , some combinations of biases significantly improve organizational performance while these biases negatively affect organizational performance . However , when they occur separately , they decrease performance . This might evoke considerations whether raises questions about the importance of rationality in decision-making should be as rational as possible .

1.3 G02.2

2134216589 Big data , (the enhanced ability to collect , store and analyze previously unimaginable huge quantities of data

#5 Text simplification reduces complexity

We can reduce text complexity of scientific text!

What Happens When Laypersons Search Scientific Articles?

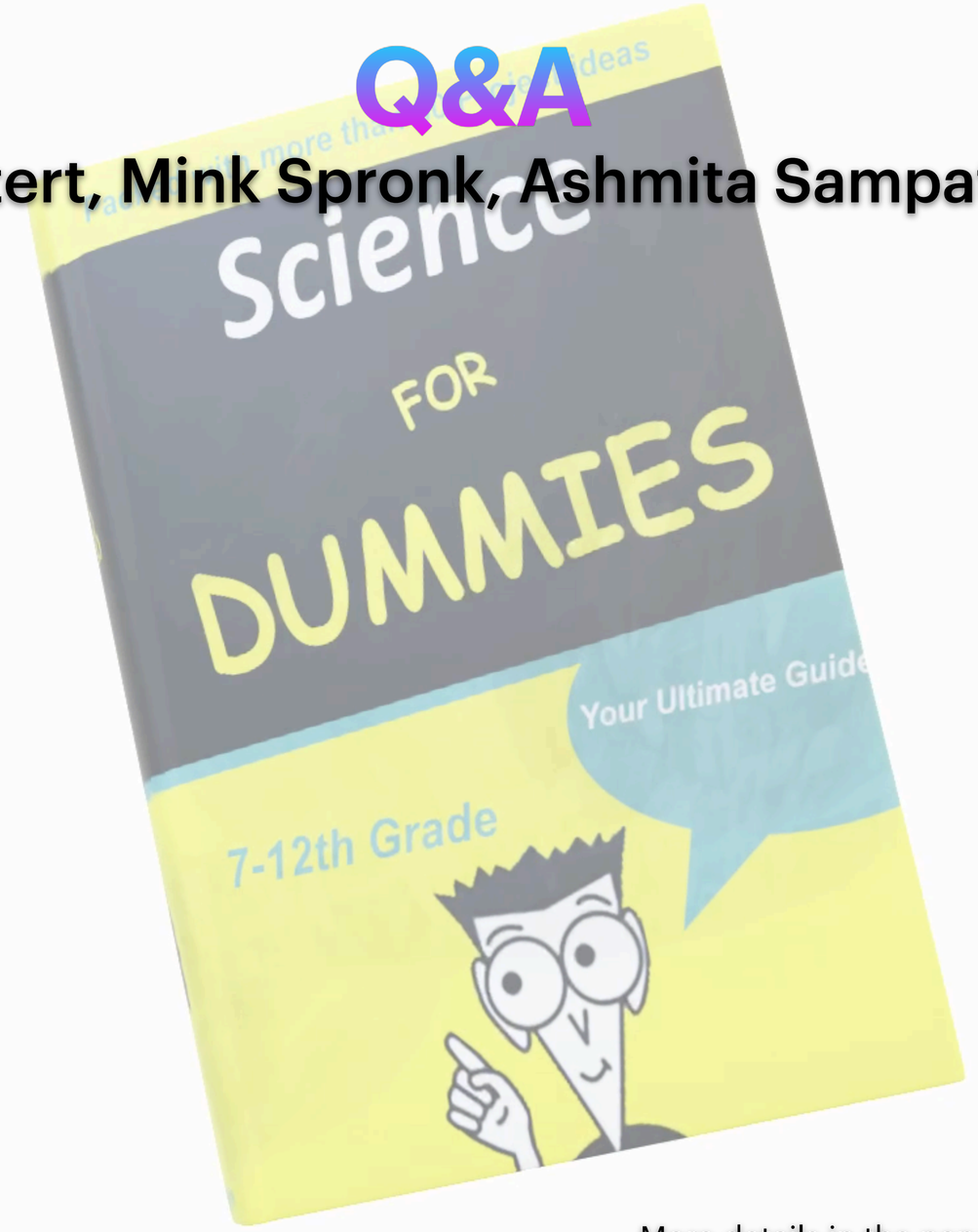
#1 Scientific texts are too complex (FKGL 14-15)
#2 Ranking ignores text complexity

#3 Per topic also readable abstracts
#4 We can filter on readability levels (FKGL ~ 12)

#5 Text simplification reduces complexity (FKGL ~12)

Q&A

Thanks to Femke Mostert, Mink Spronk, Ashmita Sampatsing, and David Rau!



More details in the paper http://ceur-ws.org/Vol-3180/paper-242.pdf