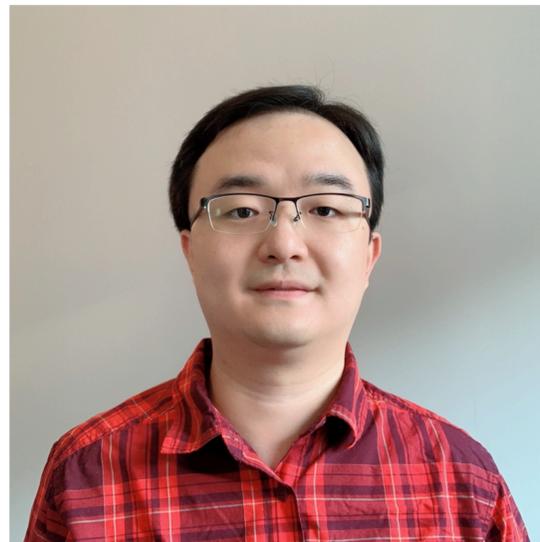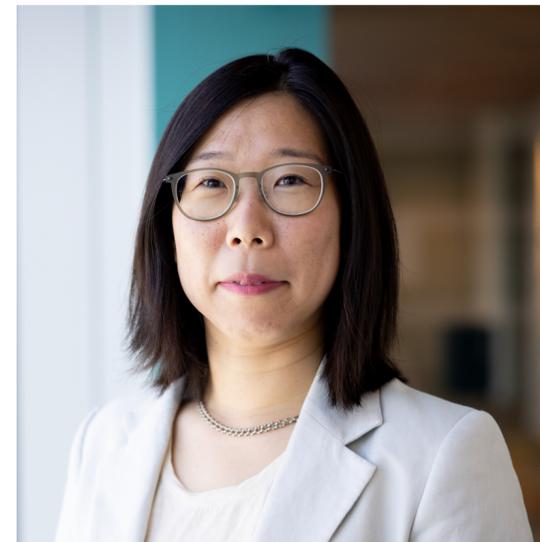# MedReadMe: A Systematic Study for Fine-grained Sentence Readability in Medical Domain

Chao Jiang

Wei Xu

Georgia Tech

An oro-antral communication (OAC) is an unnatural opening between the oral cavity and maxillary sinus. When it fails to close spontaneously, it remains patent and is epithelialized to develop into an oro-antral fistula. These complications occur most commonly during extraction of upper molar and premolar teeth (48%).

— An snippet discussing oral and dental health

Review language : English Website language : English Sign In

Title Abstract Keyword ▼

Browse   Advanced search

Cochrane Reviews ▼   Searching for trials ▼   Clinical Answers ▼   About ▼   Help ▼   About Cochrane ▶

Cochrane Database of Systematic Reviews | Review - Intervention   New search

Interventions for treating oro-antral communications and fistulae due to dental procedures

✉ Salian Kiran Kumar Krishanappa, Prashanti Eachempati, Sumanth Kumbargere Nagraj, Naresh Yedthare Shetty, Soe Moe, Himanshi Aggarwal, Rebecca J Mathew   Authors' declarations of interest

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Am score 31   Cited in 1 guideline

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Contents

Abstract

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Background

An oro-antral communication is an unnatural opening between the oral cavity and maxillary sinus. When it fails to close spontaneously, it remains patent and is epithelialized to develop into an oro-antral fistula. Various surgical and non-surgical techniques have been used for treating the condition. Surgical procedures include flaps, grafts and other techniques like re-implantation of third molars. Non-surgical techniques include allogenic materials and xenografts. This is an update of a review first published in May 2016.

An oro-antral communication (OAC) is an unnatural opening between the oral cavity and maxillary sinus. When it fails to close spontaneously, it remains patent and is epithelialized to develop into an oro-antral fistula. These complications occur most commonly during extraction of upper molar and premolar teeth (48%).

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New search

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— An snippet discussing oral and dental health

Accurately measuring the readability of medical texts is the first step toward making them more accessible.

The Gap in Medical Readability Research

The Gap in Medical Readability Research

1. Past work mainly focuses on general domains (Wikipedia, news, books).

Datasets	Data Sources	Medical Domain?
MTDE (De Clercq and Hoste, 2016)	Wikipedia, BNC, Dutch Parallel Corpus, SoNaR	N/A
S1131 (Štajner et al., 2017)	Wikipedia, Newsela	N/A
CompDS (Brunato et al., 2018)	Italian UD TreeBank, WSJ from Penn Treebank	N/A
CEFR-SP (Arase et al., 2022)	Wikipedia, Newsela	N/A
ReadME++ (Naous et al., 2023)	112 sources in 5 languages	80 sentences

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2. Existing sentence-level readability metrics work poorly in medical domain.

   - Traditional metrics: FKGL, ARI, SMOG
   - LM-based metrics: RSRS (Martinc et al. 2021)
   - $0.4 - 0.65$ Pearson correlation with human judgements.

We Introduce MedReadMe

We Introduce MedReadMe

1. A new **Med**ical **Read**ability **Mea**surement dataset.

   • In-house human ratings for 4,520 sentences.

   • Fine-grained complex span annotations.

   • Covered 15 complex-simple parallel medical resources.

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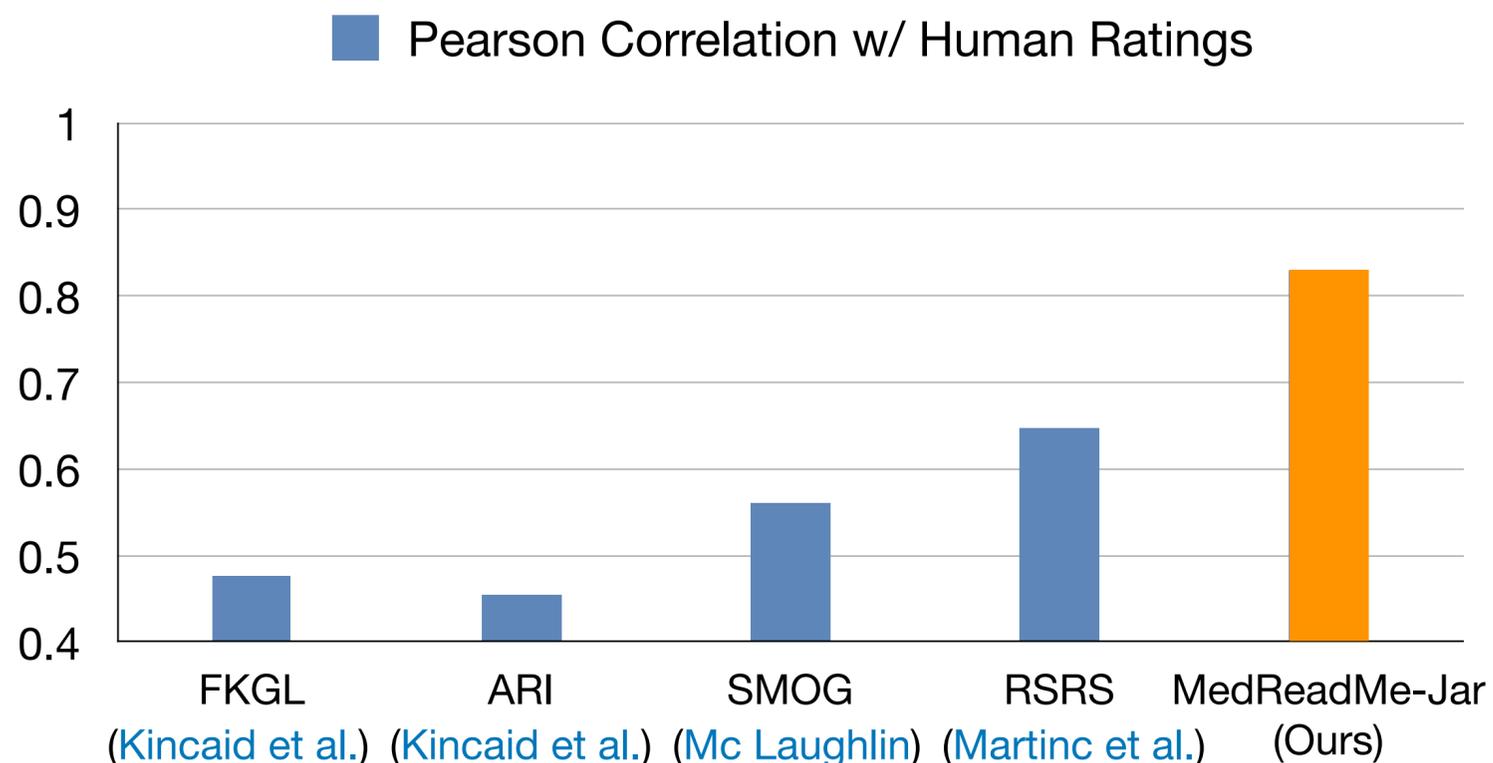   - Covered 15 complex-simple parallel medical resources.

2. State-of-the-art sentence readability metrics in medical domain.

MedReadMe-Jar = a RoBERTa-large model trained on MedReadMe + $\alpha \times$ # Jargon

Our Dataset Covers 15 Medical Resources

Widely used datasets in medical text simplification

- Online reference: medical Wiki, Merek Manual

- Systematic review: Cochrane

- Research papers from venues like PNAS, NIHR, PLOS, covering 12 sub-fields

Our Dataset Covers 15 Medical Resources

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4,520 Sentences from parallel complex-simple article pairs

- Complex: abstract from original articles.

- Simple: editor-written popular science section.
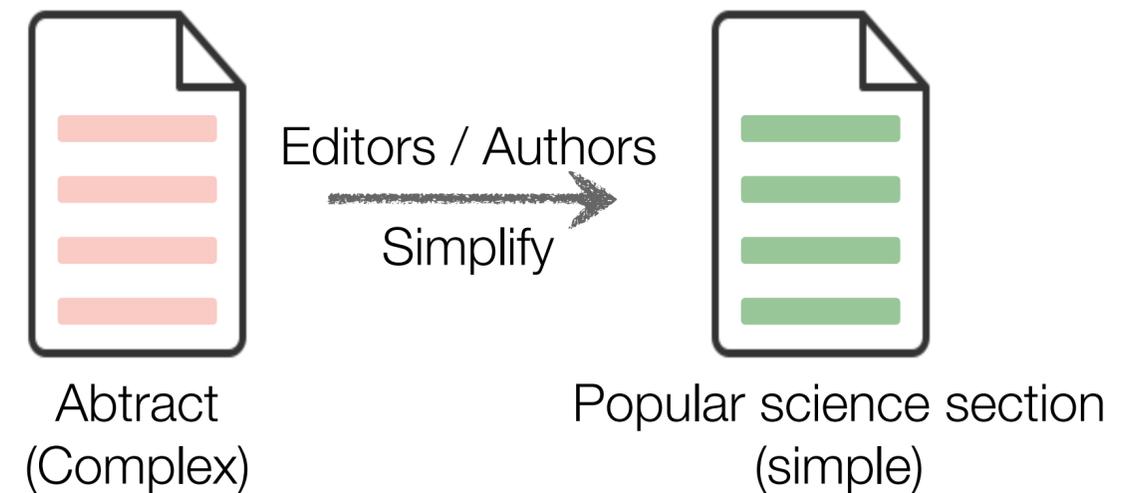
Editors / Authors

Simplify

Abtract
(Complex)

Popular science section
(simple)

Readability Ratings are Annotated Using "Rate-and-Rank"

Rank and Rate Sentences on Readability

Signed in as ▨▨▨▨
Sign out

Batch ID: ▨▨

Submit and Continue

| 3 | Jean Valjean remained silent, motionless, with his back towards the door, seated on the chair from which he had not stirred, and holding his breath in the dark. |

| 3 |
| 3- |
| 3+ |

| These bead-like structures are called nucleosomes, and interactions between histones in different nucleosomes can link one nucleosome to another, to package the DNA into a very condensed form. |

| + Context | In a sketch or outline drawing, lines drawn often follow the contour of the subject, creating depth by looking like shadows cast from a light in the artist's position. |

| + Context | The long-term functional outcomes of early administration of RDI of amino acids and the use of SMOFlipid, including neurodevelopment, body composition and metabolic health, should be evaluated. |

| + Context | All these initiatives take hold as they do, from lead pipes being removed from schools and homes, to new factories being built in communities with a resurgence of American manufacturing. |

| + Context | The illumination of the subject is also a key element in creating an artistic piece, and the interplay of light and shadow is a valuable method in the artist's toolbox. |

Step 1: Drag each box to rank sentences.

Step 2: Rate each one from 1-6 based on CEFR scale (Arase et al. 2022, Brunato et al. 2018, etc.).

Readability Ratings are Annotated Using "Rate-and-Rank"

Rank and Rate Sentences on Readability

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Readability Ratings are Annotated Using "Rate-and-Rank"

Rank and Rate Sentences on Readability

Batch ID: ▨▨ Submit and Continue

| 3 | Jean Valjean remained silent, motionless, with his back towards the door, seated on the chair from which he had not stirred, and holding his breath in the dark. |

| 3 / 3- / 3+ | These bead-like structures are called nucleosomes, and interactions between histones in different nucleosomes can link one nucleosome to another, to package the DNA into a very condensed form. |

We introduce the "+" and "-" to capture nuance in readability, e.g., 3+ and 3-.

| + Context | In a sketch or outline drawing, lines drawn often follow the contour of the subject, creating depth by looking like shadows cast from a light in the artist's position. |

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An oro-antral communication (OAC) is an unnatural opening between the oral cavity and maxillary sinus. When it fails to close spontaneously, it remains patent and is epithelialized to develop into an oro-antral fistula. These complications occur most commonly during extraction of upper molar and premolar teeth (48%).

— An snippet discussing oral and dental health

Fine-grained Complex Span Annotations

Medical - Google Hard

Medical - Google Easy

Abbreviations

General Complex Words

Multi-sense Terms

An oro-antral communication (OAC) is an unnatural opening between the oral cavity and maxillary sinus. When it fails to close spontaneously, it remains patent and is epithelialized to develop into an oro-antral fistula. These complications occur most commonly during extraction of upper molar and premolar teeth (48%).

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Fine-grained Complex Span Annotations

Medical - Google Hard

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Abbreviations

General Complex Words

Multi-sense Terms

All jargon and complex terms are NOT equally difficult.

Readability and Jargon in Medical Data Sources Vary Significantly

PNAS — Complex | Simple

Medical WikiPedia — Complex | Simple

NIHR Health Services and Delivery Research — Complex | Simple

NIHR Programme Grants for Applied Research — Complex | Simple

Readability (Boxplot)
☐ Rating

Jargon Category (Stacked Barplot)
- Multi-sense
- General
- Med-Easy
- Med-Hard
- Abbr-Med
- Abbr-Gen
- Med-Entity

Readability

Avg. num. of jargon per sent.
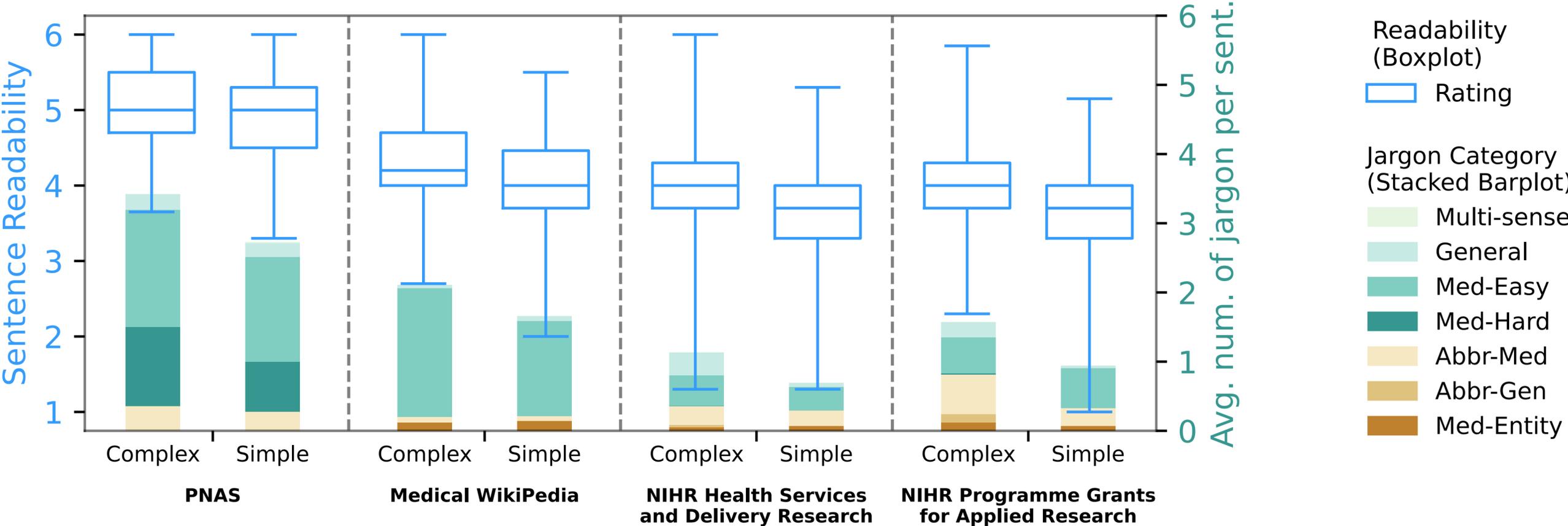
The simple texts from PNAS are harder than the complex side from medical Wikipedia.
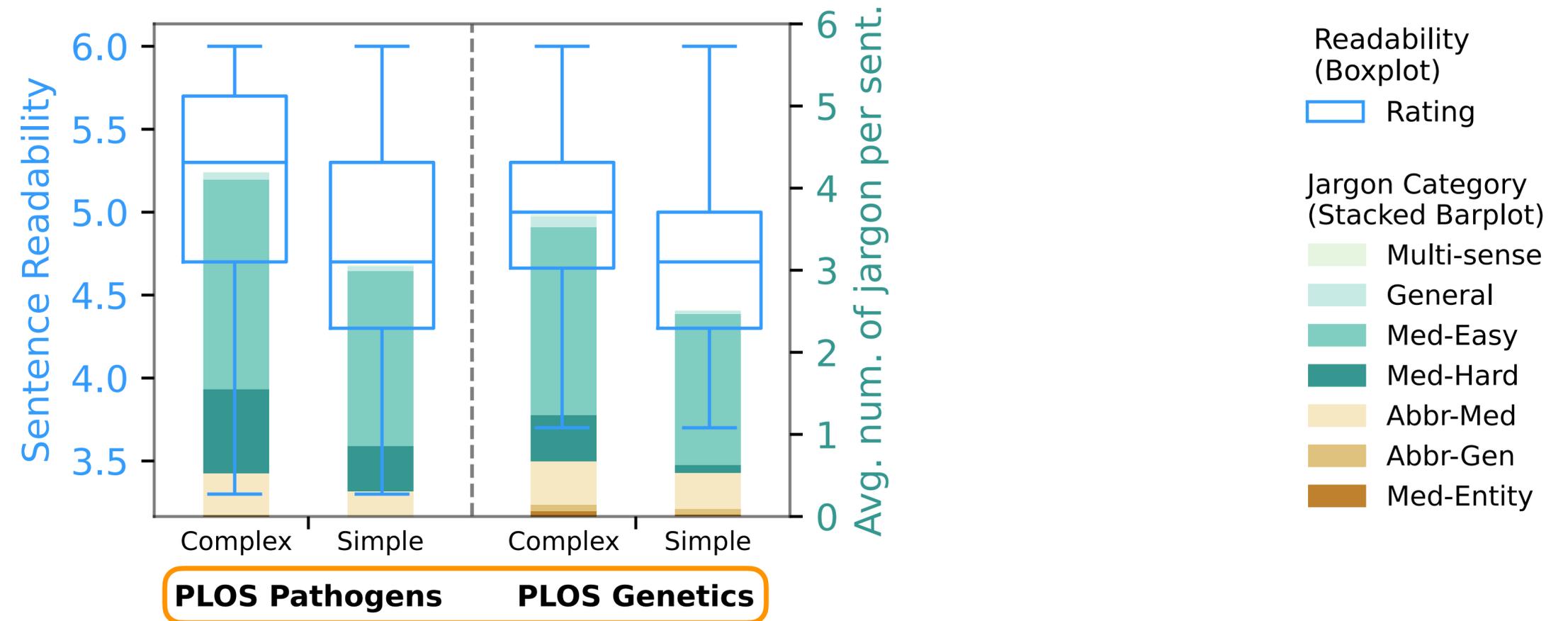
Lay readers may not interested in some domains.

Different BioMedical Data Sources Vary Significantly
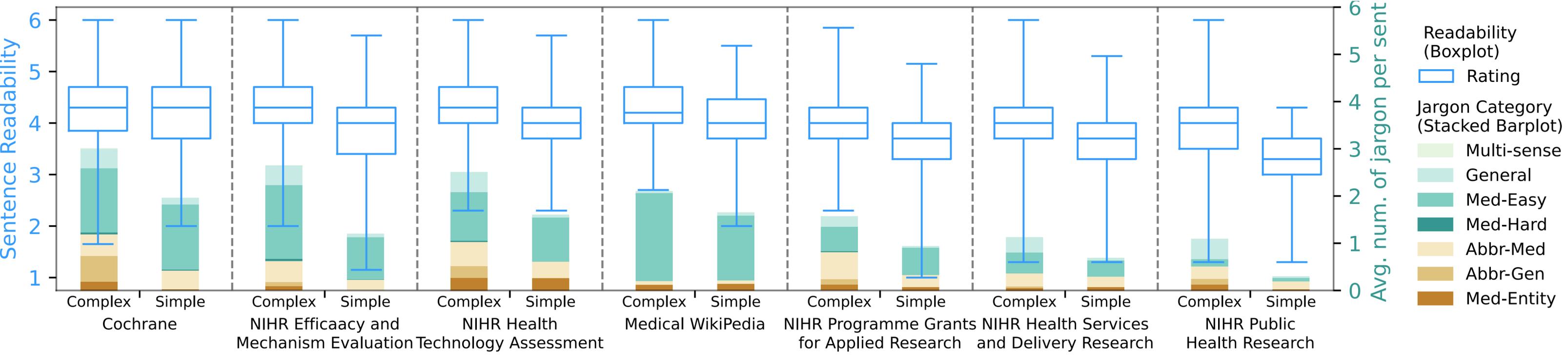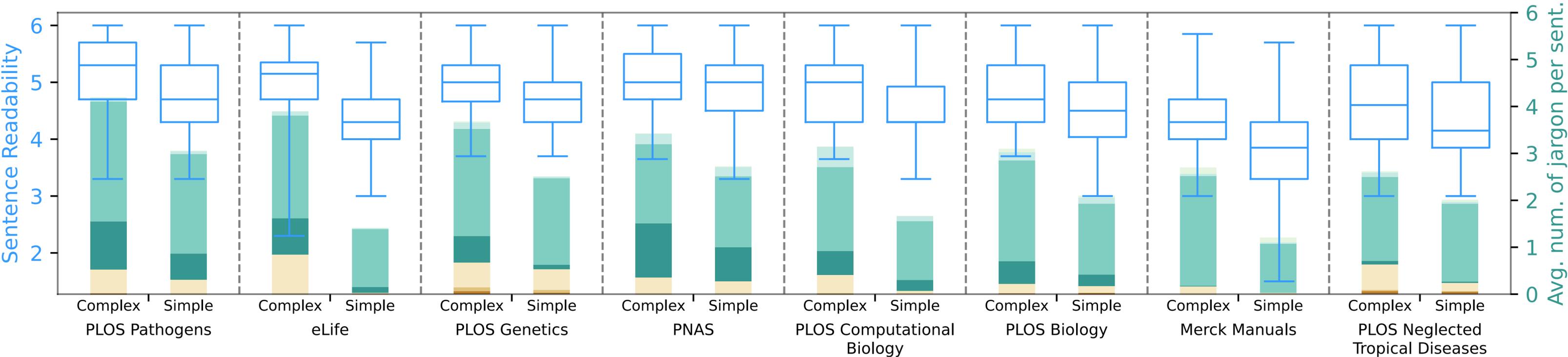
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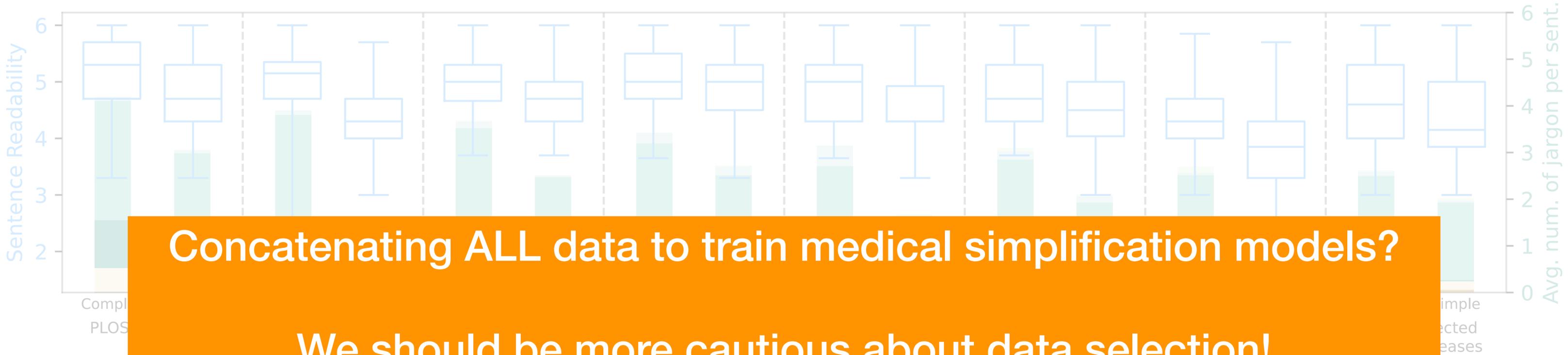
Concatenating ALL data to train medical simplification models?

We should be more cautious about data selection!

Medical Jargon in Certain Topics are More Challenging

Google-Easy

- Misc. — 16.5%
- Genetics / Cellular Biology — 13.5%
- Disease / Conditions — 16.0%
- Diagnostic / Research Tools — 9.0%
- Biology / Molecular Processes — 12.5%
- Anatomy / Physiology — 14.5%
- Treatment / Procedures — 12.0%
- Pharmacology / Chemicals — 6.0%

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Google-Hard

- Misc. — 7.5%
- Genetics / Cellular Biology — 45.4%
- Disease / Conditions — 2.0%
- Diagnostic / Research Tools — 2.0%
- Biology / Molecular Processes — 31.5%
- Anatomy / Physiology — 5.0%
- Treatment / Procedures — 2.5%
- Pharmacology / Chemicals — 4.0%

Legend:
- Misc.
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- Diagnostic / Research Tools
- Biology / Molecular Processes
- Anatomy / Physiology
- Treatment / Procedures
- Pharmacology / Chemicals

Medical Jargon in Certain Topics are More Challenging

Google-Easy

Google-Hard

Legend:
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- Pharmacology / Chemicals
- Disease / Conditions
- Anatomy / Physiology

Google-Easy values: 16.5%, 13.5%, 16.0%, 9.0%, 12.5%, 14.5%, 12.0%, 6.0%

Google-Hard values: 45.4%, 31.5%, 5.0%, 2.5%, 4.0%, 7.5%, 2.0%, 2.0%

Visual Aids Ease the Understanding of Jargon

National Institute on Aging (.gov)
https://www.nia.nih.gov › alzheimers-and-dementia › wh...

People also ask

dementia

What is the life expectancy of a person with dementia?

What is the behavior of a person with dementia?

All   Images   News   Videos   Shopping   Forums   Web   More   Tools

What is the first stage of dementia?

Dementia is the loss of cognitive functioning — thinking, remembering, and reasoning — to such an extent that it interferes with a person's daily life and activities. Some people with dementia cannot control their emotions, and their personalities may change. Dec 8, 2022

What is the best thing to help dementia?

Things to know

National Institute on Aging (.gov)
https://www.nia.nih.gov › alzheimers-and-dementia › wh...

Warning signs

What Is Dementia? Symptoms, Types, and Diagnosis

What are the 10 warning signs of dementia

About featured snippets   •   Feedback

Main cause

What is the main cause of dementia?

People also ask

Stages

What is the life expectancy of a person with dementia?
What are the stages of dementia

What is the behavior of a person with dementia?

Most common age

What age is dementia most common
What is the first stage of dementia?

6 more

What is the best thing to help dementia?

Feedback

Alzheimer's Association
https://www.alz.org › alzheimers-dementia › what-is-dem...

What is Dementia? Symptoms, Causes & Treatment

Dementia is a general term for loss of memory, language, problem-solving and other thinking abilities that are severe enough to interfere with daily life.

Types of Dementia · Alzheimer's disease · Vascular Dementia · Mixed Dementia

Mayo Clinic
https://www.mayoclinic.org › dementia › syc-20352013
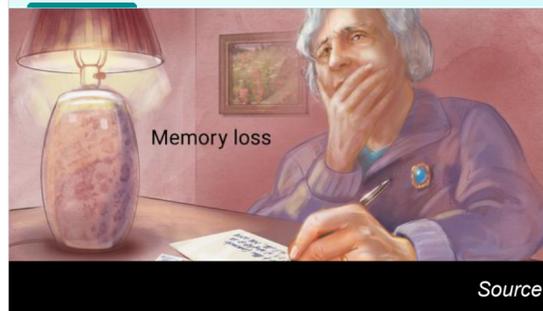
Dementia - Symptoms and causes

Causes. Dementia is caused by damage to or loss of nerve cells and their connections in the brain. The symptoms depend on the area of the brain that's damaged.

Dementia

OVERVIEW   SYMPTOMS   TREATMENTS   SPECIALISTS

Memory loss

TYPES OF DEMENTIA

Dementia is an umbrella term for loss of memory and other thinking abilities severe enough to interfere with daily life.

health

Dementia

OVERVIEW   SYMPTOMS   TREATMENTS   SPEC

Very common
More than 3 million US cases per year

Memory loss
Treatment can help, but this condition can't be cured

Chronic: can last for years or be lifelong

Requires a medical diagnosis

Lab tests or imaging often required

Source

A group of thinking and social symptoms that interferes with daily functioning.

Not a specific disease, dementia is a group of conditions characterized by impairment of at least two brain functions, such as memory loss and judgment.

Psychosis
A mental disorder characterized by a disconnection from reality.

Anxiety disorder
A mental health disorder characterized by feelings of worry, anxiety, or fear that are strong enough to interfere with one's daily activities

More than 3 million US cases per year

Visual Aids Ease the Understanding of Jargon

	Google-Easy	Google-Hard
Feature Snippets	55.3%	21.2%
Knowledge Panel	45.6%	10.3%

How Professional Editors Handle Medical Jargon?

	Google-Easy	Google-Hard	Δ
Copy	22%	13%	↓7%
Copy + Explain	8%	8%	→
Delete	56%	52%	↓4%
Delete + Explain	11%	17%	↑6%
Rephrased using simpler alternatives	3%	10%	↑7%

*Based on manual analysis of 200 medical jargon (100 in each type).

How Professional Editors Handle Medical Jargon?

	Google-Easy	Google-Hard	Δ
Copy	22%	13%	↓7%
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Google-Hard medical jargon are explained and rephrased in manual simplification.

*Based on manual analysis of 200 medical jargon (100 in each type).

Complex Spans Significantly Impact Medical Sentence Readability

- Various complex spans-based features.

- 650 linguistic features extracted using 5 toolkits.

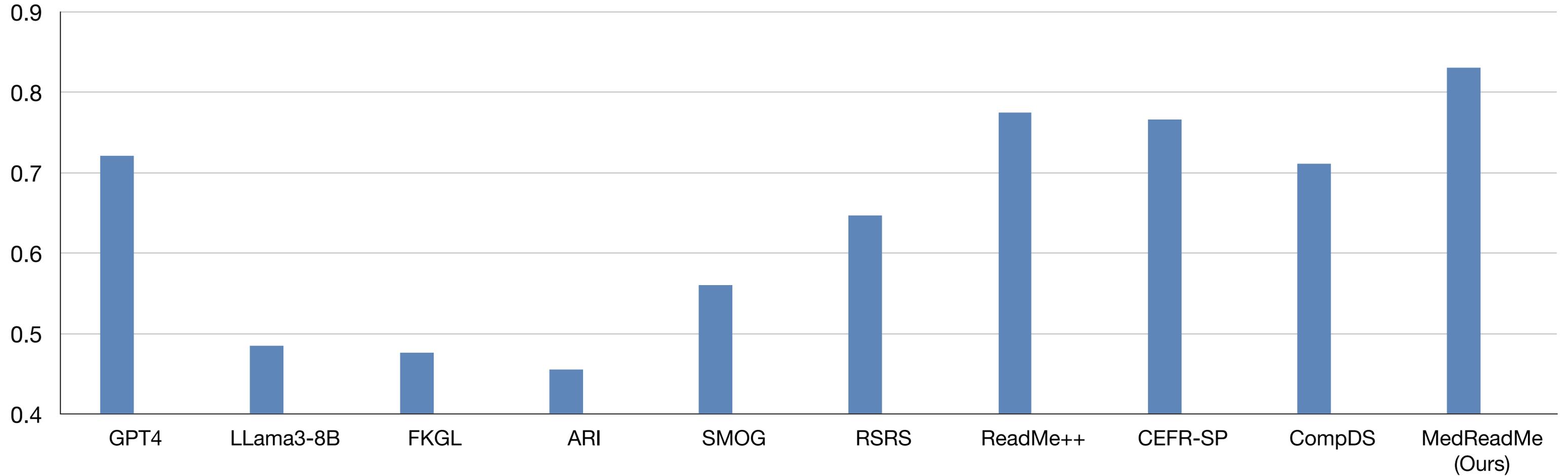# Complex Spans Significantly Impact Medical Sentence Readability

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Benchmark and Improve Medical Readability Metrics
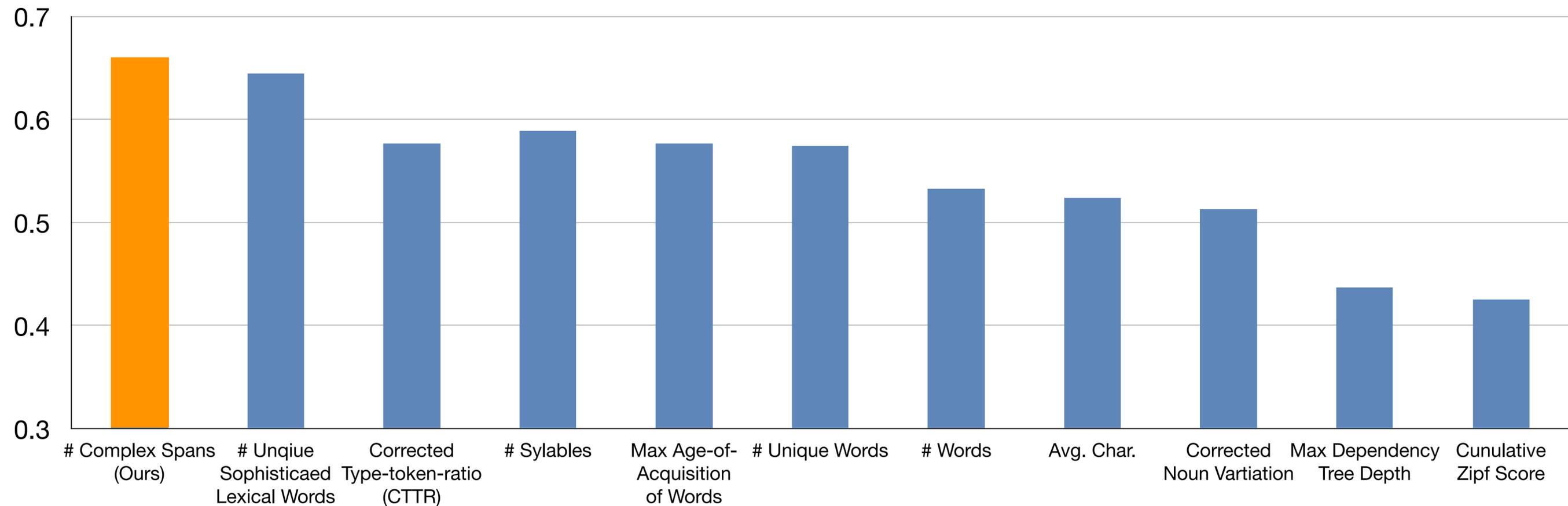
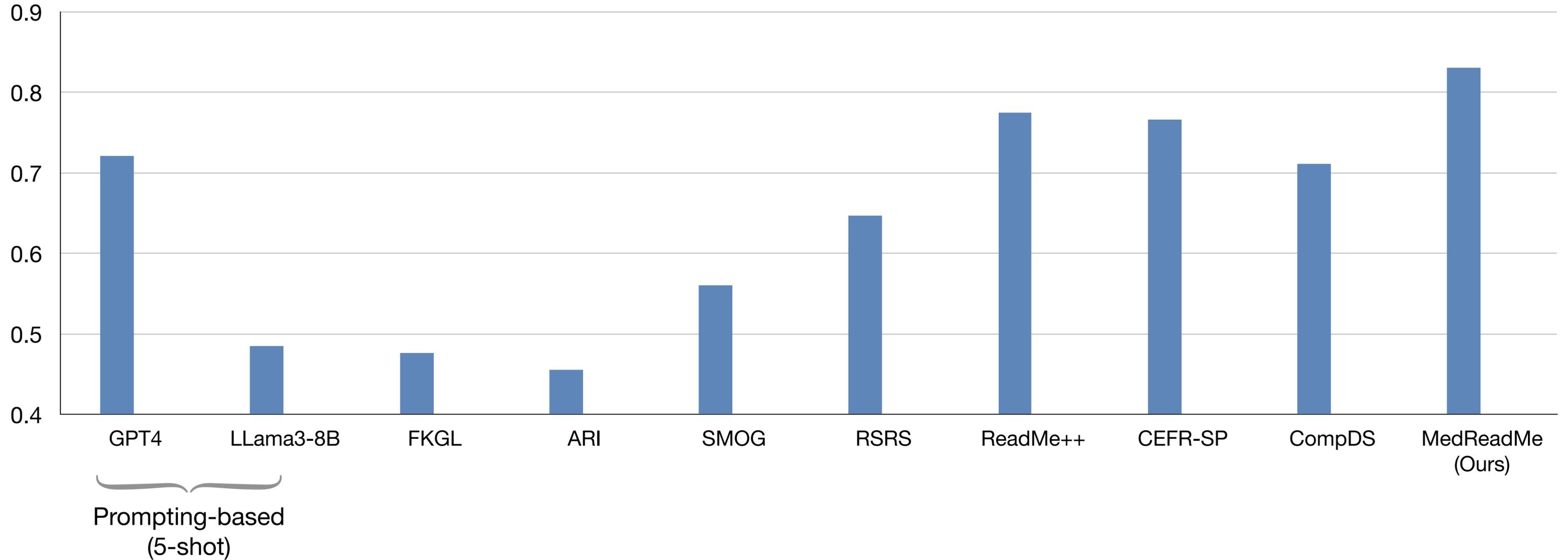# Benchmark and Improve Medical Readability Metrics
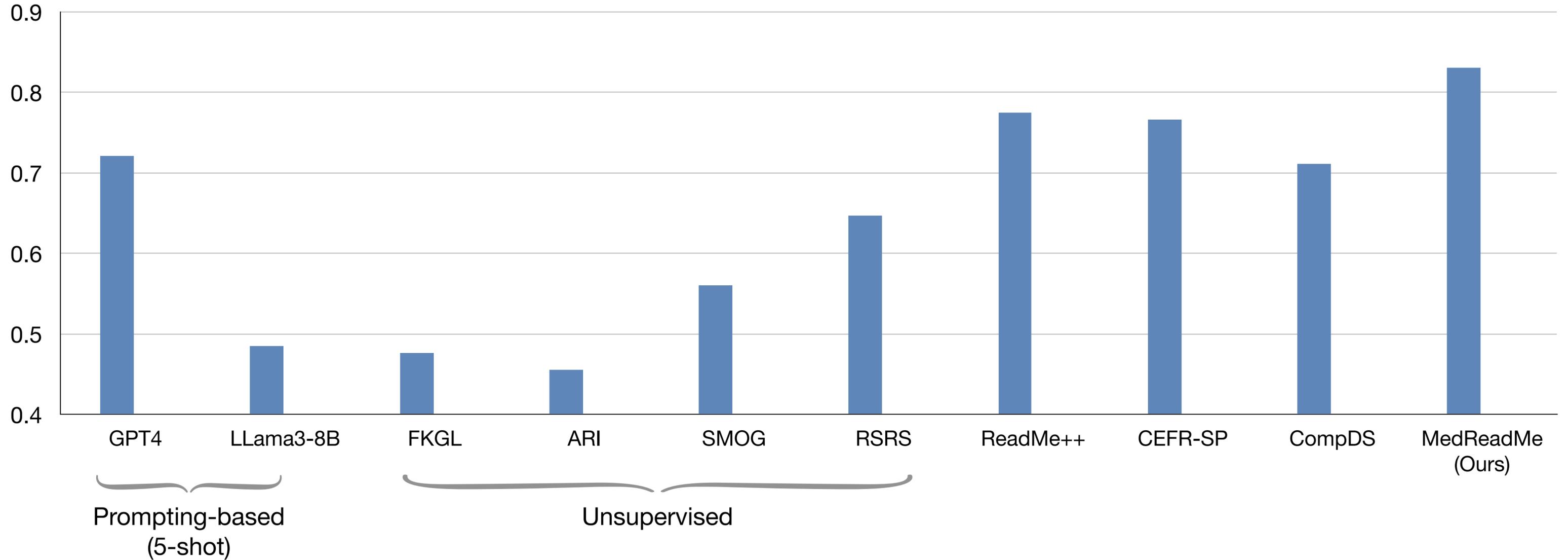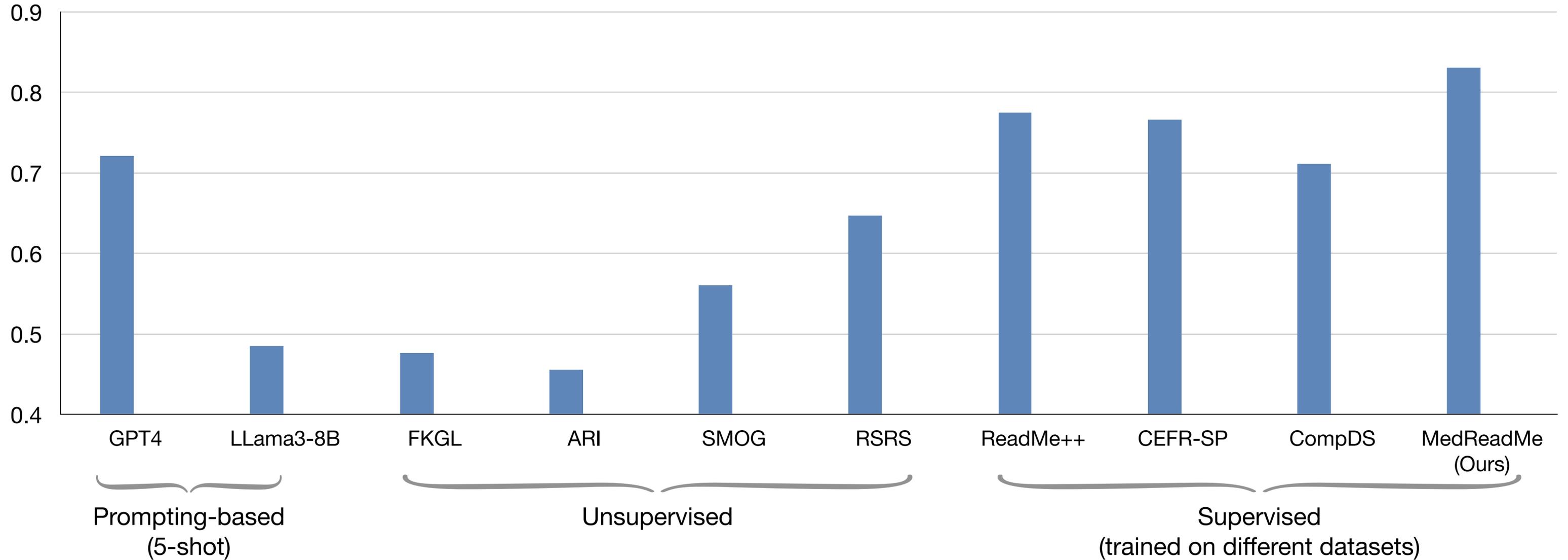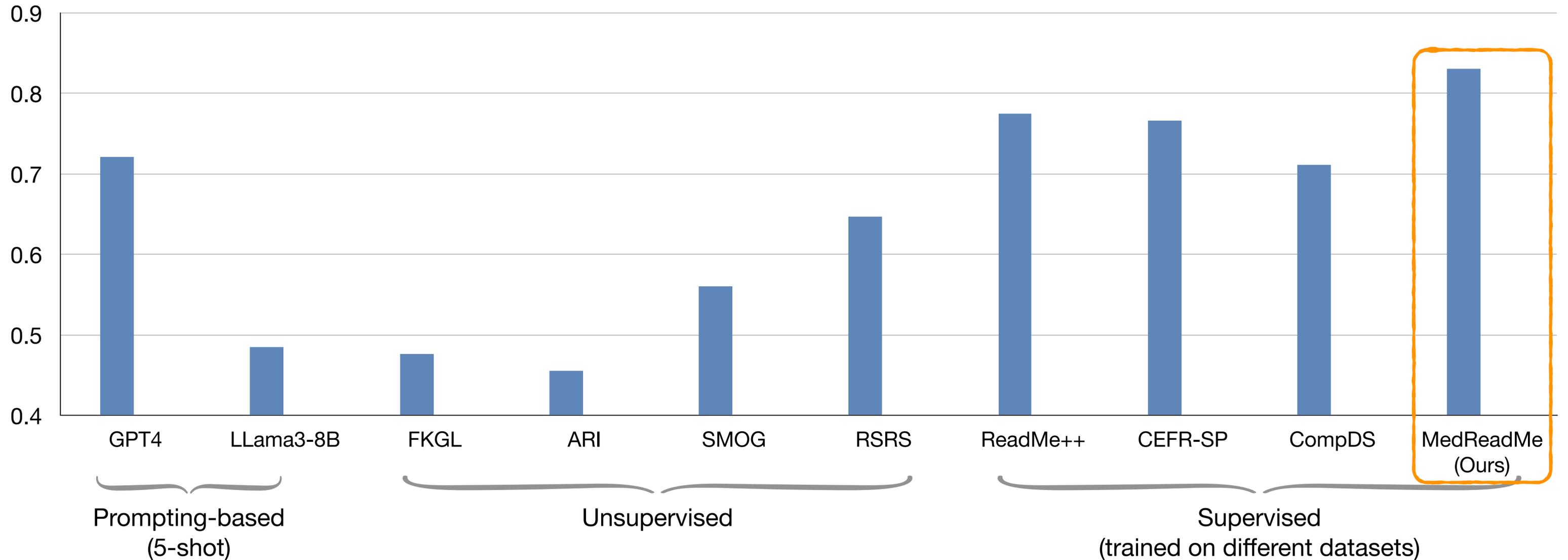
Benchmark and Improve Medical Readability Metrics

■ Pearson Correlation w/ Human Ratings for Existing Metrics

Benchmark and Improve Medical Readability Metrics

Benchmark and Improve Medical Readability Metrics

■ Pearson Correlation w/ Human Ratings for Existing Metrics

Prompting-based (5-shot): GPT4, LLama3-8B

Unsupervised: FKGL, ARI, SMOG, RSRS

Supervised (trained on different datasets): ReadMe++, CEFR-SP, CompDS, MedReadMe (Ours)

Benchmark and Improve Medical Readability Metrics

Supervised models trained on our corpus outperformed other methods, e.g., prompting GPT-4.

Benchmark and Improve Medical Readability Metrics
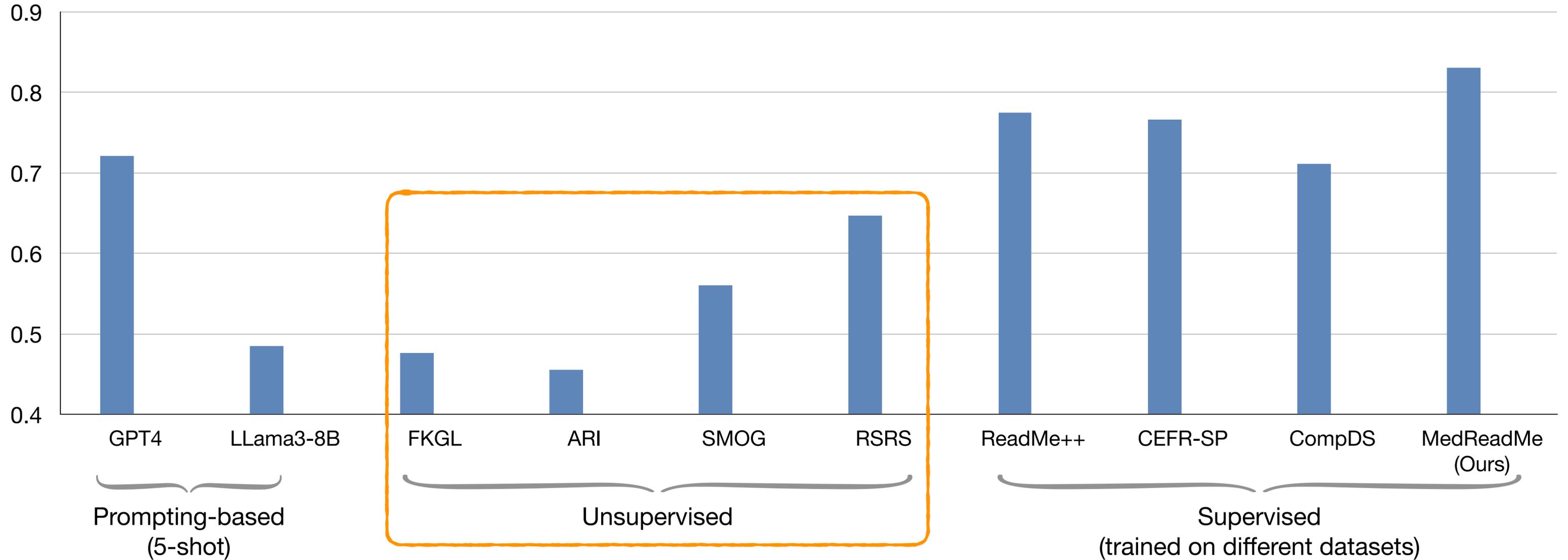
Benchmark and Improve Medical Readability Metrics

Benchmark and Improve Medical Readability Metrics

FKGL-Jar = FKGL + $\alpha \times$ # Jargon

Benchmark and Improve Medical Readability Metrics

■ Pearson Correlation w/ Human Ratings for Existing Metrics   ■ Adding a Jargon Term (Ours)
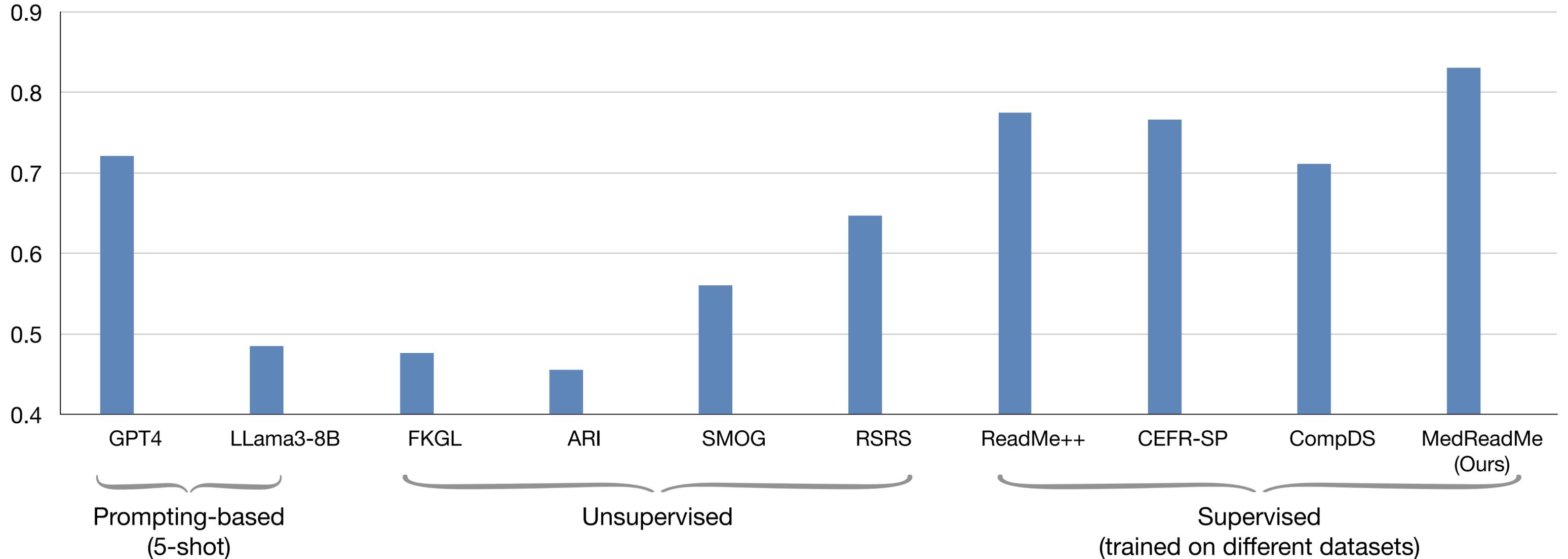
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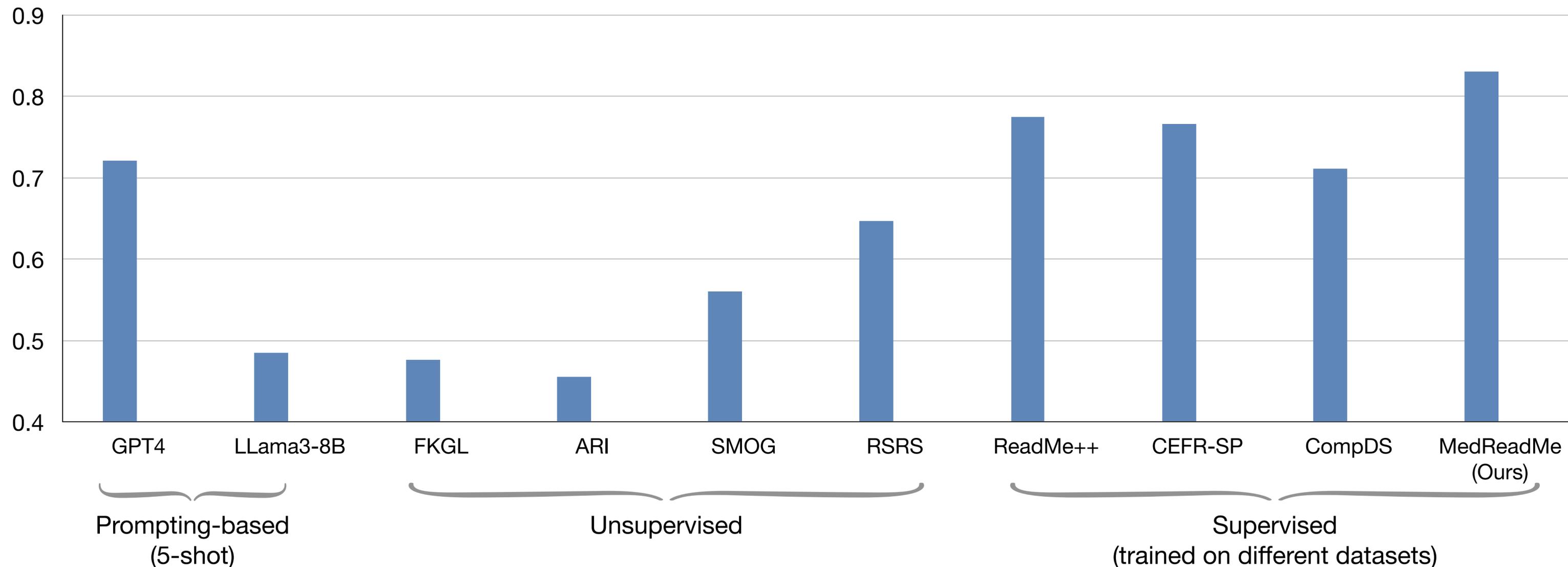
$$FKGL\text{-}Jar = FKGL + \alpha \times \#\,Jargon$$

α: a weight tuned on dev set.

\# Jargon: # of complex spans in the sentence, predicted by a complex span identification model trained on our dataset.

Benchmark and Improve Medical Readability Metrics
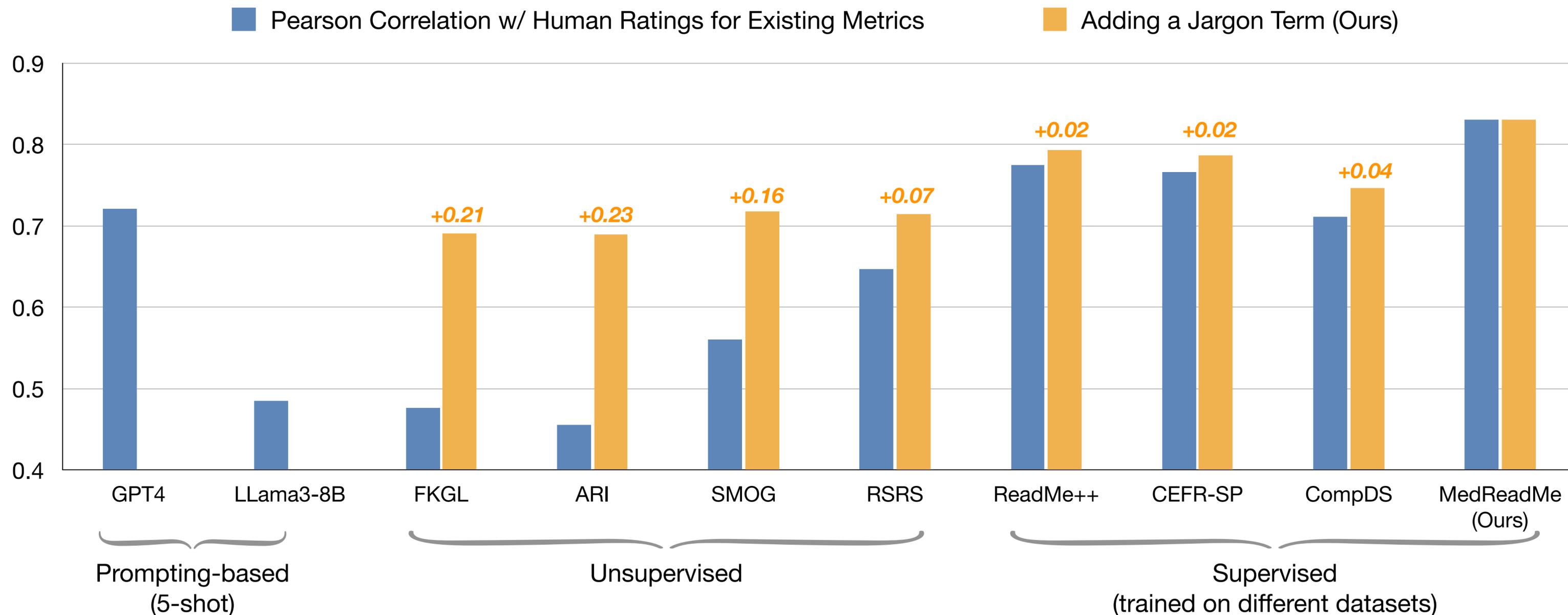
■ Pearson Correlation w/ Human Ratings for Existing Metrics   ■ Adding a Jargon Term (Ours)

Prompting-based (5-shot): GPT4, LLama3-8B

Unsupervised: FKGL +0.21, ARI +0.23, SMOG +0.16, RSRS +0.07

Supervised (trained on different datasets): ReadMe++ +0.02, CEFR-SP +0.02, CompDS +0.04, MedReadMe (Ours)

$$\textit{FKGL-Jar} = \textit{FKGL} + \alpha \times \#\ \textit{Jargon}$$

α: a weight tuned on dev set.

$\#$ Jargon: # of complex spans in the sentence, predicted by a complex span identification model trained on our dataset.

Summary

1. MedReadMe Dataset: 4,520 human readability ratings + complex span annotation.

2. The number of complex spans is the No.1 factor that impacts readability in specialized domains.

3. Add a "Jargon" term improve readability metrics in medical domain: MedReadMe-Jar

Paper
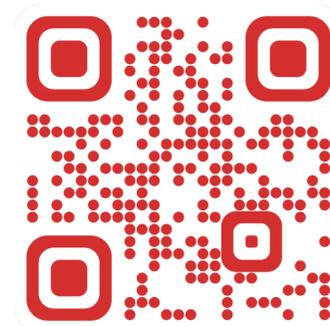
Dataset

Email me at chaojiang@gatech.edu

Follow me on Twitter **Chao Jiang**
@chaojiang06