

Introduction

"Academics do not act in a social vacuum and knowledge is not constructed outside particular communities of practice." (Hyland, 2006, p. 39). It serves as a conduit for sharing knowledge, fostering scholarly communities, and advancing the frontiers of science. In scholarly communication, the choice of linguistic resources and writing conventions varies across disciplines, resulting in distinct writing styles. These styles facilitate communication and encapsulate the cultural traditions and codes of conduct within each academic field.

Our study undertakes a large-scale quantitative analysis to delve into the evolution of writing styles across disciplines and the reasons behind their formation. We uncover the dynamic nature of scholarly language and the diversity of writing styles across academic domains:

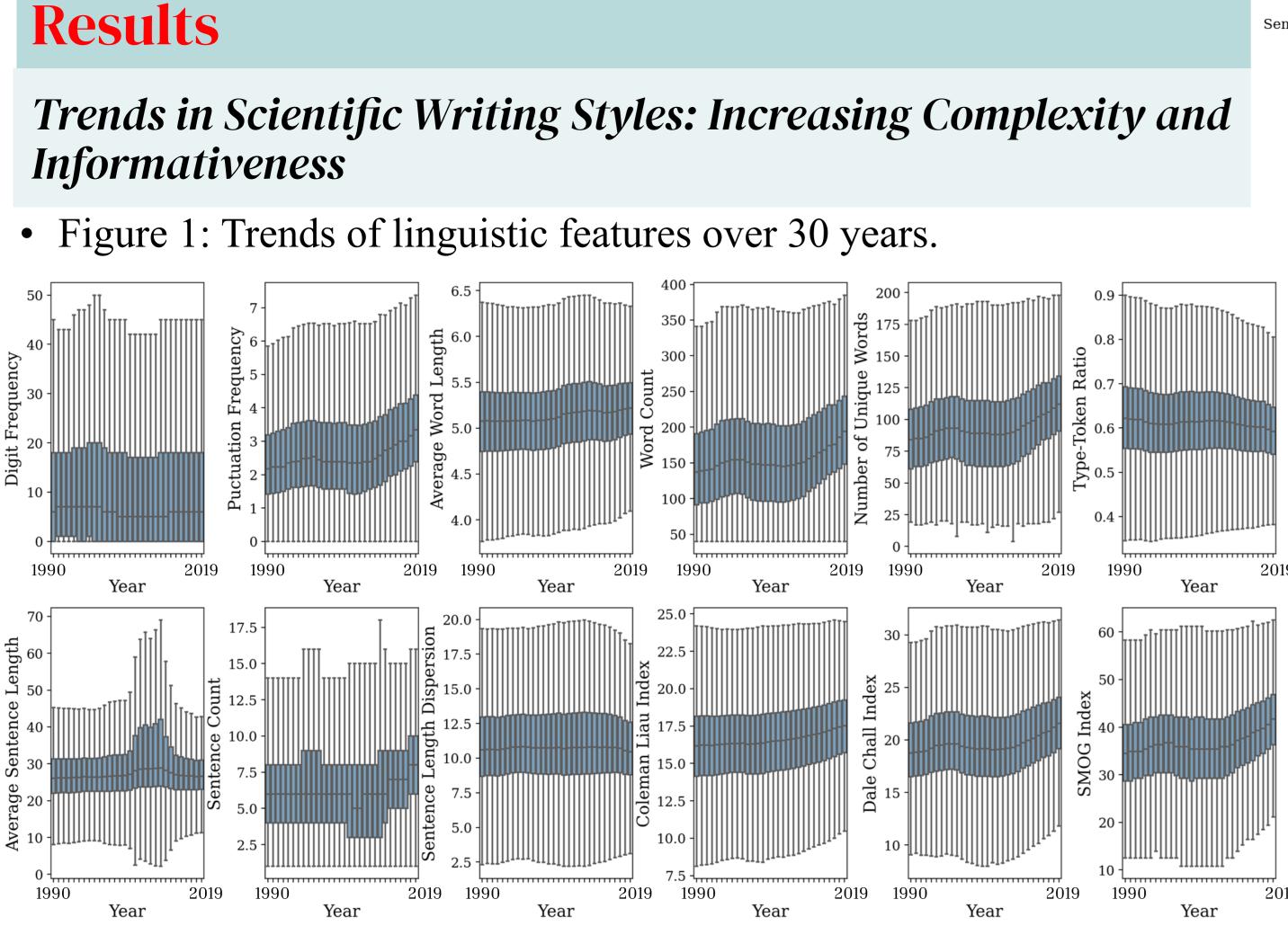
1.How have writing styles within disciplines evolved over time?

2.To what extent do writing styles differ among disciplines?

Method

Data: 14 million abstracts from Microsoft Academic Graph (1990-2019) spanning 8 disciplines (Art, Philosophy, Sociology, Psychology, Biology, Chemistry, Computer Science, Mathematics). The first four disciplines falling under soft sciences and the last four under hard sciences.

Analysis: Quantitative analysis on linguistic features (symbolic, lexical, syntactic, readability). Employed t-tests and calculated Cohen's d effect size for significance.



Comparing the Writing Styles of Multiple Disciplines: A Large-Scale Quantitative Analysis

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Notable Shifts in Writing Styles Evident in Biology, Chemistry, Computer Science, and Psychology

• Figure 2: Effect sizes of variations by disciplines over 30 years.

High Effect Sizes in Writing Styles:

- Biology (hard)
- Chemistry (hard)
- Computer Science (hard)
- Psychology (soft)

Small Effect Sizes in Writing Styles:

- Art (soft)
- Philosophy (soft)
- Sociology (soft)
- Mathematics (hard)

Distinctive Differences in Writing Styles Across Disciplines

• Figure 3: Effect sizes of pairwise comparisons of writing styles between disciplines.

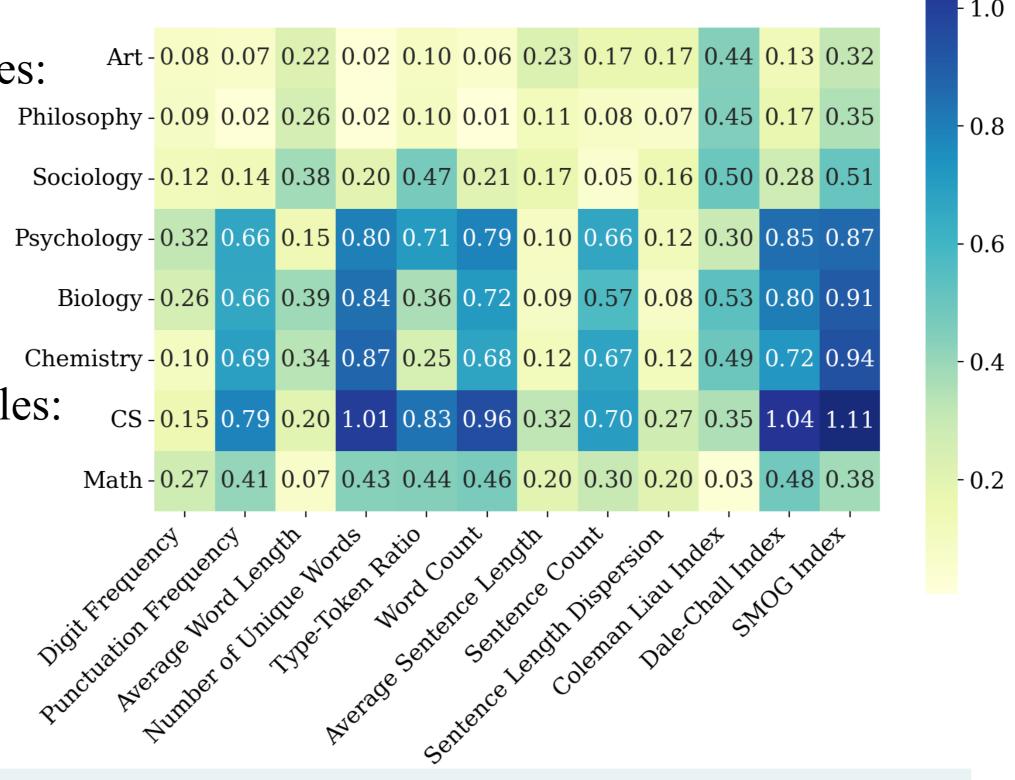
Digit Frequency																												
	- 0.28	0.41	0.17	0.52	0.59	0.52	0.00	0.05	0.40	0.66	0.74	0.11	0.20	0.47	0.72	0.80	0.05	0.25	0.46	0.53	0.60	0.16	0.04	88.0	0.55	0.96	0.62	0.36
Puctuation Frequency	- 0.04	0.12	0.23	0.47	0.18	0.00	0.41	80.0	0.28	0.52	0.22	0.06	0.37	0.37	0.60	0.30	0.14	0.30	0.27	0.04	0.26	0.66	0.30	0.52	88.0	0.19	0.58	0.47
Average Word Length	- 0.17	1.01	1.30	1.09	0.92	1.39	0.22	0.81	1.11	0.91	0.77	1.18	0.11	0.28	0.12	0.11	0.25	0.43	0.15	0.12	0.05	0.69	0.00	0.11	0.62	0.09	0.57	0.73
Number of Unique Words	- 0.06	0.07	0.40	0.72	0.43	0.31	0.37	0.15	0.48	0.80	0.51	0.39	0.30	0.34	0.66	0.36	0.23	0.46	0.32	0.02	0.12	0.79	0.30	0.45	1.11	0.14	0.83	0.71
Type Token Ratio	- 0.34	0.55	1.04	0.96	0.79	0.90	0.69	0.18	0.68	0.60	0.47	0.52	0.40	0.51	0.43	0.31	0.33	0.27	80.0	0.15	0.21	0.17	0.08	0.12	0.10	0.03	0.02	0.01
Word Count	- 0.03	0.19	0.64	0.86	0.60	0.50	0.03	0.16	0.61	0.83	0.57	0.46	0.06	0.46	0.69	0.43	0.29	0.21	0.23	0.03	0.20	0.65	0.25	0.43	88.0	0.16	0.62	0.50
Average Sentence Length	- 0.16	0.36	0.94	1.26	0.98	1.27	0.48	0.16	0.68	0.93	0.68	0.96	0.30	0.44	0.62	0.43	0.66	0.17	0.09	0.07	0.15	0.17	0.17	0.07	0.28	0.23	0.14	0.31
Sentence Count	- 0.11	0.31	0.91	1.14	0.83	0.90	0.24	0.19	0.80	1.04	0.72	0.78	0.13	0.65	88.0	0.55	0.59	0.04	0.22	0.11	0.13	0.68	0.34	0.36	0.91	0.01	0.58	0.61
Sentence Length Dispersion	- 0.07	0.21	0.83	1.33	1.24	1.07	0.61	0.13	0.72	1.20	1.10	0.95	0.52	0.52	0.91	0.84	0.72	0.39	0.27	0.20	0.16	0.06	0.08	0.10	0.33	0.03	0.26	0.21
Coleman Liau Index	- 0.16	0.90	1.28	1.06	88.0	1.22	0.18	0.72	1.10	0.89	0.73	1.02	0.06	0.38	0.20	0.14	0.22	0.47	0.16	0.18	0.19	0.83	0.03	0.01	0.72	0.02	0.63	0.75
Dale Chall Index	- 0.16	0.44	0.10	0.52	0.36	0.07	0.53	0.22	0.32	0.76	0.60	0.19	0.32	0.57	1.01	0.85	0.45	0.12	0.43	0.26	0.17	0.67	0.17	0.62	1.11	0.45	0.95	0.56
SMOG Index	- 0.13	0.50	0.99	1.23	1.14	1.02	0.14	0.36	0.84	1.07	0.98	0.86	0.00	0.48	0.71	0.59	0.46	0.33	0.22	0.08	0.07	0.80	0.15	0.30	1.04	0.15	0.93	0.80
Art - Philoso	BIL' Socio	PSYChol	ody Biol	Onennie Chennie	AT	osophy Phil	Social Social	PSYCHOL	19 Biol	Chemist Phile	Philosof Socio	Phy P	Sycholo Sociolog	SY Biold	Chemic So	iology Socio	CS THE	Strology	Chemic Psyc	nology Psycho	0099 M	inemis'	iology Bio	CPS N	nistry.	CS N	cs. M	in

Above:

- Most disciplines showed noticeable differences in writing styles. • Fewer variations among neighboring disciplines
- Similar distinction patterns existed in Art- and Philosophy-related pairs. • Consistent patterns of distinction emerge, epescially in Math-related pairs.

Left:

- a. Symbols: More punctuation, more symbols in scientific papers over 30 years.
- b. Words: Longer words, more words, more information. Fewer unique words.
- c. Sentences: Stable length, more sentences recently. Consistent rhythm.
- d. Readability: Harder to read, increasing complexity.



Conclusion & Future Plan

The results indicate a trend of increasing complexity and informativeness in scientific writing styles, with hard sciences experiencing greater changes. Disparities in writing styles were observed across disciplines, exhibiting varying degrees of differences in features.

Our study highlights the dynamic nature of scientific language and confirms that different disciplines employ distinct features to establish their unique linguistic identity. These insights contribute to a deeper understanding of disciplinary writing and disciplineoriented communication.

In our future research, we aim to explore deeply into disciplinary writing styles with:

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• using more nuanced features

• employing explainable machine learning methods to classify and identify writing styles

• analyzing the contributions of features to uncover how linguistic traits encode scientific writing across disciplines

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