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Writing for non-specialists? Investigating readability and jargon use in successful lay summaries of CRF grant proposals 2006–2024

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Abstract
Grant proposal summaries are a high-stakes academic genre requiring significant marketing efforts to enhance accessibility for a diverse audience. However, research in this field remains scarce. This study addresses this gap by examining the readability and jargon use in lay summaries of Collaborative Research Fund (CRF) grant proposals administered by the University Grants Committee (UGC) in Hong Kong from 2006 to 2024. The findings reveal that, despite temporal fluctuations, these summaries generally align with senior-college to college-graduate reading levels. They also contain a high average jargon density of 8.0% per text, surpassing the recommended threshold for general readership. Notably, readability measures related to structural complexity show a significant upward trend, while lexical difficulty remains stable. Meanwhile, normed jargon use presents a non-significant but visually noticeable upward trend over time. These temporal patterns suggest that these lay summaries have become more challenging to read, mostly due to individually-varied but densely embedded specialised terms in longer and more complex sentences. The findings raise concerns about the accessibility of lay summaries for non-specialists, such as interdisciplinary researchers, science communicators, policymakers, and the general public. The study concludes with a discussion and suggestions on readability and jargon use in grant proposal summaries.

Keywords Readability · Jargon · Lay summaries · Grant proposal writing · Diachronic study

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Introduction

Grant proposal summaries represent a high-stakes academic genre that serves as a synopsis of the full proposed research project (Tyowua, 2023). They require significant marketing efforts to increase their accessibility to a wide range of audiences (Wang, 2025). Although the absence of summaries may not decisively affect the ranking of proposals in the selection stage (Simsek et al., 2024), their significance remains due to their role as sales pitches targeting both specialist and non-specialist audiences (Flowerdew, 2016; Wang, 2025). These summaries are crucial for peer reviewers and grant review committee members in making preliminary decisions, offering an initial impression of a project's potential value and success (Charles & Whiteside, 2024; Feng & Shi, 2004; Lindgreen et al., 2019; Tyowua, 2023). They are also expected to appeal to a wide range of audiences, such as administrative officers seeking a general understanding of research proposals, and the general public or science communicators interested in the allocation of taxpayers' money (Wang, 2025).

Many funding committees, such as the University Grants Committee (UGC) in Hong Kong, have explicitly highlighted the necessity for these summaries to be accessible to a broader, non-specialist audience (e.g., see Wada et al., 2020). The UGC is the most influential funding body among Hong Kong higher education institutions, designed to facilitate communication between the government, universities, and society, and to enhance the international competitiveness of the Hong Kong higher education system (Postiglione, 2017). Among the UGC funding schemes, Collaborative Research Fund (CRF), a highly competitive scheme with a 10.4% success rate in the 2024/25 exercise,[1] is designed to foster a synergistic environment through cross-institutional collaboration, promoting the quality, scope, and impact of the funded research (Postiglione, 2017). The lay summaries of funded projects under the CRF are made publicly accessible on the UGC website to increase their visibility.

Assessing the accessibility of these summaries to a wider audience usually involves evaluating their readability, which measures how easily readers can understand the texts (Flesch, 1948; Kincaid et al., 1975). Additionally, the dense use of specialised terminology may impede readers' comprehension, so the avoidance of jargon is generally recommended when writing lay summaries (Falkenberg et al., 2024; Hauck, 2019; Hu & Nation, 2000; Wen & Yi, 2023b).

Previous studies on grant proposal summaries have largely focused on examining the prototypical rhetorical structures and their lexical-grammatical realisations (e.g., Charles & Whiteside, 2024; Feng & Shi, 2004; Matzler, 2021; Tseng, 2011). Research on their accessibility to a wider audience remains scarce. Therefore, this study aims to address this gap by examining the readability and jargon usage in the lay summaries of CRF grant proposals administered by the UGC in Hong Kong. By investigating the two aspects, the study seeks to contribute to the understanding of whether grant proposal summaries effectively communicate with a diverse range of non-specialist audiences.

[1] The CRF reflective reports have stated the success rate since the 2018/19 exercise: https://www.ugc.edu.hk/eng/rgc/funding_opport/crf/funded_research.html

Related work

Previous research has suggested that accessibility is a crucial aspect of grant proposal summaries. Successful grant proposal summaries have been found to make great efforts to effectively communicate the significance and potential impact of the proposed research (Casal & Kessler, 2020; Charles & Whiteside, 2024). Summaries written with greater certainty are more likely to receive funding from institutions like the National Science Foundation, and the use of promotional hype in successful grant applications has increased over the past forty years (Markowitz, 2019; Millar et al., 2022). In contrast, unsuccessful summaries often fail to highlight the importance of the research and tend to omit rhetorical steps related to research significance and outcomes (Charles & Whiteside, 2024).

Researchers have recognised the promotional nature of grant proposal summaries. Most of their studies focus on examining the prototypical rhetorical moves and their lexical-grammatical realisation in these summaries (e.g., Charles & Whiteside, 2024; Feng & Shi, 2004; Matzler, 2021; Tseng, 2011). For example, Pascual and Unger (2010) have observed the variety of interpersonal resources used by grant proposal writers to align with multiple voices and engage varied community members. Feng (2006) found that hedges were frequently used in establishing a niche, while boosters were often used in expressing achievement or benefit. The rhetorical move structure observed in grant proposal summaries is characterised by authors emphasising their research niche and contextual background through strategic deployment of complexity markers such as "problem", "question", and "debate" (Wang, 2025). These linguistic patterns reflect researchers' deliberate efforts to broaden their reach and enhance engagement with their target audience.

Many funding committees have also explicitly highlighted the importance of making the summaries of grant proposals accessible to a broader, non-specialist audience (e.g., Wada et al., 2020). For example, the UGC in Hong Kong stipulates in its research fund guidance note that proposal summaries should be comprehensible to non-specialists and publicly disseminates lay summaries of the funded CRF projects on its website.[2] However, the linguistic strategies and rhetorical effectiveness of these summaries in reaching non-specialist audiences remain understudied, despite the growing institutional significance of the summaries and the emphasis placed by funding committees on their accessibility.

The emphasis on accessibility likely stems from a growing recognition within the scientific community concerning the benefits that increased public access to science provides, though scholarly interests primarily centre on writing plain summaries for research articles (Dormer & Walker, 2020; Falkenberg et al., 2024; Hauck, 2019; Pushparajah et al., 2018; Rosenberg et al., 2023). "Lay summaries" (Falkenberg et al., 2024), "plain language summaries" (Hauck, 2019), or "author summaries" (Breeze, 2016) help to broaden the reach of scientific work to a diverse range of audiences, including students, colleagues from other disciplines, science journalists, funding bodies, the general public, and beyond scientific fields (Hauck, 2019). By facilitating knowledge sharing and making important information accessible, these summaries promote diversity, equity, inclusion, and accessibility, and foster more engaged dialogue between non-specialists and specialist professionals (Pushparajah et al., 2018; Rosenberg et al., 2023). For terminological consistency, we adopt the term "lay summaries" throughout this study.

[2] Readers may access the research fund guideline and lay summaries at the link: https://www.ugc.edu.hk/eng/rgc/funding_opport/crf/index.html

To enhance the accessibility of research summaries to a wider audience, scholars have emphasised several key aspects. Primarily, they advocate improving readability and minimising jargon use in writing lay summaries (Falkenberg et al., 2024; Hauck, 2019; Wen & Yi, 2023b). Readability is an essential criterion in evaluating text accessibility, as it measures how easily readers can understand the content (Flesch, 1948; Kincaid et al., 1975; Stricker et al., 2020; Wang et al., 2022). Additionally, the dense use of specialised terminology may impede readers' understanding (Hu & Nation, 2000; Kremmel et al., 2023).

Comparative studies on these two aspects between lay summaries and abstracts of scientific articles yield inconsistent results, highlighting a contradiction between the intended accessibility of lay summaries and the actual writing products. Lay summaries are generally more readable and use fewer jargon terms than abstracts (Anderson et al., 2022; Wen et al., 2023). However, Wen and Yi (2023a) found that lay summaries from the journal *Medical Mycology* are significantly more difficult to read than the corresponding scientific abstracts. They attribute this inconsistency to the shorter length of lay summaries, which may impact their readability. Furthermore, although lay summaries tend to use shorter sentences, their nominal sophistication and syntactic complexity vary across different rhetorical moves compared to scientific abstracts (Kang et al., 2024; Liu & Li, 2024). These studies suggest variability in authors' writing practices as they adopt contingent strategies to suit varied needs and contexts when composing lay summaries.

Despite intended efforts to improve readability, lay summaries remain incomprehensible to laypeople, as they require at least a college freshman reading level and contain a high proportion of technical jargon (Anderson et al., 2022; Wen & Yi, 2023a; Wen et al., 2023). Decreasing readability of scientific texts may hinder science communication with the general public, given that the readability of abstracts is significantly correlated with the online attention that research articles receive (Jin et al., 2021; Lehman et al., 2024; Wen & Lei, 2022). While readability and jargon usage have been examined in lay summaries of research articles (e.g., Falkenberg et al., 2024; Wen & Yi, 2023a, 2023b), these two aspects remain understudied in the context of grant proposal summaries. Examining these two aspects is likewise critical for communicating the significance of proposed research to a broader audience.

Therefore, this study aims to address this gap by diachronically examining the readability and jargon usage in lay summaries of CRF grant proposals administered by the UGC in Hong Kong from 2006 to 2024. There are two reasons for selecting the CRF grant proposal summaries for this analysis. First is data accessibility, as the 19 years of lay summaries of CRF-funded projects are publicly available on the UGC website. Second is the critical role of multidisciplinary collaboration, as knowledge transfer in higher education institutions today heavily relies on collaborative projects (Bellés-Fortuño, 2021). The CRF supports multi-investigator, multidisciplinary projects to encourage research groups to engage in cross-institutional endeavours. In particular, this study addresses the following research questions:

RQ1: What is the readability level and extent of jargon use in the lay summaries of CRF grant proposals?

RQ2: Do the readability level and jargon use of lay summaries of CRF grant proposals change over time?

Method

Corpus compilation

We manually collected a total of 481 lay summaries of funded CRF grant proposals from the UGC website, covering the publicly accessible summaries from 2006 to 2024 available at the time of data collection. The funded research projects over the 19 years involve collaborations among seven publicly funded universities in Hong Kong: the Hong Kong Polytechnic University, the Hong Kong University of Science and Technology, the Chinese University of Hong Kong, the University of Hong Kong, the City University of Hong Kong, the Hong Kong Baptist University, and the Education University of Hong Kong.

We followed the GRF disciplinary classification (i.e., Biology & Medicine, Engineering, Physical Sciences, Business Studies, Humanities, and Social Sciences) and applied a keyword-based classification to proposal titles using a custom Python script, supplemented by manual checks to improve accuracy. The keyword map used for classification is provided in the Appendix. We observed that the funded projects cover varying topics yet with a strong representation in the hard sciences, such as physics, chemistry, biology, medicine, engineering, environmental science, and computer science. The descriptive data is presented in Table 1.

The number of summaries per year in our corpus exhibits variability, reflecting the natural fluctuations in funded CRF grant proposals over the observed period. The CRF consistently supports two funding streams: Group Research Proposals and Equipment Proposals.

Table 1 Descriptive statistics of the corpus

Year	No. of summaries	%	Tokens	Type	Mean token length
2006	10	2.08	1,292	622	129.2
2007	8	1.66	915	481	114.4
2008	12	2.49	1,381	652	115.1
2009	9	1.87	1,390	615	154.4
2010	10	2.08	1,567	687	156.7
2011	11	2.29	1,818	813	165.3
2012	12	2.49	2,330	952	194.2
2013	14	2.91	3,458	1,233	247.0
2014	30	6.24	7,385	2,126	246.2
2015	18	3.74	4,555	1,555	253.1
2016	18	3.74	4,992	1,652	277.3
2017	18	3.74	4,432	1,566	246.2
2018	20	4.16	4,578	1,658	228.9
2019	24	4.99	6,388	1,939	266.2
2020	56	11.64	13,799	3,179	246.4
2021	48	9.98	11,554	2,916	240.7
2022	54	11.23	13,909	3,360	257.6
2023	51	10.60	13,103	3,166	256.9
2024	58	12.06	15,738	3,587	271.3
total	481	100.00	114,584	9,633	238.2

Group Research Proposals belong to the primary funding stream ($n = 369$, 76.7%), and Equipment Proposals form a smaller and stable subset ($n = 69$, 14.3%), designed to support the acquisition of shared research facilities. In 2022, the CRF divided its primary funding stream into two subtypes: Project Grant Proposals and Young Grant Proposals, the latter targeting early-career researchers. In addition, a temporary specialised funding stream was launched in addition to the major streams in 2020–2021, i.e., Covid-19 and NID Exercise Group Research Proposals ($n = 43$, 8.9%) in response to urgent public health challenges.

Despite these structural changes, all streams have adhered to a similar lay summary writing guideline with a high degree of continuity over the examined period. Applicants are required to submit a 400-word abstract tailored for a non-specialist audience, with explicit instructions that, if funded, the abstract will be published on the UGC website for public access. This continuity is inferred from two sources: 1) Three senior professors with extensive experience applying for CRF grants over the past two decades recalled no significant changes in the instruction for writing proposal summaries, and 2) the UGC website has consistently published "layman summaries" since 2006, explicitly labelling them as such. These sources thus suggest that, despite possible minor revisions, the communicative intent and target audience of lay summaries have remained stable since 2006. This provides a contextual basis for analysing diachronic trends in readability and jargon use.

Considering the consistency of writing instructions among funding streams, we included all available summaries to preserve the natural ecological context of the CRF's evolving funding landscape. We also chose to maintain the natural distribution of the corpus rather than balance the number of summaries per year. This approach ensures that our analysis captures real-world ecological contexts and provides a representative sample of the UGC grant proposal landscape in Hong Kong (Egbert et al., 2022).

Measures of readability and jargon

In our study, we employed six measures to evaluate the readability of lay summaries: Flesch-Kincaid Grade Level (Kincaid et al., 1975), Coleman-Liau Index (CLI) (Coleman & Liau, 1975), Automated Readability Index (ARI) (Smith & Senter, 1967), Dale-Chall Readability (DCR) (Chall & Dale, 1995), Gunning Fog Index (GFI) (Gunning, 1952), and Linsear Write Index (LWI) (O'hayre, 1966). Readability measures were calculated using textstat[3] on a self-written Python script.

Texstat also produces results for readability indexes of Flesch Reading Ease (FRE) (Flesch, 1948), SMOG (McLaughlin, 1969) and Spache (Spache, 1953). However, we excluded the FRE index due to its high negative values, caused by the combined effect of longer sentences and complex words in lay summaries, which may distort the distribution of readability scores and impede further statistical tests. The Spache index was also excluded due to its design for children's readability up to the fourth grade, and the SMOG index due to its norming on 30-sentence samples, which are not statistically suitable for our corpus, in which the average number of sentences per summary is 9.2.

Both the CLI and LWI are designed to operate on 100-word samples. Our corpus contains 16 summaries that fall short of this threshold, constituting a small fraction (3.3%) of the total dataset. These 16 summaries are relatively balanced in distribution, with 4 from the first 6 years (2006–2011), 5 from the second 6-year period (2012–2017), and 6 from

[3] Textstat can be accessed via: https://pypi.org/project/textstat/

the final 7-year period (2018–2024). The average word count for these summaries is 86.3 (SD = 7.8), which approximates the 100-word threshold. To assess the influence of word count on CLI and LWI readability scores, we ran a Spearman's rho test. The results indicated no statistically significant correlations between word count and either CLI or LWI scores ($p > 0.05$). Consequently, CLI and LWI were considered not to bias the results and were included to provide a comprehensive analysis of readability metrics. Including CLI also facilitates comparison with Wen and Yi (2023a), who used this metric to evaluate the readability level of lay summaries and research article abstracts.

All these six readability measures incorporate sentence length but differ in their computational emphasis and linguistic focus. Three formulas (i.e., FKG, CLI, and ARI) primarily rely on surface-level structural complexity. Specifically, FKG calculates readability based on average sentence length (*sl*) and average syllables per word (*spw*), using the equation: $0.39sl + 11.8spw - 15.59$ (Kincaid et al., 1975). The CLI shifts focus to character-level metrics, using average letters per 100 words (L) and average sentences per 100 words (sw): $0.0588L - 0.296sw - 15.8$ (Coleman & Liau, 1975). Similarly, the ARI incorporates average characters per word (*cpw*) and sentence length, calculated as: $4.71cpw + 0.5sl - 21.43n$ (Smith & Senter, 1967). The three formulas primarily reflect structural complexity, such as long sentences, long words in characters or syllables, and dense syntax.

The remaining three measures (i.e., DCR, GFI, and LWI) incorporate percentage of difficult words alongside sentence length. Specifically, DCR introduces a lexical dimension by factoring in the percentage of words not found in a list of 3,000 familiar words (D), alongside sentence length: $0.1579D + 0.0496sl$ (add 3.6365 to the raw score if $D > 5\%$) (Chall & Dale, 1995). The GFI combines sentence length with the percentage of complex words with three or more syllables ($\%lw$): $0.4(sl + \%lw)$ (Gunning, 1952). The LWI calculates a raw score (r) based on the ratio of easy words (*epw*) to hard words (*hpw*) per 100 words, divided by the sentence number (sw): $r = \frac{1epw+3hpw}{sw}$ (O'hayre, 1966). If $r > 20$, the grade level is $r/2$; if $r \leq 20$, it is $\frac{r}{2} - 1$. These three measures are thus more sensitive to polysyllabic words (more than three) and unfamiliar vocabulary.

Overall, the six measures were widely used in prior studies examining the readability of lay summaries and abstracts of research articles (e.g., Wang et al., 2022; Wen & Lei, 2022; Wen & Yi, 2023a, 2024). Table 2 presents the readability scores and corresponding grade levels for each measure. Note that DCR produces a lower range of score compared to other measures.

Jargon use is assessed using the *De-Jargonizer*, an automated online tool that identifies jargon in academic texts intended for non-expert audiences (Rakedzon et al., 2017). The

Table 2 Readability Measures and Corresponding Grade Levels

Grade level	FKG	CLI	ARI	DCR	GFI	LWI	Notes
≤ 5th	0–5	1–5	1–5	< 4.9	0–5	< 5	Very easy to read
6th–7th	6–7	6–7	6–7	5–5.9	6–7	5–6	Easy to read
7th–8th	7–8	7–8	7–8	6–6.9	7–8	6–8	Faily easy to read
9th–10th	9–10	9–10	9–10	7–7.9	9–10	8–10	Standard readability
11th–12th	11–12	11–12	11–12	8–8.9	11–12	≥ 11	Faily difficult to read
College	13–16	13–16	13–16	9–9.9	13–16		Difficult to read
College graduate	≥ 17	≥ 17	≥ 17	≥ 10	≥ 17		Very difficult to read

tool categorises vocabulary into three levels based on frequency: high-frequency (common words), mid-frequency, and rare (jargon words). This classification is derived from a corpus of over 90 million words from BBC articles published between 2012 and 2015, ensuring the tool's relevance to contemporary language use. The tool reports the frequency and percentage of the three levels and assigns jargon scores ranging from 0 to 100. Texts composed entirely of common words receive a score of 100, while the inclusion of intermediate and jargon words decreases the score. Although a one-size-fits-all lexical threshold may be problematic in different contexts, it is generally recommended that the percentage of jargon words be kept below 2% for common readers (Hu & Nation, 2000; Kremmel et al., 2023; Pellicer-Sánchez et al., 2024; Rakedzon et al., 2017).

Data analysis

To evaluate the accessibility of lay summaries to non-specialists, six measures of readability and jargon use were calculated for each text. To address RQ1, we computed the average readability scores for each measure on a yearly and overall basis. Similarly, we calculated the normalised frequency (per 100 tokens) of common, mid-frequency, and jargon words in each text and then averaged the normed frequency on a yearly and overall basis. This provided us with yearly average normed frequency of common, mid-frequency, and jargon words per text.

As the readability measures conceptually overlap yet emphasise different linguistic features, we aggregated them into two coherent composite scores to enhance interpretability in addressing RQ2. The measures that assess surface-level structural complexity, i.e., FKG, CLI, and ARI, were standardised using z-scores and averaged to form a structural readability composite score. Those that primarily measure lexical difficulty alongside sentence length, i.e., DCR, GFI, and LWI, were combined to yield a lexical difficulty composite score.

This aggregate z-score approach captures two major dimensions of textual complexity: structural complexity (e.g., sentence length, character count) and lexical difficulty (e.g., word familiarity, polysyllabic complexity). Standardising scores before aggregation controls for scale differences across measures. The approach also aligns with prior practices in cognitive and psycholinguistic research, where composite scores are derived by averaging standardised scores of related tests to improve interpretability (e.g., Smithson et al., 2024).

Given the time span of 19 years (2006–2024) that falls below the recommended minimum of 25 observations for robust regression modelling (Jenkins & Quintana-Ascencio, 2020), we opted for non-parametric methods that are more appropriate for smaller samples and do not assume normality. Specifically, we applied the Mann–Kendall Trend Test to detect monotonic shifts in composite readability scores and normed jargon use over time, and Pettitt's Test to identify potential change points in the series (Lehmann & D'Abrera, 2006; Mann, 1945; Pettitt, 1979). To provide a more comprehensive view of temporal patterns, we used both mean and median values for each variable on a yearly basis, despite non-normal distribution of the data (Shapiro–Wilk $p < .001$). We then ran LOESS smoothing to visualise temporal trajectories for subtle nonlinear trends (Jacoby, 2000). These tests were performed in Rstudio.

Results

Overall readability and jargon use of lay summaries

To answer RQ1, we present the average scores of six readability measures of the lay summaries of CRF grant proposals: FKG, CLI, ARI, DCR, GFI, and LWI (see Table 3).

The results show varying levels of readability across the years from 2006 to 2024. Notably, most of the readability measures indicate that the grant proposal summaries generally fall within the senior-college to college-graduate reading level, with slight fluctuations observed over time.

In particular, FKG ranges from a low of 14.8 in 2006 to a peak of 17.6 in 2014, with an overall average of 16.6 during the entire period, suggesting a senior-college level of reading. LWI shows an average score of 16.3, indicating a complexity level similar to FKG. CLI averages around 17.2, with values fluctuating between 15.4 in 2013 and 17.8 in 2023. Similarly, ARI, which measures ease of reading based on sentence length and character counts, averages 19.8 over the years. DCR records an average score of 11.3, while GFI, which factors in sentence length and the percentage of difficult words, averages 17.7. These four measures indicate a slightly higher level of complexity consistent with college-graduate education. Overall, the results indicate that the readability grade level of lay summaries of CRF grant proposals is rather high, with varying levels of readability depending on the formula used. These summaries are generally complex for common readers and are (very) difficult to read.

Table 3 Average readability score and its corresponding grade level

Year	FKG	CLI	ARI	DCR	GFI	LWI	Reading level
2006	14.8	15.5	17.1	11.8	17.2	15.2	College: FKG, CLI, LWI; College graduate: ARI, DCR, GFI
2007	15.9	17.3	18.3	11.7	17.0	15.8	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
2008	16.5	17.1	19.8	11.3	18.3	17.2	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
2009	16.9	17.2	20.0	11.4	17.8	15.6	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
2010	16.3	16.6	18.8	11.3	17.8	16.4	College: FKG, CLI, LWI; College graduate: ARI, DCR, GFI
2011	16.0	16.0	18.6	11.2	17.7	15.7	College: FKG, CLI, LWI; College graduate: ARI, DCR, GFI
2012	15.2	16.9	18.1	10.9	16.5	14.1	College: FKG, CLI, GFI, LWI; College graduate: ARI, DCR
2013	16.5	15.4	19.5	10.6	17.8	16.7	College: FKG, CLI, LWI; College graduate: ARI, DCR, GFI
2014	17.6	17.1	20.9	11.4	18.9	17.9	College: LWI; College graduate: FKG, CLI, ARI, DCR, GFI
2015	17.2	17.4	20.4	11.3	18.4	19.0	College: LWI; College graduate: FKG, CLI, ARI, DCR, GFI
2016	17.5	16.7	20.7	11.0	18.2	16.0	College: CLI, LWI; College graduate: FKG, ARI, DCR, GFI
2017	16.5	17.7	19.6	11.2	17.5	16.3	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
2018	16.1	16.8	19.2	11.5	18.0	16.7	College: FKG, CLI, LWI; College graduate: ARI, DCR, GFI
2019	16.0	17.2	19.1	11.0	17.3	15.2	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
2020	16.3	17.0	19.6	11.2	17.4	16.5	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
2021	17.0	17.4	20.5	11.3	17.9	16.2	College: LWI; College graduate: FKG, CLI, ARI, DCR, GFI
2022	17.2	17.6	20.7	11.3	18.2	17.1	College: LWI; College graduate: FKG, CLI, ARI, DCR, GFI
2023	16.6	17.8	20.3	11.3	17.7	15.6	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
2024	16.1	17.6	19.4	11.4	17.2	15.3	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI
total	16.6	17.2	19.8	11.3	17.7	16.3	College: FKG, LWI; College graduate: CLI, ARI, DCR, GFI

Table 4 presents the jargon use on a yearly and overall basis, categorised by the normed frequency of common, mid-frequency, jargon words from 2006 to 2024.

We can observe a relatively stable presence of specialised terminology over time, with fluctuations in the proportion of common, mid-frequency, and jargon words. In particular, mid-frequency words account for an average of 15.2% per text used throughout the period. Jargon words take up at an average of 8.0% per text, with occasional spikes in 2015, 2017, and 2019 (9.3, 9.5, 9.1%, respectively).

Despite the prevalence of common words, our findings indicate that the percentage of jargon is generally higher than the recommended threshold of 2% for materials intended for general readers (Hu & Nation, 2000; Kremmel et al., 2023; Pellicer-Sánchez et al., 2024; Rakedzon et al., 2017). This suggests that the lay summaries may present challenges for non-expert audiences, indicating a potential need for text simplification. Overall, the results of readability and jargon use suggest complex and jargon-heavy language in lay summaries of CRF grant proposals over the past 19 years, requiring a senior-college to college-graduate level of understanding and potentially limiting accessibility for broader audience.

Readability and jargon trend of lay summaries over time

Mann–Kendall Trend Tests were conducted on yearly medians and means of the two composite readability scores and normed jargon use, along with Pettitt's Test to evaluate the presence of abrupt structural shifts. Figure 1 illustrates the trajectories using LOESS smoothing (parameter = 0.5).

Table 4 Average normed frequency of common, mid-frequency, jargon counts per 100 tokens

Year	Common	SD	Mid-frequency	SD	Jargon	SD
2006	80.1	4.7	14.3	3.5	5.6	2.3
2007	77.1	7.6	16.0	5.3	6.9	3.3
2008	76.6	6.1	15.8	5.7	7.6	3.3
2009	79.3	3.5	15.6	2.7	5.1	2.3
2010	76.7	7.0	14.8	3.9	8.5	4.3
2011	74.9	7.5	17.1	4.9	8.0	5.0
2012	76.8	5.9	16.6	4.9	6.6	3.6
2013	79.2	6.1	14.2	3.1	6.6	5.0
2014	76.2	4.8	16.0	3.0	7.9	3.8
2015	75.2	7.1	15.5	4.0	9.3	6.2
2016	77.7	8.2	14.5	3.6	7.9	6.0
2017	75.2	6.6	15.3	3.7	9.5	4.3
2018	78.1	7.5	13.4	4.1	8.4	4.6
2019	75.1	5.8	15.8	3.7	9.1	4.3
2020	77.5	6.0	14.6	3.8	7.9	4.7
2021	77.4	7.1	14.7	3.9	7.9	5.0
2022	75.0	6.2	16.3	4.0	8.7	5.0
2023	76.4	6.4	15.3	3.2	8.3	4.8
2024	77.8	5.8	14.4	4.1	7.8	4.3
Total	76.8	6.3	15.2	3.9	8.0	4.6

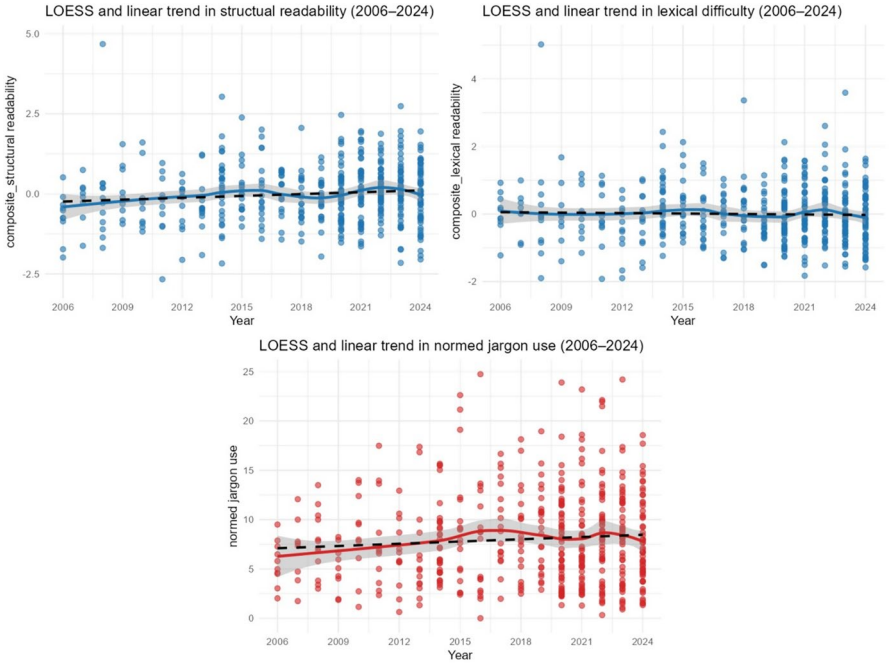

Fig. 1 The LOESS trend of composite readability scores and normed jargon use

For the structural readability composite score, a significant upward trend was observed using both mean and median values ($\tau = 0.368$, $p = .030$ for both). In contrast, the lexical difficulty composite score showed no evidence of a monotonic trend (median: $\tau = –0.111$, $p = .529$; mean: $\tau = –0.158$, $p = .363$). For normed jargon use, results diverged slightly depending on the measure of central tendency. While no significant trend was observed using medians ($\tau = 0.228$, $p = .184$), a significant upward trend emerged when using means ($\tau = 0.345$, $p = .042$). The Pettitt's tests revealed no definitive change points for any of the three variables. The results indicate a statistically significant increase in structural readability over time, alongside a non-significant rise in jargon use.

However, the LOESS plots illustrate a visually noticeable and fluctuating upward trajectory in both structural readability and normed jargon use (see Fig. 1). A slight dip in all three curves is also observed around 2020, likely reflecting the impact of specialised COVID-19-related funding stream in 2020–2021 and a heightened societal expectation for accessible science communication during the pandemic (Druckman et al., 2025). In addition, the presence of more outliers in normed jargon use per text suggests greater variability, possibly driven by individual stylistic choices. As the corpus primarily comprises lay summaries from hard sciences, this variation suggests that communicative norms and technical demands are diverse across subfields, even within similar research domains.

Conclusion and discussion

Our study examines readability and jargon use in lay summaries of CRF grant proposals over the 19 years from 2006 to 2024. The findings suggest that, although readability measures fluctuate over time, these summaries generally fall within the senior-college to college-graduate level of readability and contain an 8.0% high average proportion of jargon use per text. These summaries are generally very difficult to read and the proportion exceeds the recommended 2% threshold for comprehension intended for general readers (Hu & Nation, 2000; Kremmel et al., 2023; Pellicer-Sánchez et al., 2024; Rakedzon et al., 2017).

Our results are in line with the high-level reading complexity and dense jargon use observed in lay summaries of research articles across various disciplines (Anderson et al., 2022; Rakedzon et al., 2017; Wen & Yi, 2023a; Wen et al., 2023). Furthermore, the average readability scores in our study suggest a higher level of reading complexity in lay summaries of CRF grant proposals compared to the roughly high-school graduate to college-junior level of readability identified in those of research articles (e.g., see Anderson et al., 2022; Wen & Yi, 2023a), hinting at an even greater accessibility challenges for non-expert audiences and the need for text simplification in writing lay summaries of grant proposals.

Furthermore, we observed a divergent temporal trend between structural and lexical readability. The structural readability composite score, aggregated from FKG, CLI, ARI, shows a significant increase over time. However, the lexical readability remains statistically stable, and normed jargon use exhibits a non-significant but visually noticeable upward trend. The combination of greater structural complexity and non-significant yet visible increase in jargon density suggests a trend towards a more detailed and compact writing style in lay summaries of CRF grant proposals, where individually-varied but densely-used specialised terms are embedded in longer and more complex sentences.

The detailed and compact writing style may reflect disciplinary norms in hard sciences, which dominate the present dataset. This tendency has been partially noted in prior studies (e.g., Kang et al., 2024; Wen & Yi, 2024), suggesting that disciplinary conventions influence rhetorical style and language use in writing academic abstracts. Soft and hard sciences may prioritise different aspects of academic writing due to their contrastive epistemic knowledge orientations (Becher & Trowler, 2001). In this sense, researchers in the hard sciences may prioritise precision and technical accuracy, prompting them to produce structurally complex and jargon-heavy prose that enhances perceived accuracy and professionalism (Cruz & Lombrozo, 2025; Knight, 2003). In contrast, soft disciplines such as the social sciences or humanities may favour narrative-driven and contextually grounded writing style (Marsden, et al. 2024).

In addition to disciplinary norms, previous research has suggested a negative correlation between abstract readability and citation counts (Ante, 2022; Wang, et al., 2022), implying that researchers may be incentivised to produce complex writing to signal intellectual rigor or enhance perceived impact among the public. Despite ongoing efforts by funding agencies to promote accessible grant writing (e.g., Charles & Whiteside, 2024; Matzler, 2021), our findings reveal a continued preference for longer sentences and specialised terms in grant proposal summaries over the two decades, consistent with the pattern observed in the scientific abstracts of disciplines like linguistics (Wang, et al., 2022) and information science (Lei & Yan, 2016).

It is plausible that these incentives also influence grant proposal writing practices, wherein authors replicate the rhetorical strategies typical of scientific abstracts to boost the

intellectual rigor, even when addressing non-specialist audiences. The disconnect suggests a consistent tension among the intended disciplinary precision, intellectual rigor, and public accessibility in science communication. Such writing can foster illusory comprehension among lay readers, where the text appears well-written and authoritative, but its content remains incomprehensible to readers (Cruz & Lombrozo, 2025; Shulman et al., 2020).

Improving the accessibility of scientific literature for interdisciplinary researchers, science communicators, policymakers, and the general public can facilitate knowledge transfer, translate findings into practice, enhance research impact, and inform policy-making (Dormer & Walker, 2020; Jin et al., 2021; Pushparajah et al., 2018; Rosenberg et al., 2023). In this sense, if accessible science knowledge is genuinely valued by funding committees, they may consider providing more explicit instructions on the rhetorical structure and language use of the submitted lay summaries, such as jargon, active voice, and comprehension threshold. Text mediation tools, such as readability analysers, de-jargonisation tools and AI-powered writing tools, can be useful solutions for simplifying linguistic complexity and minimising jargon (e.g., see Falkenberg et al., 2024; Wen & Yi, 2023b).

However, it remains unclear whether grant applicants perceive the general public as the intended audience for lay summaries. In practice, authors may write with specialist reviewers in mind, despite explicit instructions to address non-specialist readers. This may lead to their choice of complex writing style in preparing both lay summaries and the full proposal content. To rationalise or demystify their choice, we need to address two crucial questions: the extent to which review panels assess the communicative effectiveness of lay summaries and whether readability or other linguistic features influence funding decisions. Although some studies have hinted a plausible link between the rhetorical features and funding outcomes (Charles & Whiteside, 2024; Markowitz, 2019), this relationship remains largely unexplored.

This study focuses on funded CRF proposals due to limited access to unfunded submissions and reviewer evaluations. This limited access restricts our ability to assess how language use factors into funding decisions and to understand who applicants perceive as their audience. However, future research could benefit from a more comprehensive analysis, including unfunded proposals and reviewer assessments, to examine whether or how linguistic features play a role in grant evaluation and funding outcomes. Qualitative interviews with writers or readers could provide insights into the authors' stylistic rationale and readers' expectations and experiences.

The study also identified a slight dip across all measures around 2020 in the LOESS plot, which may reflect greater societal demands for accessible science communication during the COVID-19 pandemic (Druckman, et al., 2025). Furthermore, the presence of outliers in normed jargon use per text suggests variability in individual stylistic choices, suggesting differences in how authors approach grant proposal writing. These patterns highlight possible route for future research into the societal influences on academic writing practices and the heterogeneity of rhetorical strategies employed by researchers.

Although we suspect that soft disciplines may produce more reader-friendly summaries than hard sciences, to the best of our knowledge, no cross-disciplinary studies have systematically examined this issue in the context of lay summaries. In this study, we also did not pursue statistical comparisons between disciplines due to the pronounced imbalance of hard science over soft science topics in the corpus. Nonetheless, as disciplinary conventions can influence writing style in science communication (e.g., Wen & Yi, 2024), future research would benefit from a comparative analysis across disciplines or across subfields. Alternative text complexity measures, such as Coh-Metrix (Graesser et al., 2004), could be used to reveal more linguistic features in lay summary writing.

Appendix

Keyword-based classification map

- *Biology & Medicine*: "protein", "cancer", "pathology", "ginsenoside", "steroid", "carcinoma", "liver", "peptidomimetics", "neuroscience", "biology", "biomedical", "cell", "physiology", "genetics", "pharmacology", "immunology", "medical", "medicine"]
- *Business Studies*: "business", "economics", "finance", "management", "marketing", "accounting", "organization", "commerce", "corporate", "entrepreneurship"
- *Engineering*: "engineering", "technology", "ion", "implantation", "resonant", "structures", "coding", "circuit", "robotics", "mechanical", "nanotechnology", "energy", "simulation", "optics", "system", "device", "material", "design", "network"
- *Humanities*: "history", "philosophy", "literature", "art", "religion", "aesthetics", "culture", "narrative", "ethics", "language"
- *Social Sciences*: "sociology", "anthropology", "education", "psychology", "law", "politics", "gender", "identity", "communication", "media", "society", "policy"
- *Physical Sciences*: "physics", "chemistry", "quantum", "mathematics", "computation", "data", "algorithm", "plasmonics", "neural", "spectroscopy", "thermodynamics"

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Competing Interest None.

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