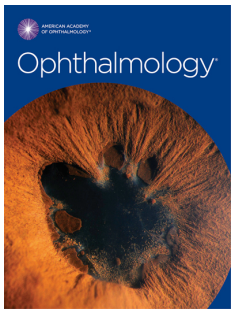
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Positive Language in Ophthalmology Abstracts: A 30-Year Sentiment Analysis

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Positive Language in Ophthalmology Abstracts: A 30-Year Sentiment Analysis

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Abstract

Positive language in ophthalmology abstracts increased 2.8-fold between 1996 and 2025, with acceleration after 2021. The trend persisted after adjustment for abstract length and study characteristics, suggesting a substantive shift in scientific language.

Keywords: positive language, sentiment analysis, ophthalmology, bibliometrics, research reporting, VADER, natural language processing

Abbreviations and Acronyms

CI = Confidence Interval

OR = Odds Ratio

VADER = Valence Aware Dictionary and sEntiment Reasoner

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Positive language in scientific abstracts has increased substantially across biomedical literature.[1,2] Vinkers et al. reported an 880% increase in positive-word use in PubMed abstracts between 1974 and 2014,[3] and spin in scientific reporting remains common. However, whether this trend extends to ophthalmology, and whether it varies across study types and subspecialties, remains unknown. Because abstract language can influence how readers interpret the strength of evidence, identifying specialty-specific patterns in linguistic framing is important for accurate scientific communication.

Accordingly, this study quantified 30-year trends in positive and negative language in ophthalmology abstracts using complementary lexicon-based and VADER sentiment analyses and examined variation across study and publication characteristics.

We performed a retrospective bibliometric analysis of ophthalmology-related PubMed abstracts published between 1996 and 2025 using the National Center for Biotechnology Information E-utilities API. Ophthalmology-related records were identified using 58 Medical Subject Headings (MeSH) terms covering major ophthalmic diseases, conditions, and subspecialties, without restriction by journal. Study type was classified using PubMed publication-type tags, geographic region from first-author affiliations, and ophthalmic subspecialty using MeSH-based mappings. After exclusion of retracted records, non-English abstracts, and abstracts shorter than 50 characters, 482,988 abstracts were included. This study used only publicly available bibliographic data from PubMed and did not involve human participants or identifiable private information; therefore, institutional review board

approval and informed consent were not required, and the Declaration of Helsinki was not applicable.

Positive and negative language prevalence, defined as the proportion of abstracts containing at least one positive or negative word, was quantified using a validated lexicon of 25 positive and 25 negative words derived from Vinkers et al.[3] Abstract-level sentiment polarity was independently assessed using the Valence Aware Dictionary and sEntiment Reasoner (VADER) algorithm.[4] For specialty-specific validation, 100 randomly selected abstracts were manually assessed for positive and negative language and overall valence by a reviewer blinded to the automated results; agreement with lexicon-based classifications was assessed using Cohen κ, and human-rated valence was compared with VADER compound scores using Spearman correlation. Temporal trends were evaluated using linear regression, Mann-Kendall tests, and Joinpoint regression.[5]

For multivariable and supporting analyses, a year-stratified sample was constructed by randomly selecting without replacement up to 1,000 PMIDs per publication year to maintain comparable representation across years (N = 29,310). To assess whether this sample differed systematically from the overall corpus, PMID-matched records were compared with the remaining abstracts using standardized mean differences. Multivariable logistic regression was performed to examine factors associated with high positive language use (top quartile of positive-word counts), adjusting for publication year, study type, geographic region, subspecialty, abstract structure, journal impact status, and abstract length. Sequential adjustment, mediation, and sensitivity analyses were performed to

assess the robustness of the temporal association. Statistical analysis was conducted using Python 3.12, with statistical significance defined as P <0.05.

Positive language prevalence increased from 8.2% in 1996 to 23.3% in 2025, representing a 2.8-fold increase (P <0.001; **Fig 1A**). Joinpoint regression identified an inflection point in 2021, after which the annual increase steepened from 0.354%/year to 2.782%/year (**Fig 1B**). By contrast, negative-word prevalence increased only modestly (2.8% to 3.2%). VADER sentiment analysis similarly showed an increase in mean compound score from 0.114 in 1996 to 0.325 in 2025 (P <0.001). In the manually reviewed random sample (n = 100), human assessments showed 84% and 88% agreement with the lexicon-based positive- and negative-language classifications (κ = 0.66 and 0.64, respectively), and human-rated overall valence correlated with VADER compound scores (Spearman ρ = 0.57; P <0.001).

In multivariable analysis of the year-stratified sample (N = 29,310; **Fig S1**, available at www.aaojournal.org), publication year remained independently associated with high positive language use (odds ratio [OR], 1.03 per year; 95% confidence interval [CI], 1.02–1.03; P <0.001). Using the top quartile of VADER compound scores as the outcome showed a similar association with publication year (OR, 1.026 per year; 95% CI, 1.021–1.031; P <0.001). Greater standardized abstract length was associated with positive language (OR, 1.23; 95% CI, 1.19–1.27). Randomized controlled trials (OR, 1.77; 95% CI, 1.53–2.05), clinical trials (OR, 1.54; 95% CI, 1.27–1.86), and reviews (OR, 1.64; 95% CI, 1.50–1.79) had higher odds than original articles (all P <0.001). Of the 29,310 year-stratified abstracts, 29,296 matched the full corpus by PMID. Positive-language measures were similar to the remaining 453,692 abstracts, although the matched sample included somewhat

earlier publications (mean year, 2010.7 vs 2012.7; |SMD| = 0.223). In sequential adjustment models, the association between publication year and positive word use remained significant after adjustment for abstract length, structured abstract format, and study type. Mediation analysis showed that abstract length accounted for 18% of the temporal increase in positive word use (**Fig S2A-B**, available at www.aaojournal.org). Sensitivity analyses, including restriction of the study period, exclusion of the most prevalent positive word ("novel"), and normalization by abstract length, yielded consistent results (**Table S1**, available at www.aaojournal.org). Excluding "novel" attenuated the slope by 61% but did not eliminate the temporal trend (**Fig S2C**, available at www.aaojournal.org).

In this 30-year bibliometric analysis of nearly half a million ophthalmology abstracts, positive language increased substantially, with marked acceleration after 2021. The findings extend prior work demonstrating increasing positive language across biomedical literature and suggest that similar patterns are present within ophthalmology. Abstract length accounted for only a minority of the temporal increase, suggesting that structural changes in abstract formatting did not fully explain the observed trend. The acceleration observed after 2021 may reflect evolving editorial practices and increasing use of manuscript-preparation technologies.[6] Higher positive language use in trials and reviews may reflect greater emphasis on communicating treatment efficacy and overall evidence. Subspecialty differences may relate to variation in research focus, therapeutic activity, and reporting practices.

This study has limitations. Lexicon-based analyses may not fully capture specialty-specific terminology, and the analysis was limited to English-language

abstracts. Increased positive word use should not be equated with scientific spin, as we did not assess whether abstract wording accurately represented the underlying study findings. Restriction to PubMed-indexed records may have excluded ophthalmology literature indexed only in other databases, potentially limiting the completeness and generalizability of the observed language trends. In addition, observational bibliometric analyses cannot determine causality.

Overall, positive language in ophthalmology abstracts has increased substantially over the past three decades. Although increased positive wording does not necessarily constitute scientific spin, the observed trend underscores the importance of balanced and precise abstract writing that accurately reflects research findings.

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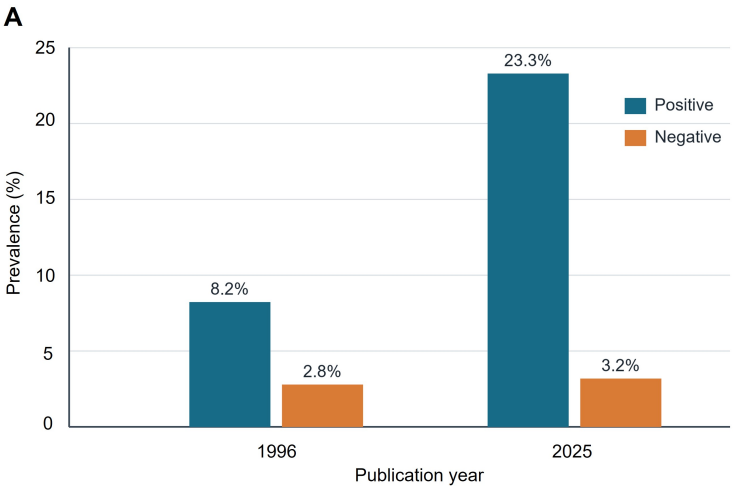
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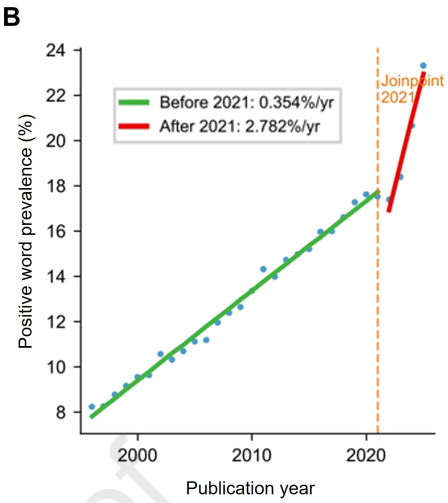
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Figure Legend

Figure 1. Temporal changes in positive and negative language in ophthalmology abstracts. (A) Positive- and negative-word prevalence in 1996 and 2025. (B) Joinpoint regression of positive-word prevalence, showing an inflection point in 2021 and a steeper annual increase thereafter.

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Young Kook Kim	☒	☒	☒	☒	☒
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	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
	☐	☐	☐	☐	☐
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OTHER CONTRIBUTIONS: