Presented at 2025 European Meeting of ISMPP;
27-29 January 2025; London, United Kingdom.

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Poster 21

Using storytelling to communicate complex science: a quantitative and qualitative assessment of the narrative properties of journal articles on genetic medicines

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> Introduction

- Healthcare providers, who are faced with scientific and medical information of ever-increasing volume and complexity, may benefit from greater use of a narrative style in journal articles
- Storytelling has been associated with several advantages, including increased ease of comprehension, higher engagement, shorter reading times, and improved knowledge retention[1,2]
- We wanted to understand the extent to which a narrative style is being used in industry-supported journal articles on genetic medicines, a complex field where education gaps are widespread among clinicians and nonexperts alike[3-5]

> Objectives

- To characterize the narrative structure of industry-supported journal articles on genetic medicines, using abstracts as a surrogate for the full texts
- To evaluate the degree of narrativity of abstracts from review articles on genetic medicines
- To determine whether a more-narrative style of abstract might increase the influence of the corresponding articles (citation count and Altmetric Attention Score)

> Methods

Selection of journal articles

- We searched Embase (Elsevier) for industry-supported journal articles on genetic medicines (antisense oligonucleotides, RNA interference therapies, gene therapies, and gene-editing therapies), published over a 5-year period (2018-2022)
- Various descriptors for each therapeutic modality were used as search terms in the "title or abstract" field, and the names of 143 clinical-stage genetic medicine companies were used as search terms in the "affiliation" field

Characterizing the narrative structure of abstracts

- The narrative structure of the abstracts from these articles was characterized using Linguistic Inquiry and Word Count (LIWC-22) text analysis software, which calculates the percentage of total words in a text that fall within predefined linguistic and psycholinguistic categories[6]
- The abstracts were divided into 5 equal-length segments, each of which was analyzed for 3 underlying processes: Staging (exposition and establishing context), Plot Progression (actions that drive the story forward), and Cognitive Tension (cognitive processes, conflict, or uncertainty) **(Table 1. STRUCTURE)**
  - The 3 process scores and Overall Narrativity score (average of the 3 process scores) were obtained for each abstract
  - Overall Narrativity score indicates the degree of similarity between the narrative arc of the examined text and the normative arc defined by Boyd et al **(Figure 1)**[7]

Evaluating the degree of narrativity of review article abstracts

- The abstracts were evaluated for an additional 11 narrative elements across 6 themes, based on research from the fields of narrative theory, psychology, and linguistics **(Table 1)**
- Data were collected using LIWC-22, Coh-Metrix 3.0 (a computational tool that analyzes text on measures of cohesion, language, and readability), and human assessment (for narrative elements that lacked automated solutions or were of a more subjective nature)[8]

Assessing the relationship between narrative elements of the abstracts and the influence of review articles

- Citation count (Web of Science) and Altmetric Attention Score were used as measures of influence for the articles associated with each abstract. These variables were log-transformed to mitigate their skewed distributions
- We tested for associations between individual narrative elements and citation count or Altmetric Attention Score, using Wilcoxon rank-sum test (binary variables) and Pearson or Spearman's correlation coefficients (continuous variables with normal and non-normal distributions, respectively)
- Multiple linear regression modeling was used to identify narrative elements predictive of citation count or Altmetric Attention Score, with alpha = 0.05 defining statistical significance

Figure 1. Traditional narrative structure of stories

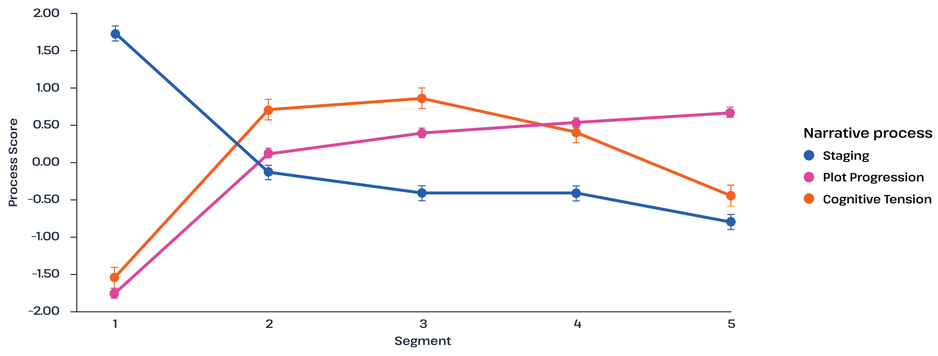


Table 1. Narrative structure and narrative elements evaluated

Themes	Narrative elements	Description
STRUCTURE (narrative structure)	Overall Narrativity[a]	Extent to which the abstract resembles a normative narrative arc. Score is an average of the 3 subscores and ranges from -100 to +100 (perfect alignment)[6,7]
	Staging[a]	The relative frequency of articles and prepositions in the text, which indicates communication of initial background information in the story[6]
	Plot Progression[a]	The relative frequency of pronouns, auxiliary verbs, and other function words in the text, with higher rates signifying momentum of the story[8]
	Cognitive Tension[a]	The relative frequency of cognitive process words (eg, "think," "believe"). Higher rates may reflect rising action in the story[6]
TIME OR LOCATION	Time or location (setting)[b]	Setting provides context and is a critical component of narratives[9]
ORIGINALITY OR CREATIVITY	Lexical diversity[c]	The variety of unique words relative to the total number of words[10]
	Hook[b,d]	Presence of a "hook"—an element within the title or first 3 sentences that may grab the readers' attention (defined as: declarative statement, alliteration, onomatopoeia, idiom, simile, metaphor, oxymoron, unanswered or rhetorical question, data/statistics, quotation)[11]
RECOMMENDATIONS	Recommendations[b]	Presence of advice or a recommendation from the authors[9]
IMMEDIACY	First-person narration[a]	Use of first-person plural pronouns ("we," "our"), which can increase immediacy.[8]
	Frequency of articles[a]	Frequency of articles ("a," "an," "the"). Increased frequency may reduce immediacy.[8]
EMOTION	Emotional tone[a]	Composite measure of emotional tone that combines positive and negative tones. Score is converted to percentiles based on standardized scores from large comparison corpora. Score ranges from 1-100[6]
SIMPLICITY AND CLARITY	Words per sentence[a]	Use of shorter sentences may improve readability and clarity[12]
	Concreteness of content words[c]	Use of concrete (rather than abstract) words, which evoke mental images and are more meaningful[10]
	Connectives[c]	Incidence of words that provide links between ideas, including causal (eg, "because"), logical (eg, "and," "or"), adversative (eg, "whereas"), temporal (eg, "first"), and additive (eg, "moreover")[9,10]
	Supporting resources[b]	Examples include graphical abstracts, plain-language summaries, glossaries, and videos[13]

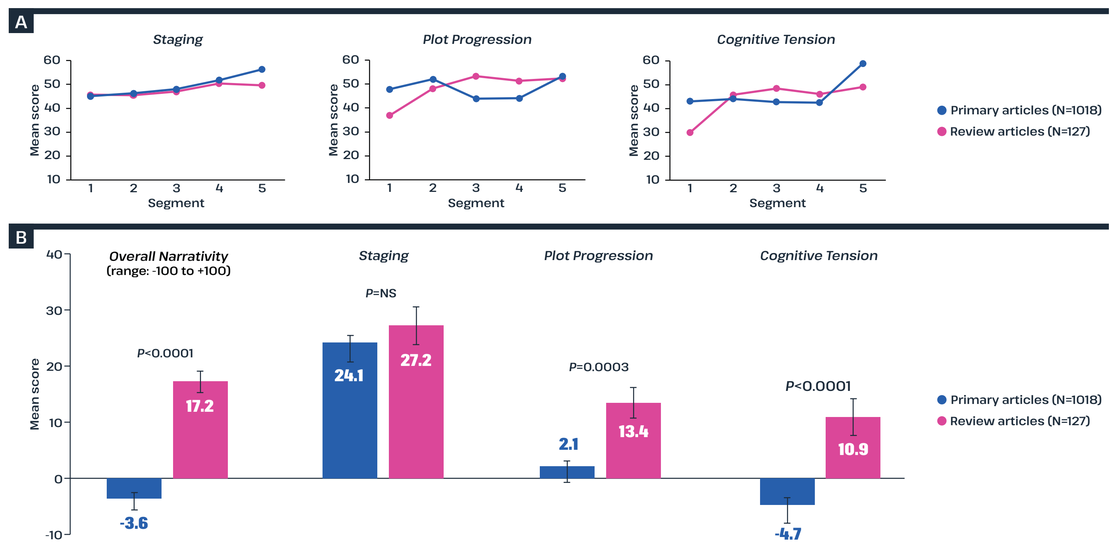
[a]Assessed using LIWC22 software. [b]Values obtained by manual review of the abstracts. [c]Assessed using Coh-Metrix 3.0. [d]Volunteers (12 medical communications professionals with mean 10.5 years' industry experience) reviewed the title and first 3 sentences of the abstracts for the presence of the following: declarative statement, alliteration, onomatopoeia, idiom, simile, metaphor, oxymoron, unanswered question, rhetorical question, data or statistics, or a quotation. Abstracts were assigned a binary value of 0 (absence of hook) or 1 (presence). Each abstract was reviewed by 3 volunteers, and the final scores were binarized as 0 (absence of a hook) or 1 (presence).

> Results

Narrative structure of abstracts from primary articles and review articles

- A total of 1145 articles were included (1018 primary articles and 127 review articles)
- Line plots of the average Staging, Plot Progression, and Cognitive Tension scores showed that the narrative arcs of these abstracts diverged from the normative narrative arcs of other texts **(Figure 2A)**
- The Overall Narrativity **(Figure 2B)** of review articles was higher than that of primary articles ($P<0.0001$), an effect that may have been driven by higher scores for Plot Progression ($P=0.0003$) and Cognitive Tension ($P<0.0001$)

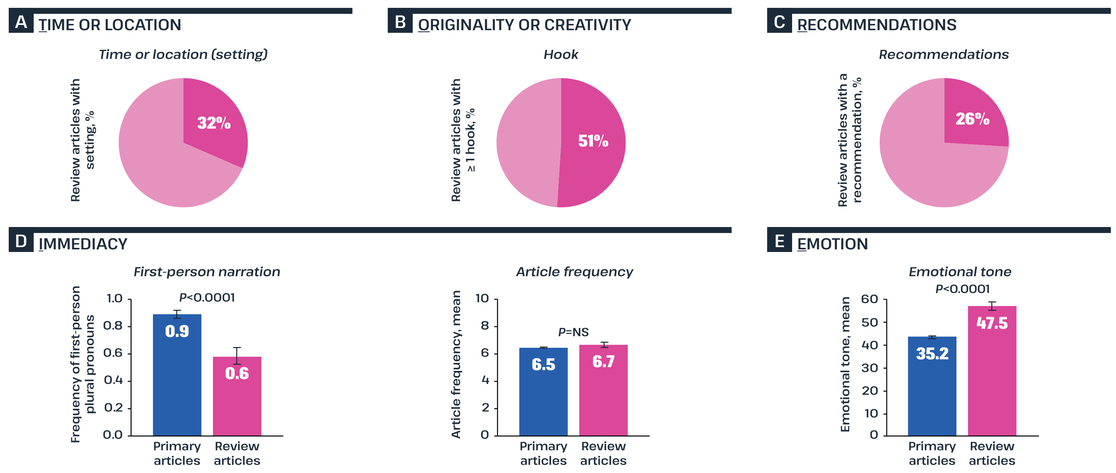
Figure 2. Comparison of the narrative structure of abstracts from primary articles vs review articles.



The degree of narrativity of review article abstracts: 11 narrative elements

- Time or location (setting), a hook, and a recommendation to the reader was included in 32%, 51%, and 26% of review article abstracts, respectively **(Figure 3A,B,C)**
- First-person pronouns, which can increase the immediacy of writing, were used less frequently in review articles, but the frequency of articles ("the," "a," "an") in sentences, which can decrease immediacy, was similar in both types of articles
- Emotional tone was significantly higher in abstracts from review articles than in abstracts from primary articles

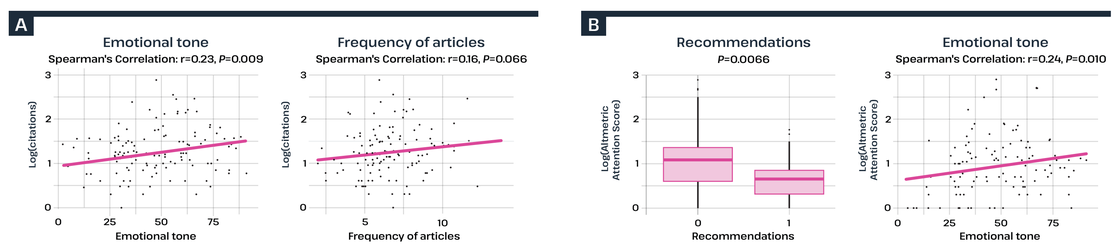
Figure 3. Narrative elements of abstracts from review articles.



Association between individual narrative elements and influence of review articles

- Overall Narrativity was not predictive of citation count or Altmetric Attention Score ($P>0.05$; data not shown)
- Emotional tone was positively associated with citation count (r=0.23, $P=0.009$), and there was a nonsignificant trend toward frequency of articles and citation count being positively associated (r=0.16, $P=0.066$) **(Figure 4A)**
- Surprisingly, there was a negative association between recommendations and Altmetric Attention Score (Wilcoxon rank-sum test, $P=0.007$). Emotional tone was positively associated with Altmetric Attention Score (r=0.23, $P=0.009$) **(Figure 4B)**

Figure 4. Plots showing relationships between individual narrative elements and review article (A) citation count and (B) Altmetric Attention Score.



Multiple linear regression models: impact of narrative elements on review article influence

- **Model 1 - log(citations)**: Citation count was positively associated with changes in frequency of articles ($P=0.013$) and emotional tone ($P=0.004$), controlling for other variables
  - Only 15.3% of the variance in citation count was explained by the model
  - The F-statistic of 1.71 ($P=0.073$) indicates the model is not statistically significant at predicting the dependent variable
- **Model 2 - log(Altmetric Attention Score)**: Altmetric Attention Score was negatively associated with recommendations ($P=0.004$), whereas emotional tone had a statistically significant positive relationship ($P=0.017$), while holding other variables constant
  - Taken together, the narrative variables explained 18.3% of the variance in Altmetric Attention Score
  - The F-statistic of 1.81 ($P=0.056$) indicates the model is not significant, but it is close to the threshold for significance

> Conclusions

- Although the abstracts of journal articles on genetic medicines had low narrativity relative to traditional stories (eg, novels, movies), review articles scored higher than primary articles
- Increased emotional tone was associated with both increased citation count and higher Altmetric Attention Score
- Multiple linear regression analyses for predicting citation count or Altmetric Attention Score found a trend toward the narrative elements we selected being collectively significant; however, this trend did not meet the significance level at 0.05
  - Adopting a more-narrative style may translate to increased influence of review articles, but this requires further confirmation
  - Limitations of the study include the small sample size, inclusion of a diverse range of journal titles, and the omission of journal impact factor as a variable in the analyses
- Nevertheless, our findings suggest there is room for improved storytelling in both primary and review articles

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Acknowledgements

The authors wish to thank Kristen Andersen, PhD; Jeff Hannah, PhD; Mike Hobert, PhD; Kristin French, PhD; Brianna Hoang, PharmD; Sarah Hutchinson, PhD; Dan Hutta, PhD; Dina Marenstein, PhD; Meghan Mooring, PhD; Justin Potuzak, PhD; and Levy Reyes, PhD for their assistance with reviewing the abstracts; Dan Cragg, Jennifer Park, Ma. Concepcion C. Sevilleno and Paulo Estriga of HCG for their creative support; Steven Graybow for editorial support; and Sabrina Hussaini from HCG for her logistical support.

Date of preparation January 2025.