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RESEARCH RESULT. THEORETICAL AND APPLIED LINGUISTICS

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СОДЕРЖАНИЕ

CONTENTS

РАЗДЕЛ I. ТЕОРИЯ ЯЗЫКА
SECTION I. THEORY OF LANGUAGE

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What happened to Complexity? A review of definitions, measurement and challenges

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Abstract. The widely recognised multi-compositionality of linguistic complexity has led scholars to formulate several definitions of the construct according to the perspective taken on the matter in each field. The measurement of English complexity, in particular, seems to have long relied on a few indices, mainly lexical and morpho-syntactic, which in some cases appear to have been preferred over other measures for their ease of computation rather than methodological effectiveness. The picture of complexity emerging from the present review is that of a construct that often still lacks a thorough and shared definition and operationalisation. Notwithstanding these issues, it is argued that investigating linguistic complexity is still important and its study becomes more tractable when 1) it is carefully discerned from cognitive complexity (i.e., difficulty), thus when the linguistic forms characterising a text and their functions are studied separately from the implications these have on cognitive processing; 2) resorting to evidence-based inductive approaches, which reduce the impact of the set of *a priori* assumptions inherited from traditional categories of linguistic analysis about how language works; 3) adopting a register-functional approach, which adds an explanatory dimension to the study of linguistic complexity by taking into account how the communicative purposes, the type of audience and the production circumstances of a text influence its complexity.

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1. Introduction

The construct of linguistic complexity has always been elusive and problematic from the point of view of its definition, operationalisation and measurement (Norris, Ortega, 2009; Pallotti, 2009; Bulté, Housen, 2012; Housen et al., 2019; Joseph, 2021; Biber et al., 2022). Many scholars have tried to contribute to the debate by widening or narrowing its scope and proposing an array of complexity indices for measurement (Norris, Ortega, 2000; Arends, 2001; McWhorter, 2001; Nichols, 2009; Trudgill, 2001, 2004; Miestamo, 2008; Bulté, Housen, 2012; Kortmann, Szmrecsanyi, 2015; Lintunen, Mäkilä, 2014; Pallotti, 2015; Biber et al., 2022). Nonetheless, a comprehensive theory which could account for the complexities of

all levels of linguistic analysis, i.e., grammatical, lexical, phonological, pragmatic, was never put forward. Dealing with one level of linguistic complexity or the other requires different theoretical frameworks and measures, also mirroring the linguistic field within which the studies on complexity are being conducted: for instance, the approach to complexity in linguistic typology is different from the one adopted in second language acquisition (SLA henceforth) with the former mainly focusing on structural complexity, i.e. the complexity of a language system, and the latter on developmental complexity, i.e. the complexity of the process of language learning and acquisition.

Most of the problems concerned with the definition of linguistic complexity lie with the terms that have been used in the literature to describe it, which are recognised to be vague and circular (Bulté, Housen, 2012; Joseph, 2021; Biber et al., 2022). For example, from the SLA perspective Skehan (2003: 8) claims that complexity 'refers to the complexity of the underlying interlanguage system developed' and Ellis and Barkhuizen (2005: 139) define complexity as the 'use of challenging and difficult language.' These tautological statements do not allow to pose a common basis as to what 'complex' actually means in linguistics and how to establish whether certain linguistic features or structures are more complex than others, both within the language and across languages (cf. Equicomplexity Hypothesis, Dahl, 2004; Kusters, 2003; McWhorter, 2001; Miestamo, 2006).

An array of different definitions of linguistic complexity have been put forward in the literature (e.g., structural, cognitive, discourse-interactional), each one touching upon one or more dimensions of complexity (see Section 2). Among these, perhaps the most cited is Miestamo's (2008) articulation of linguistic complexity into *absolute* and *relative* complexity, which introduced the important distinction between the complexity intrinsic to a language system (e.g., phonological, lexical and syntactic inventory and rules) and the impact of user's variables (such as motivation, L1 background, etc.) on the complexity of their linguistic production. In fact, complexity can be articulated into at least three main sub-constructs: one is the *complexity of the structure*, i.e., the language system under analysis with its features and rules; another is *cognitive complexity* which involves the cognitive cost (i.e., difficulty) required by the processing of more or less complex language (Hulstijn, Graaf, 1994); the last is *developmental complexity*, which corresponds to the order in which language features and rules are acquired and mastered in both first and second language acquisition (Bulté, Housen, 2012; Pallotti, 2015). Discerning between *structural, cognitive* and *developmental* complexity, however, represents only a first step into defining the components of such a multi-faceted construct. Moreover, provided one manages to satisfactorily define its sub-constructs, it is rarely made explicit how the sub-constructs stand in relation with one another as well as where they overlap. A further issue with the systematisation of linguistic complexity is represented by the identification of analytical measures, as this stage heavily depends on the formulation of definitions concerning what counts as complex, how linguistic features are placed on the continuum less-to-more complex, and what are the measures that could reliably provide a quantitative indication of the degree of complexity of a feature or dimension under study.

2. Aims and methodology

The present review provides an overview on the definitions, operationalisation and measurement of English complexity as dealt with in the literature between the decades 1900-2020 with a focus on the challenges and issues presented by this construct. The final aim is to propose a number of adjustments to be implemented in the study of complexity that could solve some of the issues that have earned complexity the label of 'intractable' construct (Joseph, 2021).

The questions that will be answered are:

1) Which definitions of linguistic complexity are there and what are their limitations?

2) How has linguistic complexity been measured so far?

3) What methodological changes could improve the reliability of complexity studies?

The theories reported in the paper and the related operationalisations through a number of indices and complexity measures will be critically discussed in order to highlight the ways in which such theories and measures can be biased or ineffective. This step is particularly relevant since many studies on complexity have simply borrowed measures and indices without testing whether these could yield reliable results.

For reasons of space, the paper focuses on English linguistic complexity and its relation to SLA, which has fostered a substantial body of scholarly production and discussion on the topic (see DuBay, 2004; Nelson et al., 2012; Pallotti, 2015; Joseph, 2021). The author, however, is aware of the contribution made by functional-typological studies (e.g. Kusters, 2003; Miestamo, 2006, 2008; Nichols, 2009; Sinnemäki, 2011; Di Garbo, Miestamo, 2019) to the debate on linguistic complexity and will occasionally resort to them.

It will be maintained that changing the approach to the definition of complexity, while also becoming aware of certain linguistic bias, substantially improves the quality of research and the reliability of results.

The paper is structured as follows: definitions of linguistic complexity are illustrated in Section 3 from the first global definitions of 'code complexity' to the articulation into sub-constructs of linguistic complexity; Section 4 outlines the measures of complexity and discusses the limitations; Section 5 deals with the complexity of written vs. spoken language; finally, in Section 6 methodological adjustments are proposed and conclusions are drawn.

3. Definitions of complexity

It is difficult to find a commonly accepted definition of linguistic complexity in the literature (Bulté, Housen 2012: 22, Pallotti, 2009), due to the polysemy of the term 'complexity' itself. As Pallotti (2015: 2) points out, even when looking at the dictionary definition of complexity, the term encompasses at least two main meanings: the first underlines the multi-compositionality of complex items as 'composed of two or more parts'; the second highlights the difficulty implied in something complex as 'hard to separate, analyze or solve'[1].

The first notions of 'code complexity' (Candlin, 1987, Skehan, 1996), thus complexity applied to language, were proposed by researchers who, as many teachers and lay people, noticed that some communicative tasks appeared to be more difficult than others in that they required more complex language, such as sophisticated vocabulary and syntactic structures, to be processed and produced. Linguistic complexity, in other words, has long been bound to the concepts of effort and difficulty. As a consequence, certain expressions, namely long structures and infrequent words, were deemed linguistically complex because generally perceived as difficult to process (cf. DuBay, 2004, Nelson et al., 2012). Between the 1800s and 1960s the literature focused on the implications length, frequency and predictability of linguistic expressions had on linguistic complexity: Sherman (1893) studied the sentence length of novels and noted that sentences were becoming shorter, thus simpler, over time; Zipf (1935) highlighted how frequent words in languages tend to be short, thus optimising form-meaning matching by requiring less processing effort (cf. Law of Abbreviation;

[1] https://www.merriam-webster.com/dictionary/complex (accessed: 06.02.2025)

Principle of Least Effort); Shannon (1948) related the unpredictability of the occurrence of certain words or expressions in a context to complexity; focusing on the written text, the literature on readability (Kitson, 1921; Lively, Pressey, 1923; Thorndike, 1934; Gray, Leary, 1935; Lewerenz, 1935; Patty, Painter, 1931; Flesch, 1948; Klare, 1963, 1974-5; Fry, 1968) claims that shorter sentences and words, as well as frequent vocabulary items, promote reading ease. Finally, with Chomsky (1957), syntax too begins to be given considerable importance in contributing its own complexity to the text, which is not only related to the length of sentences but also to the underlying rules of combination of its elements.

Over time complexity turns out to be a broader construct than the one originally outlined and begins to include different aspects of linguistic competence and sophistication. As mentioned in Section 1, two broad definitions of complexity become most often adopted and investigated in the literature around the years 2000s: *absolute complexity* and *relative complexity* (Miestamo, 2008).

Absolute complexity refers to the degree of sophistication of a language system. This approach studies the number of parts a linguistic system is composed of (e.g., sounds, vocabulary, morphological marks, etc.) together with the number and types of connections between the parts (e.g., word formation rules, syntactic rules, etc.). As outlined by Pallotti (2015), the expression 'structural complexity' is often preferred to 'absolute complexity', since the latter implies the existence of a theory-free description of language which is, in fact, very unlikely (Kusters, 2008: 8); what is complex according to an analytical framework or theory might not be according to another (Bulté, Housen, 2012: 26). The study of structural complexity is approached in two main ways (Dahl, 2004: 51): one is through *Kolmogorov complexity* (Li, Vitányi, 1997) according to which complexity directly corresponds to the length of the description of a linguistic feature or language system; the second is *descriptive complexity* which, in a similar way to *Kolmogorov complexity*, still defines structural complexity in quantitative terms, yet instead of considering the length of descriptions as an indicator of complexity, it counts the number of different elements in a linguistic production – or language system – and their interconnections (Pallotti, 2015: 4). For instance, German pronominal system requires a longer description than the English one. Similarly, the number of features expressed by German personal pronouns is higher compared to English pronouns. Indeed, German pronominal paradigm is characterised by a rich case system which marks accusative and dative by suffixation, whereas English pronouns have fewer cases marked by suffixation (see table 1 below); the dative case is marked in English either by the prepositional phrase *to + Noun Phrase* or by the accusative case in double accusative constructions (e.g., *She gave him a book*). Furthermore, differently from English, German encodes the distinction between formal and informal address on the second person, namely *du* vs. *Sie*, which produces pairs of second person pronoun forms in the plural, and in the accusative and dative cases (see table 1 below). Therefore, according to the quantitative parameters used to measure structural complexity (including Kolmogorov complexity), German personal pronouns are more complex than English personal pronouns.

Table 1. Personal pronouns in German and English

	German			English	
	Nominative	Accusative	Dative	Nominative	Accusative
1st	Ich	mich	mir	I	Me
2nd	Du (inf.)/Sie (form.)	Dich/ Sie (form.)	Dir/Ihnen (form.)	You	You
3rd	Er, Sie, Es	Ihn/sie/es	Ihm/ihr/ihm	He, she, it	Him, her, it
1st PL	Wir	Uns	uns	We	Us
2nd PL	Ihr (inf.)/Sie (form.)	Euch/Sie (form.)	Euch/Ihnen (form.)	You	You
3rd PL	Sie	Sie	Ihnen	They	Them

Although conceptually straightforward, descriptive complexity may be a not so reliable construct for two reasons: first, the linguistic systems and sub-systems in which a lack of order is observed will be deemed more complex (Sinnemäki, 2011), since they will require longer descriptions. For example, irregular verb morphology in English would generate a longer description than regular verb morphology. Nonetheless, length of description does not constitute proof of complexity (Pallotti, 2015) due to the second reason i.e., the descriptive approach is deeply theory-laden as the length of the description depends on the analytical categories adopted (Joseph, 2021). In other words, being the analytical categories mainly based on Latin, the attempt to make traditional linguistic categories fit other languages is bound to produce longer descriptions, especially the more the language under analysis drifts apart from the one on which the analytical categories are based. This becomes particularly evident when looking at functional-typological studies, in which the categories used to analyse European languages are often not suitable to be applied to languages spoken outside of Europe (cf. Miestamo, 2008). Therefore, longer descriptions might not necessarily correspond to an actually higher degree of complexity as, simply, to a lack of appropriate labels and, ultimately, to biased analyses.

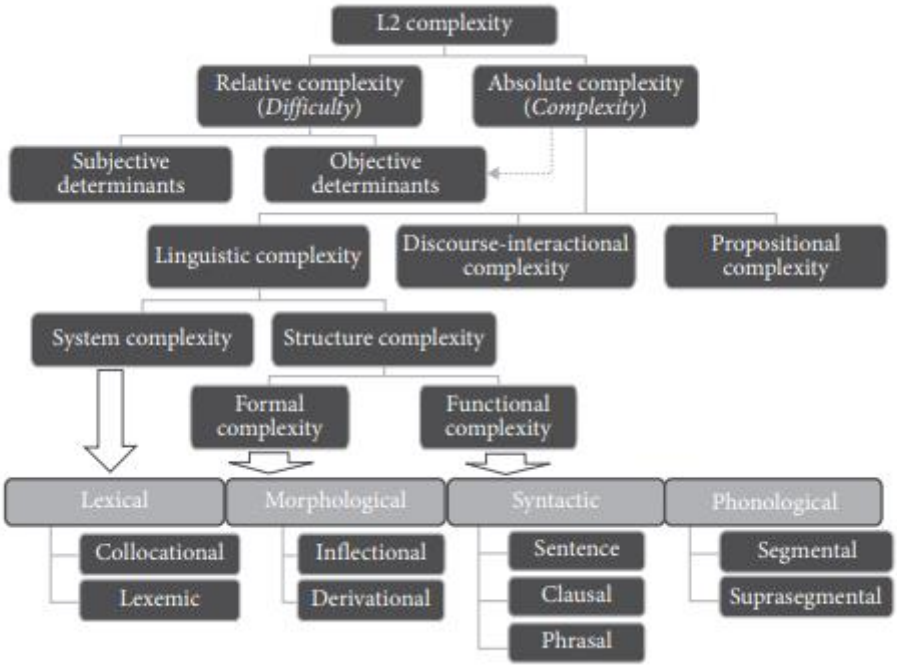
The second most common sub-construct of complexity is labelled *relative complexity*, since complexity is studied in relation to the language user and how individual variables affect the mastery of a second language (L2 henceforth). In particular, relative complexity investigates, on the one hand, the impact the structural complexity of the L2 exerts on teaching and learning (DeKeyser, 1998; Doughty, Williams, 1998; Spada, Tomita, 2010; Bulté, Housen, 2012) and, on the other hand, the linguistic complexity of the L2 output produced by learners. Furthermore, it makes inferences about the cognitive complexity (i.e. difficulty) experimented by the learner by looking at the order of acquisition of a number of linguistic features (e.g. 3SG present tense *-s*, passive constructions, relative clauses) based on the assumption that features that appear later in language development must be more difficult to master. While the impact of linguistic complexity on teaching and learning is believed to be related to the structural complexity of the target language, the complexity of the production of L2 learners is seen as the mirror of a learner's stage of

acquisition and level of proficiency as well as the result of the influence of learners' individual variables such as linguistic and cultural background, motivation, attention capacity, identity, etc. (Bygate, 1996; Derwing, Rossiter, 2003; Collentine, 2004; Norris, Ortega, 2000). *Relative complexity* in English has been eagerly studied in SLA through the Complexity, Accuracy, Fluency (CAF) paradigm (cf. Hunt, 1965; Brown, 1973; Skehan, 1996; Pallotti, 2009; DeKeyser, 2005 for a detailed discussion). Within the CAF paradigm, complexity is a characteristic of the learner's output and is related to the ability to produce linguistically demanding language in both variation and sophistication i.e., considering both quantitative (e.g., length, frequency of units) and qualitative (e.g., types of dependency) aspects (Ellis, Barkhuizen, 2005). This falls within the conception of 'more is more complex', whereby complexity ends up corresponding to a greater number of components in a unit and deeper levels of embeddings e.g., clauses occurring as part of other clauses, as happens in subordination (Bulté, Housen, 2012; Verspoor et al., 2017). In SLA complexity is most often investigated in terms of *systemic complexity* of an L2 learner's system through measures of global elaborateness (Bulté, Housen, 2012: 26) which bring together the learner's phonological, morphological, lexical, syntactic systems and so on. However, as pointed out by Bulté, Housen (2012: 22), studies on L2 complexity have often produced contradictory results, probably as a consequence of the ways in which complexity has been defined and operationalised in the first place. For example, the 3SG present -s in English has been characterised as simple (Krashen, 1994), formally simple yet functionally complex (Ellis, 1990) and formally and functionally complex (DeKeyser, 1998). A further limitation of L2 complexity studies can be found in the fact that the descriptions of a learner's interlanguage complexity have short-term value given the intrinsic variability and lack of stability of the interlanguage system (Pallotti, 2015). What can be observed is the complexity of learners' linguistic production at some stage of acquisition through the analysis of their production (e.g., texts and utterances), bearing in mind that any claim and generalization about the interlanguage system and its global complexity would represent a mere inference obtained from a few facts (Pallotti, 2015: 3).

3.1. Sub-constructs of complexity

Given the variability and proliferation of definitions of complexity, Bulté and Housen (2012: 23) propose a unified graphic representation of complexity constructs, which is reported in figure 1 below. Since their work adopts the L2 research perspective, both absolute and relative complexity are joined under the construct of *L2 complexity*, also given the intuition by many scholars about the interplay between absolute/structural complexity and relative complexity. Although the relationship between the two has not been clarified yet, scholars are prone to hypothesise, based on both experience and the results of cognitive studies (cf. Goldschneider, DeKeyser, 2001; DeKeyser, 2005), that the structural complexity of a linguistic feature may trigger what is referred to as *difficulty* (see figure 1 below) and more precisely defined as *cognitive complexity* i.e., the cost of using or learning and mastering that feature (see below).

Figure 1. Constructs of complexity: a taxonomy (Bulté, Housen, 2012: 23)



As can be observed in Figure 1 above, both absolute and relative complexity can be analysed on different levels, which vary according to the scope and dimension of language analysis. Structural complexity can be investigated locally by focusing on single aspects of the phonology, lexis, morphology or syntax, which can be analysed both formally (e.g. length, number of morphemes, lexical variation) and functionally (e.g. type of clause, semantic processes). On the phonological level, the aspects investigated in terms of complexity can be the size of the phoneme inventory, tonal distinctions, the maximum complexity of consonant clusters, the incidence of marked phonemes (Nichols, 2009; Shosted, 2006). Morphological complexity can be investigated through a mapping of the inflectional and derivational morphology, the degree of allomorphy, the number and types of morphophonemic processes (Kusters, 2003; Dammel, Kürschner, 2008; Pallotti, 2015). Syntactically, complexity can be investigated by looking at the level of clausal embedding permitted by the language, dependencies, the number of syntactic rules, the degree of movement allowed to the items in a sentence (Ortega, 2003; Givón, 2009; Karlsson, 2009). From a semantic and lexical point of view, complexity can be found in the degree of transparency (with one-to-one mapping of meaning onto form being considered less complex), homonymy and polysemy, the size of the vocabulary, the inclusive/exclusive distinction marked on pronouns, lexical variation, collocations, etc. (Fenk-Oczlon, Fenk, 2008; Kuiken, Vedder, 2008; Nichols, 2009; Bulté, Housen, 2012).

Structural complexity can be further combined with higher-level complexities which are relevant to the analysis of discourse, such as *pragmatic complexity, propositional complexity*, *interactional complexity* (Ellis, Barkhuizen, 2005). *Pragmatic complexity*, also labelled ‘hidden complexity’ (Bisang, 2009), concerns the quantification of pragmatic inferencing and its relationship with markedness and ambiguity (cf. Kilani-Schoch et al., 2011). *Propositional complexity* refers to the number of ideas encoded by the speakers in order to convey a given message (Zaki, Ellis, 1999; Ellis, Barkhuizen, 2005). Thus, the more idea units are encoded in narrating a story, the higher its propositional complexity. However, the authors do not explicitly state what exactly corresponds to an ‘idea unit’ and how it is

measured. Even the definitions of proposition found in the literature (Kintsch, Keenan 1973, Kintsch 1974, Turner, Greene, 1977) tend to vary according to whether certain elements are considered as constituting new propositions or as part of other propositions (e.g. the information contributed by verb tense and aspect, verb arguments, nouns, adjectives, etc.). It derives that the measurement of propositional complexity may oscillate greatly depending on the definition of 'idea unit' chosen. *Discourse-interactional complexity* (Young, He, 1998) measures how interactive a speaker gets in group exchanges. Interactional competence is defined as the knowledge and ability developed as a result of 'interactional processes during interactive tasks such as negotiation of meaning, feedback, and production of modified output' (Kim, 2009: 255). This type of complexity requires the mastery of processes such as corrective feedback, confirmation checks, recasts, metalinguistic comments as well as interaction management. It is a discursive practice in which participants are expected to recognise and to comply with expectations of participation in discourse by contributing with cultural, identity, linguistic and interactional resources (Morales, Lee, 2015: 34).

Taken all together, the different sub-constructs of linguistic complexity constitute parts of *absolute complexity*, which in the taxonomy by Bulté, Housen (2012) is conceived as an overarching construct comprising *structural complexity*. *Absolute complexity*, in turn, is seen as a determinant of *relative complexity*, which combines with user-related variables (i.e. subjective determinants) and ultimately results in the degree of difficulty experimented by a learner, thus making *relative complexity* overlap with *cognitive complexity* (Burleson, Caplan, 1998; Bell, 2004). In this view, complexity also needs to be defined in terms of what is cognitively costly or difficult to language users. However, many scholars have warned about the relativity of the concept of *difficulty* and the issues of including it in the definition of linguistic complexity. For example, based on psycholinguistic studies Kusters (2003) argues that a first hint of the relativity of difficulty is to be found in the different effects it has on speakers as opposed to hearers. In particular, Kusters (2003) reports that redundant agreement is found to be difficult to learn for L2 users, yet represents no burden for L1 speakers and facilitates the task of both L1 and L2 hearers (cf. Miestamo, 2008: 5). A second hint to the relativity of difficulty can be found in the development of proficiency: the more the learner's competence evolves, the more the L2 becomes second nature to them, the less the perceived cognitive complexity. A third point supporting the relativity of difficulty lies in the fact that the degree of difficulty experimented will depend on how accustomed learners are to certain structures and vocabulary (Van der Slik et al., 2019; Joseph, 2021). For example, speakers of languages that do not possess noun declension will find more difficult to learn a second language that does. Thus, the real question to be discussed when including difficulty in the construct of complexity is: 'complex to whom?'. The question would probably yield no user-type-neutral definition of complexity (Miestamo, 2008: 5) and represents a pivotal point which throws into question what the differences in structural complexity really mean and whether they are mere artifacts of the structural analysis linguists apply (Joseph, 2021).

In an attempt to adopt a more objective, user-independent perspective which would measure the cognitive cost of processing certain linguistic structures independently of the individual learner's variables, *difficulty* has been reformulated and investigated in terms of *cognitive complexity* (cf. Bieri, 1955 for a psychological approach, Wang et al., 2012 for a mathematics-based cognitive linguistic approach). Among user-independent factors contributing to cognitive complexity attention has been paid to *perceptual salience*, *frequency of occurrence*, *imageability* and *perceptibility* (Goldschneider, DeKeyser, 2001; DeKeyser, 2005). *Perceptual salience* can be defined as an intrinsic property of

certain linguistic entities which makes them more easily noticed (Kerswill, Williams 2002); for example, syllabic grammatical suffixes are more perceptually salient than non-syllabic ones e.g., the past tense syllabic /Id/ was found to be more easily attended to than the non-syllabic /t/ or /d/ (as in *learned* or *kissed*) (Goldschneider, DeKeyser, 2001; Klein et al., 2004). Syntactically, items occurring at the beginning or at the end of sentences are observed to be prioritised compared to items occurring in other positions. Indeed, marked word orders such as dislocations use sentence peripheries as loci for highlighting dislocated items and draw attention to them (Biber et al., 1999, 2021). *Frequency of occurrence*, therefore frequency of exposure, allows to draw attention to common expressions and to memorise them (Caruana, 2006; Van Lommel et al., 2006; Ghia, 2007). *Imageability* describes the ease with which a linguistic expression and its meaning can be associated with a mental image (Ellis, 1999; Griffin, Ferreira, 2006). The imageability factor is particularly evident in the difference between content and function words, with content words being more easily visualised, thus, prioritised in processing. *Perceptibility* refers to how easily the linguistic expression can be perceived (Goldschneider, DeKeyser, 2001; Gagarina, 2002): factors influencing perceptibility are, for example, the length of the expression, with longer items being more easily perceptible than short ones, and clarity of articulation, with voiced syllables being more perceptible than unvoiced ones (Ellis, 1999; DeKeyser, 2005). These quantitative and qualitative factors affect cognition in a proportionally inversed fashion: the less frequent, perceptible, imageable and salient a linguistic element is in its context, the more cognitively complex. It follows that more cognitively complex linguistic expressions are less easily, thus less likely, noticed and internalised in a context of L2 learning (Bley-Vroman, 2002; Bybee, 2008). Psycholinguistic studies have also demonstrated a relation between cognitive complexity and syntactic complexity showing how relative clauses and passives are harder to process than other structures such as coordinate and active structures (Diessel, 2004; Byrnes, Sinicrope, 2008). Cognitive complexity has always been an integral part of SLA studies because it is believed to be intertwined with developmental timing. In other words, what is acquired later in the process of developing an L1 or L2 was considered more cognitively complex (Diessel, 2004; Byrnes, Sinicrope, 2008). However, as intuitive as might seem to deem the occurrence or non-occurrence of certain features at a certain developmental stage as related to cognitive complexity, this would only represent 'perceived' cognitive complexity i.e., difficulty. Objective cognitive complexity is hardly demonstrable (Pallotti, 2009) unless brain-activity imaging techniques such as fMRI and PET scans are employed.

4. Measures of complexity

There is no shortage of measures of complexity, as highlighted, among others, by Bulté and Housen (2012) who provide a full inventory of the most and least used complexity indices (reported in Table 2 below). The inventory is divided into two main categories: indices of grammatical complexity, which comprise syntactic and morphological measures, and indices of lexical complexity, which deal with diversity and sophistication. The measures of syntactic complexity generally aim to quantify the range of syntactic structures, length of unit, degree of structural complexity of certain structures and amount and type of coordination, subordination and embedding. These measures tap into different layers of the syntactic structures by focusing on the phrase, clause or sentence/utterance (Norris, Ortega, 2009). The measures of morphological complexity deal with the number of morphemes and their inflectional or derivational function (Bulté, Housen, 2012). Lastly, the measures of lexical complexity aim to quantify how dense a text is, how variable its vocabulary is and whether less frequent words are used.

Table 2. Measures of complexity (Bulté, Housen, 2012: 30)

A. GRAMMATICAL COMPLEXITY
a. Syntactic
i. Overall
- Mean length of T-unit
- Mean length of c-unit
- Mean length of turn
- Mean length of AS-unit
- Mean length of utterance
- S-nodes/T-unit
- S-nodes/AS-unit

ii. Sentential – coordination
- Coordinated clauses/clauses

iii. Sentential – subordination
- Clauses/AS-unit
- Clauses/c-unit
- Clauses/T-unit
- Dependent clauses/clauses
- Number of subordinate clauses
- Subordinate clauses/clauses
- Subordinate clauses/dependent clauses
- Subordinate clauses/T-unit
- Relative clauses/T-unit
- Verb phrases/T-unit

iv. Subsentential (Clausal + Phrasal)
- Mean length of clause
- S-nodes/clause
- Syntactic arguments/clause
- Dependents/(noun, verb) phrase

v. Other (+/- syntactic sophistication)
- Frequency of passive forms
- Frequency of infinitival phrases
- Frequency of co-joined clauses
- Frequency of wh-clauses
- Frequency of imperatives
- Frequency of auxiliaries
- Frequency of comparatives
- Frequency of conditionals

b. Morphological
i. Inflectional
- Frequency of tensed forms
- Frequency of modals
- Number of different verb forms
- Variety of past tense forms

ii. Derivational
- Measure of affixation

B. LEXICAL COMPLEXITY

i. Diversity
- Number of word types
- Type-Token Ratio
- Mean segmental Type-Token Ratio
- Guiraud Index
- Lexical richness
- Diversity

ii. Density
- Lexical words/function words
- Lexical words/total words

iii. Sophistication
- Less frequent words/total words

Three indices are mostly used to measure syntactic complexity: length of clause, number of phrases per clause and number of clauses per unit (see Table 2 above) (Van Valin, La Polla, 1997; Lu, 2010). Different degrees of complexity are assumed in the calculation of a variety of syntactic complexity measures such as the Syntactic Complexity Formula by Botel et al. (1973) and the Elaboration Index by Loban (1976), which assign syntactic structures different weights according to putative different degrees of difficulty. Subordinate structures are generally given great weight in the measurement of complexity because they are believed to be cognitively harder to process compared to other strategies of linking (Bygate, 1999; Biber et al., 2022). However, as already stated in Section 3, different degrees of difficulty in processing some syntactic structures do not necessarily and automatically correspond to syntactic complexity, since it is not demonstrated that there is a correspondence between the two (Pallotti, 2009; Bulté, Housen, 2012). A different approach to investigating syntactic complexity focuses on the number of word order patterns allowed in a language or present in a text. This approach is more typical of typological studies and brings about the issue of establishing what counts as pattern, also considering that even basic word orders are not particularly easy to identify (Dryer, 2007). Adopting Kolmogorov complexity in this context would mean deeming more complex the texts exhibiting a higher variability of syntactic patterns, whereas adopting a quantitative perspective, the occurrence of regular word order patterns would be counted (Pallotti, 2015). Therefore, a linguistic production using a variety of regular word orders (e.g., basic, clefts, dislocations) would be said to be more complex than one using less variation and adhering to the same word order throughout the text.

Morphological complexity has not been investigated in many studies on English (Pallotti, 2015). The morphological measures employed in the study of complexity include *frequency of tensed forms, number of different verb forms, variety of past tense forms* (Bulté, Housen, 2012). All of these, however, deal with verbal morphology. Pallotti (2015) proposes measures of inflectional morphology that explore the relationship between the forms of lexemes and the semantic or syntactic features they express, such as gender, number, case, person. Starting from a quantification of the basic word classes (e.g., noun, verb, adjective, adverb, etc.), their 'exponents', i.e., the forms in which the lexemes are turned so as to express grammatical information, are investigated. This implies the identification of stems (i.e., the base forms of the lexemes) and then the

inflection. Obviously, the process is more straightforward with concatenative morphological processes such as suffixation (e.g., *book-s*), whereas it becomes harder to identify in non-concatenative processes with internal stem change, such as the past tense forms of irregular verbs (e.g., *flew* as a past form of *fly*). Periphrastic morphemes are treated as a single operation (e.g., *be V-ing* or *have V-en*) and different strategies for expressing the same grammatical function are counted as separate operations, as happens with the past tense marked with suffixation (e.g., *arriv-ed*), suppletion (e.g., *went*) or stem change (e.g., *took*). Being this measure type-based, it is sensitive to text length, therefore it will become more accurate the more data are available. Another measure of morphological complexity is proposed by Haspelmath and Sims (2010) and deals with the relationship between form and function by classifying as more complex the exponents encoding more features than others. In other words, if nouns are inflected for number and case in one language and only for number in another language, the former will be considered more complex.

Lexical complexity aims to measure the number of components of the lexical system leaving out the analysis of semantic complexity (e.g., specificity, transparency, concreteness, polysemy). While the semantic aspects of complexity are undeniably important, they also tend to be difficult to measure objectively (Pallotti, 2015). Thus, lexical complexity is usually calculated by measuring variation based on the assumption that a linguistic production where lexemes are diversified will be deemed more complex than a production with a higher number of repetitions. The most frequently used measures of lexical complexity are the *type-token ratio*, which quantifies lexical variation, *lexical density*, i.e., the amount of information encoded in a text quantified by focusing only on the lexical words in a text, and *core vocabulary*, i.e., the list of the most frequent 7000-7500 words in the entire language system (Halliday, 1985; Stubbs, 1996; Biber et al., 1999; Rundell, 2007).

The measurement of discourse-interactional complexity, which is not included in Bulté and Housen's (2012) taxonomy, is carried out by quantifying the extent of a speaker's contribution to the interaction (Young, He, 1998; Ellis, Barkhuizen, 2005; Kim, 2009; Morales, Lee, 2015). The more regularly a speaker contributes to a communicative exchange the higher their interactional complexity. Two scales are generally used to measure it: the *index of elaborate and complex interaction* counts the total number of turns performed by each speaker and calculates a ratio between the total number of words produced by each speaker divided by the total number of turns taken by each speaker. The *density of interaction* measures how many exchanges there are in an interaction. The more actors have connections with others, the denser the interaction is. As these measures require a qualitative analysis of the interaction, they are difficult to apply to large datasets.

As far as the reliability of measures of complexity is concerned, the studies in English L2 acquisition using length measures show mixed results (Bulté, Housen, 2012). Scholars such as Larsen-Freeman and Strom (1977) and Wolfe-Quintero et al. (1998) maintain that syntactic measures of complexity are reliable when picturing only a coarse-grained development of L2 proficiency. Other researchers, such as Dewaele (2000) and Unsworth (2008) point out that linear results follow circular argumentation depending on how the linguistic unit and proficiency levels are defined. Although measures of subordination are considered more reliable indices of complexity, Norris and Ortega (2009) notice that subordination appears only at later stages of L2 development (i.e., intermediate), while at advanced stages complexity is mainly achieved through the sophistication of phrases (see also Biber et al., 2022). Therefore, Norris and Ortega (2009) underline the importance of including measures of coordination and

phrasal complexity, such as the Coordination Index and the Mean Length of Clause. Concerning the latter, however, Bulté and Housen (2012) refrain from considering it as a pure measure of phrasal complexity given that clause length also increases through the addition of adjuncts (e.g., time, manner, place), thus still at the clausal level and not only through the expansion of the phrase via pre- and post-modification.

The picture resulting from comparing measures of linguistic complexity and the follow-up discussion about their effectiveness and reliability is one characterised by variability and several limitations. Besides observing a preference for only a number of measures that are easy to compute (e.g. syntactic vs semantic measures) (Bulté, Housen, 2012: 34), indices of linguistic complexity vary according to the definitions provided for the parts that are counted. In order to be able to measure any dimension of complexity and to obtain comparable results, scholars would have to agree on how several linguistic units are defined i.e., what is intended by 'word', 'clause', 'phrase', etc. For example, it is necessary to decide whether the unit 'word' comprises compounds or multi-word expressions: does *sports car* count as one or two words? (Booij, 2012; Pallotti, 2015). As far as the clause is concerned, provided that the verb phrase is essential to have a clause (Van Valin, La Polla, 1997), does its definition include non-finite forms of verbs as well? And does the subject of the verb need to be explicitly expressed? It should also be defined what a complex predication is and whether predicates such as *keep trying, make stop, begins to rain* constitute a single clause or multiple clauses (Bulté, Housen, 2012). A further issue is represented by coordinated phrases, such as *the boy and the girl*, as it needs to be established whether they should be treated as a single constituent, thus representing only one slot in the argument structure, or as two constituents (Pallotti, 2015). Furthermore, it should be decided whether clauses can be combined into overarching units. For example, Hunt (1965) introduced the T-Unit[2] and Foster et al. (2000) introduced the AS-Unit[3], which comprise a main clause with all its dependent clauses leaving coordinated clauses out to be interpreted as new units. The explicitation of what is intended when referring to the different units of measurement is the first step to be taken when segmenting a text with the aim of counting its parts, as happens with type-token ratios, clauses per text, length of clauses and so on. Any variation in these definitions could result in different numerical values and ultimately affect the validity and comparability of results.

5. The complexity of written versus spoken language

Most empirical studies about complexity have focused on written texts (Ortega, 2012). As a consequence, it is likely that the measuring tools fitting written language might not perform as well when applied to spoken language. Since spoken language exhibits specificities in the syntax, vocabulary and communicative strategies which differ from written language, it is worth asking whether linguistic complexity in spoken language should be expected to be operationalised and measured in the same way as written language. As Biber et al. (1999, 2021) highlight, spoken language is typically syntactically more fragmented (cf. also Greenbaum, Nelson, 1995), with a freer organisation of discourse, uses more general rather than specific or technical vocabulary, hedging devices, vocatives and interjections, discourse markers, false starts, politeness and conversational formulae. If one adopts the definition of complexity as 'lexical and syntactic sophistication', it follows that

[2] The *Minimal Terminable Unit* (T-Unit) is defined by Hunt (1965: 20, 49) as "an entity that consists of one main clause and (optional) subordinate clauses (i.e. dependent clauses) and non-clausal units or sentence fragments attached to it".

[3] The *Analysis of Speech Unit* (AS-Unit) introduced by Foster et al. (2000: 365) as "a single speaker's utterance consisting of an independent clause, or sub-clausal unit, together with any subordinate clause(s) associated with it".

spoken language is not very complex, being it mainly characterised by coordination, short units and low degree of embedding (Biber et al., 1999, 2021). However, if pragmatic and interactional complexity were taken into account and measured thoroughly, spoken language would likely result to be more complex than when only considering lexical and syntactic complexity indices. Spoken language, indeed, especially conversation, heavily relies on inferences and implicatures i.e., cognitive processes that draw on the situational context and shared knowledge (cf. Kilani-Schoch et al., 2011) and represent a sort of 'invisible' complexity. As Halliday (1985) claims, neither spoken nor written language is more complex than the other *per se*; the two varieties display different degrees of complexity on different levels (see also Biber et al., 2022). Therefore, the question revolves around the central issue of identifying the best sub-constructs of complexity to be investigated according to the aims of the study as well as the type of data under investigation.

A first problematisation of the measures of complexity taking into account the differences between written and spoken language is found in Lintunen and Mäkilä (2014). The study focuses on the syntactic complexity of written and spoken production by 18 L1 Finnish learners of L2 English. The authors observe that when changing the unit of segmentation of the data (they use the U-unit[4] instead of the traditional T-unit and AS-unit), spoken language appears to be more similar to written language in terms of syntactic complexity. Therefore, it is called for further studies with the aim of uncovering whether the differences in complexity between written and spoken language are due to either the nature of the modes or the units and measures used in the analysis.

Aiming to find measures of complexity that could perform efficiently on spontaneous spoken language, Lahmann et al. (2019) study highly proficient L2 English speakers and L1 German attriters. By focusing on grammatical and lexical complexity, the authors analyse a corpus of oral history testimonies to confirm the multidimensionality of the two sub-constructs of complexity. The study also puts forward the possibility to reduce the number of traditional measures of complexity (following Bulté, Housen, 2012) after noticing considerable overlap. Grammatical complexity is shown to be captured by measures of length and subordination. Lexical complexity is recognised to be a multidimensional construct that needs to be articulated in at least two sub-constructs, namely *lexical diversity* and *lexical sophistication*. The latter, in turn, should be analysed in terms of abstractness and hypernymy as well as polysemy. The authors conclude that the measures of lexical complexity could be reduced to three essential ones: frequent, infrequent and abstract lexical items.

Stemming from empirical evidence, a problematisation of the definition of complexity in relation to modes of expression can be found in Biber et al. (2022) who observe, after having compared a number of corpus-based studies on the differences between spoken and written language, that the two registers are characterised by two different types of complexity. The complexity of the spoken register lies in the regular use of long and structurally elaborated dependent clauses (see 1 below), whereas the complexity of the written registers can be witnessed in the embedding of the noun phrase. In other words, complexity in writing (in particular, specialist and academic) is to be found in linguistic units containing phrases embedded in other phrases as well as a low occurrence of verbs. This results in 'compressed' structures in which the relationship between

[4] The *Modified Utterance* (U-Unit) is defined as "one independent clause or several coordinated independent clauses, with all dependent clauses or fragmental structures attached to it, separated from the surrounding speech by a pause of 1.5 seconds or more, or, especially in occurrences of coordination, a clear change in intonation and a pause of 0.5 seconds or more (depending on the average length of boundary pauses in the sample), containing one semantic unity" (Lintunen, Mäkilä, 2014: 385).

phrases (i.e., premodifiers and head) is not always clear; see, for example the phrases *system perspective* and *new systemic mechanisms* in (2) below reported from Biber et al. (2022, Ch. 5, Section 3, para 3).

(1) Sentence from conversation:

But I don't think [we would want [to have it [sound like [it's coming from us]]]].

(2) Sentence from a university sociology textbook:

From the system perspective, these stages are marked by the appearance of new systemic mechanisms and corresponding levels of complexity.

Spoken registers are found to express complexity through adverbial and complement clauses, thus as clause modifiers, whereas academic written registers tend to express complexity through noun modification (Biber et al., 2022). The point on which particular attention is drawn is the fact that grammatical complexity cannot be considered as a unified concept, as there are different ways in which structure can be made complex and these ways essentially represent different types of grammatical complexity, namely clausal vs. phrasal (Biber et al., 2022). Clausal vs. phrasal complexification is a distinction that also mirrors two developmental stages of linguistic competence: studies of child language acquisition, such as Givón (2009), Hunt (1965) and Diessel and Tomasello (2001), have shown that clausal complexity is developed earlier than phrasal complexity. More specifically, the latter continues to be acquired into adulthood (i.e., university education) and is not necessarily fully acquired or mastered, also given its use being limited to specialist academic writing (Biber et al., 2022).

6. Discussion and conclusion

This article has proposed an overview of the definitions of linguistic complexity, its measurement and the issues related to its investigation between the decades 1900-2020. The multi-faceted nature of the construct of complexity brings out issues when comprehensive and unambiguous definitions need to be provided. Even the most agreed-upon definitions in the literature correspond to a number of constructs and sub-constructs characterised by different focuses and research aims which call for different analytical frameworks and measures. Nonetheless, it is acknowledged that several of these complexity constructs may be, in reality, intertwined, although it seems complicated to identify the boundaries between them and understand the nature of the interplay of the sub-constructs with each other. Despite the issues and limitations related to its investigation, the many theories and attempts at measuring complexity show that there is a common intuition that complexity is there in the language and deserves some attention.

In order to reduce the limitations due to the polysemy and the multiplicity of the constructs of complexity, Pallotti (2015) proposes to adopt a 'simple view of complexity' to be seen as a purely descriptive category. Its scope is limited to structural complexity; therefore, it is concerned with the formal and functional characteristics of the language. However, as the other sub-constructs of complexity can be deemed equally interesting and rich in providing perspectives on the different dimensions of language and linguistic competence, including the interactional one, it is perhaps more useful to stress the importance of definitions; rather than reducing the multi-faceted nature of complexity to structural complexity for ease of investigation, scholars should be invited to put more effort into clearly identifying which sub-construct of complexity they are investigating, how it is operationalised and which measures are considered more effective.

Drawing on past theorisations and operationalisations of linguistic complexity, a number of adjustments can be proposed to make its study more tractable. First of all, the study of linguistic complexity would benefit from an evidence-based bottom-up approach. The bottom-up approach, which relies on the

emergence of patterns from language data, constitutes an advantage when it comes to limiting the impact of *a priori* conceptions of what linguistic complexity is and where it should be found in the text. As shown by Biber et al. (2022), the distribution of certain grammatical features in the written and spoken registers analysed allowed the emergence of at least two types of grammatical complexity which differ substantially. The same data-driven approach could be applied to other sub-constructs of linguistic complexity, such as lexical complexity, pragmatic complexity, etc., in order to obtain new and reliable insights that account for register-related variation in linguistic complexity.

Second, by adopting a register-functional approach (Biber et al. 2022), the study of linguistic complexity may also be enriched by an explanatory dimension: the linguistic complexity of registers varies because different registers rely on different structures, vocabularies and pragmatic strategies in order to fulfil their communicative purposes. Communicative purposes, type of audience and the production and reception circumstances (e.g. mode, time for pre-planning) of a text are taken into account as factors influencing the linguistic complexity of texts, hence as reasons underlying the variation in linguistic complexity across texts and registers.

Third, in accordance with Pallotti (2009; 2015), this author believes that efforts should be put into keeping cognitive complexity (i.e., cognitive costs and difficulty in processing language) separate from the linguistic complexity characterising texts. As often pointed out in the literature (Pallotti, 2009; Bulté and Housen, 2012; Joseph, 2021; Biber et al., 2022), it would be misleading to believe that linguistically complex texts are always difficult and that difficulty can only be experienced with linguistically complex texts. As tempting and natural as it may be to infer the difficulty of linguistic features based on how sophisticated a text may look like, our personal experience with language and observing L2-learners developing competence, many scholars have already pointed out how difficulty largely depends on individual variables and is far from being an objective property of linguistic features. Therefore, cognitive complexity should rely on very different methodologies, measures and tools compared to linguistic complexity. Its study should employ tools that measure cognitive processes, such as brain-activity imaging (e.g., fMRI, PET scans). The data about language reception and production costs should then be triangulated with data about the linguistic complexity of the texts used as input and the subjects' individual variables (e.g. age, motivation, language level, education level, L1 and L2 similarity, etc.).

Carefully discerning between linguistic and cognitive complexity also represents a step towards eliminating one main issue with the study of complexity i.e., defining a less-to-more complex continuum of linguistic structures. If cognitive complexity (i.e. difficulty) is not taken as a factor intrinsic to the linguistic complexity of language features, the question can shift from 'which language features are more complex?' to 'how is this text complex?'. In answering the latter question, instead of relying on measures such as length of sentences or number of subordinate clauses, once could observe the degree of in-text variation. From this perspective, the measurement of linguistic complexity would become the measurement of how variable the vocabulary, structures, pragmatic strategies in a text are, borrowing an approach that is more typical of typological studies (Dryer, 2007; see also Pallotti, 2015). Hence, the more variation in these parameters, the more linguistic complexity; the more repetition, the less complex. Linguistic complexity, thus, would not be conceived as a property of single language features or constructions as, rather, of texts and as linguistic richness rather than sophistication. A view of complexity that relies on variation is compatible with both evidence-based and register-functional approaches, since it allows different registers

to display different types of linguistic complexity characterised by the occurrence of a variety of linguistic features, which are not necessarily the same across registers (cf. Biber et al. 2022). This would also avoid the perpetuation of absolute statements, such as 'finite dependent clauses are more complex than coordinate clauses' (see, for example Huddleston, 1984; Purpura, 2004; Carter, McCarthy, 2006; Givón, 2009) that may result in interpretative biases such as 'texts that do not feature subordinate clauses are less linguistically complex'.

Studying linguistic complexity in terms of in-text variation may also prove useful to developmental complexity. Measuring variation in L2 learners' outputs would be in line with the natural variability of learning trajectories. Whether displaying native or non-native patterns, the learner is believed to be effectively learning when producing new structures and vocabulary, thus adding linguistic variation to the output.

Finally, as already claimed in the literature, the reliability of the results of complexity studies can be improved by reducing scope (Sinnemäki, 2011). As measuring linguistic complexity globally (e.g. the entire language system or learner's interlanguage) has proven hardly feasible, the study of linguistic complexity would benefit from choosing one target sub-constructs at a time (e.g., grammatical, pragmatic, discourse-interactional) (cf. Miestamo, 2006, 2008 and Nichols, 2009) and addressing texts and registers rather than entire language systems. Narrowing down scope allows to avoid overgeneralisations that cannot acknowledge the variation required by different registers and level of language analysis and enables the development of more suitable methodologies for the study object at hand which possibly include a qualitative dimension.

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Sudden Fiction Through the Lens of Decoding Stylistics

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This summer I saw a white frog. It would not have been startling if I didn't know that this species of frog is normally green. This is the way such a mutant literary form unsettles us. We know what is expected, in a given arrangement of words; we know what is supposed to come next. And then it doesn't.
Margaret Atwood, Canadian writer

Abstract.
Objective: The main purpose of the research is primarily to consider different types of stylistics focusing on decoding stylistics and its basic features, such as coupling, convergence, semantic repetition, salient feature and text strong position together with defeated expectancy. The subsidiary goals are to examine sudden fiction as a very specific genre in the prism of decoding stylistics and to specify types of foregrounding typical of it.
Background: Analysis of literature shows that various types of stylistics are based on different principles: types of general and specific character, diachronic approach, stylistics based on the relations between an author and a reader and some others. Discussing decoding stylistics, we must keep in mind its such important techniques as close reading, the role of intertextuality in proper text decoding, stylistic devices employed by the author as a means of encoding information and importance of reader-response theory.
Method: The article presents the results of the textual, stylistic, lexical, and contextual analyses of literary texts belonging to a very specific genre – sudden fiction. Stylistic analysis covers all the language level: phonetic, morphological, syntactic, and lexical; its results are widely illustrated by numerous examples from the texts under consideration. As far as short fragments from the text are extracted as illustrations of the different types of foregrounding, contextual analysis appears to be very helpful in explaining signals of addressee-orientation hidden by an author.
Originality: Comprehensive multi-aspect approach to the texts of sudden fiction provides a new perspective in text linguistics in general and decoding stylistics in particular. The author not only analyses the role of foregrounding and its types, but connects it with information theory, intertextuality, types of plot development, and text strong positions.
Result: Much attention in the study is paid to foregrounding as the basic notion of decoding stylistics as well as its types: coupling, convergence, semantic repetition,

salient feature and text strong position, and defeated expectancy. Numerous examples vividly show which of these types are the most important in the texts of sudden fiction, how they are intertwined in the text, and with what purpose are used.
Conclusion: Though the hypothesis was that due to a specific genre of the considered texts, that is sudden fiction, the main types of foregrounding would be defeated expectancy, the results show that foregrounding in 152 texts of sudden fiction is realized mainly due to text salient feature, namely the title, the beginning and the ending of the text. Other very important types of foregrounding are convergence and defeated expectancy.
Keywords: Sudden fiction; Decoding stylistics; Foregrounding; Salient feature; Convergence
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Малая проза через призму стилистики декодирования

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Статья поступила 30 июня 2025 г.; принята 15 сентября 2025 г.; опубликована 30 сентября 2025 г.

Аннотация. Целями проведенного автором исследования был анализ и систематизация различных видов стилистики (делая акцент на стилистике декодирования), а также анализ художественных текстов, которые принадлежат к очень специфическому жанру – малой прозе (sudden fiction) – представленной британскими и американскими авторами. Эти тексты рассматриваются через призму стилистики декодирования, или стилистики восприятия, ключевыми чертами которой являются краткость, непосредственность и внушительность; при этом выделяются самые общие техники декодирования текста: внимательное чтение, интертекстуальность, контекстуальный и стилистический анализ. Значительное внимание уделяется выдвижению как базовому понятию стилистики декодирования и его разновидностей, таких, как сцепление, конвергенция, семантический повтор, характерный признак, сильная позиция текста и эффект обманутого ожидания. Многочисленные примеры ярко иллюстрируют, какие из этих видов выдвижения наиболее важны в текстах малой прозы, как они переплетаются в тексте и с какой целью используются. Рассматривая малую прозу через призму стилистики декодирования и фокусируя свое внимание на выдвижении, автор показывает, что именно делает сигналы, адресованные читателю, более очевидными и понятными для него. Автор использует текстуальный, стилистический, лексический и контекстуальный анализ, что дает возможность более полно интерпретировать тексты малой прозы и расшифровать сигналы ориентации на читателя, закодированные

автором в тексте. Результаты проведенного анализа текстов малой прозы показывают, что выдвижение реализуется в них главным образом благодаря характерному признаку и сильной позиции текста, которая включает его заголовок, начало и конец, а также благодаря конвергенции и эффекту обманутого ожидания.

Ключевые слова: Малая проза (sudden fiction); Стилистика декодирования; Выдвижение; Характерный признак; Конвергенция

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1. Introduction

Sudden fiction is celebrated for its ability to capture the essence of a story in a brief and potent form, making it well-suited for readers with limited time and attention spans. It challenges writers to distil their ideas to the purest form and offers readers a quick yet satisfying literary experience. As a popular literary genre, sudden fiction has been in the focus of linguists who examined its features (Abbasi, Al-Sharqi, 2016); types of plot development (Othman, 2023; Panasenko, 2017); semantics of colour terms (Panasenko, 2019); application of flash fiction in teaching reading and writing (Tarrayo, 2019). Now I intend to consider it from a different perspective. My aim is to make an interpretation of the texts written by English-speaking writers and to consider these texts from the point of view of decoding stylistics, which may be a good theoretical background for decoding the messages sent to the reader by the author and identify them as signals of addressee-orientation.

Traditionally, foregrounding includes coupling, convergence, semantic repetition, salient feature, and text strong position, together with defeated expectancy. My task is to specify their role in short stories by English-speaking writers. My hypothesis is that texts of sudden fiction are based on defeated expectancy, which is intensified by convergence and semantic repetition.

For my research, I have chosen 152 short stories and used textual, stylistic, lexical, and contextual analyses.

2. Stylistics and its types

Before proceeding to decoding stylistics, I would like to make a short retrospective journey into the history of stylistics and its types. If you try to find varieties of stylistics in different serious sources, you will be surprised how many can be found. In the alphabetic order the list from different sources looks like this: affective, applied, attributional, author's, classical, cognitive, comparative, computational, contrastive, corpus, decoding, dialectal, encoding, expressive, forensic, formalism, functional, general, generative, genetic, historical, immanent, interpretative, linguostylistics, literary, practical, pragmatic, reader-response, reader's, structuralist, stylistics of a national language, stylistics of effects, stylistics of intentions, stylometric (statistical), text (textual, textualist), and systemic functional stylistics (36).

In my opinion, all these types of stylistics can be sorted on some principles.

Firstly, some terms are synonyms, like genetic (author's/reader's) stylistics, text (textual/textualist) stylistics, decoding (reader-response) stylistics, etc.

Secondly, some of the types of stylistics are of general character (**general, interpretative, linguostylistics,** and **literary**), whereas the others are very specific, like, for instance, **computational**, which uses definite techniques for processing large corpora of works identifying the authorship and text stylistic elements; **forensic**, which also determines the authorship using traditional stylistic analysis, but is mainly

applied in criminology or academic plagiarism cases; **affective**, which deals with the process of reading and the reader's emotional and psychological response to it.

If we take into account a diachronic approach, we would definitely start with **classical** stylistics, which focuses on the study of literary texts from ancient Greece and Rome, examining their linguistic and stylistic features; scholars associated with classical stylistics include Aristotle, Cicero, and Quintilian (Burke, 2023). Subsequently, we would proceed to **cognitive** stylistics, which draws on insights from cognitive linguistics that appeared in the 1970s and psychology with the purpose to analyse the cognitive processes involved in the production and interpretation of literary texts. Scholars like Reuven Tsur, Peter Stockwell, and Vera Tobin have made important contributions to this field (see also Bretones et al., 2021; Ganieva, 2023; Semino and Culperer, 2002). **Historical** stylistics, focusing on the stylistic system of a language, is also connected with a diachronic aspect.

Another approach is associated with different scholars who have made significant contributions to the field.

Immanent stylistics (stylistics from a textual perspective) rests upon such basic concepts, as literary fact relativity principle, artistic image rejection, literariness, defamiliarization, distinction between plot and story, fusion of form and content, motivation, entire text partitioning, and some others. It is related to Russian Formalism, which developed in the early 20th century. Russian Formalism emphasizes the study of literary devices and the internal structure of texts. Prominent scholars in this field include Viktor Shklovsky, Roman Jakobson, and Boris Eichenbaum. It is also connected to French structuralism associated with scholars like Claude Levi-Strauss, Roland Barthes, and Jacques Derrida; it examines the underlying structures and systems that govern language and literature. Structuralist approaches to stylistics often involve the analysis of narrative structures and the decoding of implicit meanings (Burke, Evers, 2023).

Functional stylistics was developed by the Prague School linguists, or the Prague Linguistic Circle, in the 1920s and 1930s. Such scholars as Jan Mukařovský, René Wellek, and Roman Jakobson contributed to the development of this field, which focuses on the communicative functions of language and the analysis of literary texts (Burke, 2025; Lin, 2016).

We cannot forget about **systemic functional** linguistics, developed by Michael Halliday, which focuses on the relationship between language and social context. Stylistic analysis within this type of stylistics examines how language functions in specific registers, genres, and social situations (Matthiessen, Teruya, 2023).

Linguostylistics and **literary** stylistics can be considered via the opposition of language and speech (Alaghbary, 2022; Jeffries, McIntyre, 2025).

The object-matter and research methods specify the type of linguistics: **applied, comparative, contrastive, corpus, interpretative, practical, stylometric (statistical),** and **text (textual, textualist).** I do not include into this list **graphical** stylistics and those types which are connected with different language levels: **phonetic, morphological, lexical**, and **syntactic,** though this classification is very popular and can be found in any textbook on stylistics, often named as stylistic phonetics, stylistic morphology, stylistic syntax, and stylistic semasiology.

Another group includes types of stylistics connected with the relations between an author and a reader, i.e. on the functional or pragmatic parameter. These are **author's, decoding, genetic, reader's,** and **reader-response** stylistics.

There are three basic points of view in **genetic stylistics** (**stylistics of intentions, of effects**): that of the addresser, the message, and the addressee. It covers the research of the author's choice of speech forms, their message to the receiver and its realization, the

main ideas and themes based on the author's emotions, attitudes and views, the information (message) is coded uniquely according to the author's choice. The encoder (writer) sends information to the recipient (addressee, reader) and the reader is supposed to decode the information.

Genetic stylistics is represented by a number of schools and trends: logical analysis of Marius Roustan, psychological analysis of Maurice Grammont, statistic stylistics of Pierre Guiraud, philological analysis of Leo Spitzer and Dumitru Caracostea. The aim of stylistic analysis is to bring out the writer's intention to describe non-textual reality (extra-linguistic reality): writer's biographical, social, economic, and political facts (Guiraud, 1969; Spitzer, 2015).

Now let us proceed to decoding stylistics and highlight its most important constituents.

2.1. Decoding stylistics and its basic features

Decoding stylistics, or stylistics of perception, refers to the analysis and interpretation of the underlying meanings and messages conveyed through the stylistic choices made by the author. It involves unravelling the various linguistic and literary devices to communicate the writer's ideas and evoke specific responses from the reader. Using theoretical findings in several branches of science (informatics, mathematics, media studies, etc.), it overlaps with other types of stylistics and with information theory.

In the field of stylistics, scholars often use a range of techniques to decode and analyse literary texts. Here are a few common approaches:

Close reading. This technique involves carefully examining the language and literary devices used in a text to uncover its deeper meanings and thematic elements. It focuses on analysing the stylistic choices made by the author and how they contribute to the overall effect of the text (for more, see Tarrayo, 2019).

Intertextuality. Decoding stylistics also involves exploring the intertextual references and allusions employed by an author. By examining how a text refers to or quotes from other texts, scholars can better understand the intended meanings and connections that the author is making (for more, see Kryachkov, 2023).

Contextual analysis. It is essential to consider the social, historical, and cultural factors that shape the production and reception of a text. Analysing the sociocultural context surrounding a text can help decode the stylistic choices and understand the author's intended meanings (for more, see Svensson, 2020).

Stylistic devices. Scholars examine the various literary devices of different language levels, tools, and techniques used by the author, such as metaphor, simile, alliteration, repetition, imagery, irony, and symbolism. These devices contribute to the overall aesthetic and communicative aspects of the text and can be decoded to reveal deeper layers of meaning (Kövecses, 2018; Panasenko, 2013).

Reader-response theory. Decoding stylistics can also involve considering the response and interpretation of the reader. The way readers engage with and interpret a text can influence the decoding process, as readers bring their own experiences and perspectives to the reading process (Widdowson, 1975). This approach is closely connected with pedagogy and information theory.

The author encodes his/her point of view using his/her own style, ideas, vocabulary, biography, etc. and sends it to the reader. Arnold (1990) who has considerably contributed to this type of stylistics offers the following scheme: code – message – sign – text. It is the shortened version of the information theory adjusted to linguistics. After Shannon (1998 [1940s]), the communications process over a discrete channel has 6 parts: 1) encoding the message; 2) its transmission; 3) its realization as a signal; 4) channel of receiving and transmission; 5) its reception; 6) its decoding.

Discussing the information theory applied to linguistics, it is important to keep

in mind obstacles of decoding, which arise due to the level of the competence of the reader, who can be experienced or naïve; there may be social, historical, temporal, cultural, etc. hindrances to proper text understanding; many works of art are sophisticated in form and content, full of implications, contain understatements, and open-ended composition. Decoding stylistics helps the reader understand the author's messages by explaining and decoding pieces of hidden information, which can be treated as signals of addressee-orientation, the detailed analysis of which in media texts is given by Panasenko et al. (2021).

Perception of the text can be enhanced by **foregrounding**, which, as Arnold (1990) specifies, is a self-explanatory term, because foregrounding assures the hierarchy of meanings with artistic value to be brought to the foreground. The scholar claims that the idea of foregrounding appeared first in the Prague School, where the phenomenon was mostly called the "deautomatization" of the linguistic code (Arnold, 1990; Kupchyshyna, Davydyuk, 2017).

Foregrounding refers to the deliberate manipulation of linguistic elements to draw attention to certain features, creating emphasis or deviation from the norm; it involves bringing certain linguistic features into prominence, making them stand out from the ordinary or expected usage. This can include deviations from the standard grammar, the use of unusual or striking vocabulary, and the application of rhetorical devices. Foregrounding serves various purposes, such as emphasizing key ideas, creating memorable language patterns, or evoking specific emotions in the reader or audience. It is a conscious choice by the writer to make certain aspects of language more noticeable.

Under the general heading of foregrounding Arnold (1990) includes the following phenomena: **coupling, convergence, semantic repetition, salient feature and text strong position,** and **defeated expectancy.** They differ from expressive means known as tropes and stylistic figures because they possess a generalizing force, function, and provide structural cohesion of the text and the hierarchy of its meanings and images, bringing some to the fore and shifting others to the background. They also enhance the aesthetic effect and memorability.

Let us discuss these types of foregrounding.

Coupling is associated with Samuel R. Levin and Roman Jakobson. Coupling is based on the affinity of elements and provides cohesion, consistency, and unity of the text form and content. There are several types of coupling: phonetic (alliteration and assonance; rhyme and rhythm mainly in poetry, though not only there), structural, and semantic.

Convergence is a combination or accumulation of stylistic devices promoting the same idea, emotion or motive; it helps decode the author's message attracting the reader's attention to text fragments abounding in stylistic devices of different levels – phonetic, morphological, syntactic, etc.; each of them performs a specific stylistic function. This term was first introduced by Riffaterre in 1959 (1959: 172).

Semantic repetition. Repetition is a natural language phenomenon; stylistics traditionally singles out repetition on the phonetic level and repetition on the syntactic level. Lessard and Levison (2013: 52) define semantic repetition as "the recurrence of elements of meaning, possibly in the absence of repeated formal elements". Very often it leads to semantic satiation, i.e. a psychological phenomenon that occurs when a word or phrase loses its meaning due to repetitive exposure.

Salient feature and text strong position. Arnold (2014: 173) names this type of foregrounding as "a modification of the so-called 'philological cycle' described by one of the most widely known stylistic critics of the beginning of the 20th century Leo Spitzer". The title, the prologue, the epigraph, the opening lines, and the ending always occupy a **text strong position** due to their great

informative value. A salient feature proves "a convenient starting point for an analysis that is further continued on the basis of other types of foregrounding" (ibid.).

Defeated expectancy is also a type of foregrounding. It implies such a narrative technique where the author sets up certain expectations or anticipations in the reader's mind, only to subvert or thwart those expectations later on in the story. This technique plays with the reader's assumptions and creates tension or surprise by deviating from the anticipated outcome. It occurs when the story leads the reader to expect a particular resolution, plot twist (Panasenko, 2017), or character development, but then delivers something unexpected or contrary to those expectations. This can result in a range of effects, including irony, humour, suspense, or emotional impact (for more, see Davydyuk, 2012; 2013a; 2013b).

Authors may employ defeated expectancy for various reasons: surprise and suspense, subversion of tropes, characterization, and emotional impact. It may come up on any language level, but is mainly based on stylistic semasiology of expressive meaning and lexico-syntactical stylistic devices (pun, zeugma, paradox, oxymoron, irony, anti-climax, etc.).

3. Sudden fiction as a literary genre

Sudden fiction, also known as flash fiction or microfiction, refers to extremely short stories characterized by their brevity and concise storytelling. These narratives typically range from a few words to a few hundred words in length, often encompassing complete plots, character arcs, or thematic elements within a minimalistic structure.

Traditionally its varieties are connected with its size: minisaga – 50 words, dribble, or drabble, or microfiction – from 100 to under 300 words, short short story or flash fiction – up to around 1,000 words, sudden fiction – usually a little over 1000 words, new sudden fiction – up to 1,500 words (Abbasi and Al-Sharqi, 2016), short story – up to 7,500 words. It is a common approach, but I have to state that sudden fiction, as any other literary text, is not only the calculation of words. These texts have a deep context and a specific structure. Considering them from a decoding stylistics perspective considerably facilitates proper interpretation of the author's message.

What are the key features of sudden fiction? Taking into account the number of words mentioned above, I start with **conciseness**, because sudden fiction relies on brevity, condensing a story's essential elements into a compact form. Authors must convey meaning, portray characters, and communicate emotions efficiently, using only a limited word count. Then comes **immediacy**, because sudden fiction often plunges readers directly into the heart of the story, wasting no time on exposition or background information. The narrative may begin abruptly, engaging readers from the opening lines and maintaining a sense of urgency throughout. We must also keep in mind **suggestiveness**, because, due to their limited length, sudden fiction stories often leave much to the reader's imagination. Authors may employ suggestive or ambiguous language, allowing readers to fill in the gaps and interpret the story's meaning for themselves. **Impact** is also important, because, despite their brevity, sudden fiction stories aim to pack a punch, leaving a lasting impression on the reader. They may deliver unexpected twists, profound insights, or emotional resonance in a short span of time. The "**suddenness**" of the plot depends on the experimentation of the author (Othman, 2023), because sudden fiction encourages experimentation with narrative forms, structures, and styles. Authors may employ unconventional techniques, such as **fragmented narratives**, **nonlinear storytelling**, or **minimalist prose**, to achieve maximum impact within a limited space.

Each country has outstanding representatives of this genre, like Bolesław Prus, Franz Kafka, Yasunari Kawabata, Kurt Vonnegut Jr., Daniil Kharms, and many, many others.

As my analysis of the text is based on English-speaking writers, I would like to

name some of them, paying tribute to their literary activity in the alphabetical order: Russel Banx, Charles Baxter, Donald Barthelme, Hugh Behm-Steinberg, Lydia Davis, Amy Hempel, Tania Hershman, Joyce Carol Oates, Jamaica Kincaid, Grace Paley, Robert Shapard, George Saunders, Deb Olin Unferth, among others.

Sometimes it is difficult to interpret properly the author's messages hidden in the text and we have to read it several times. The flash fiction "*For Sale, Baby Shoes, Never Worn*" attributed to Hemingway may have many interpretations, but negative feelings like sadness, disillusionment, grief, anxiety, etc. are very likely.

4. Discussion

The short stories which I have processed represent authors from different English-speaking countries: Australia, Canada, South Africa, United Kingdom (including England and Wales), and United States. A short biography of each author is given at the end of each book; in case the short story is written in another language, the language is specified, as is the name of the translator. Though some of the stories are incredibly interesting, I claim that making the stylistic analysis of the translated text fragments may lead to wrong conclusions due to specific features of languages with different structures (Slavic languages, Japanese, etc.).

The basic feature of decoding stylistics is foregrounding, which aims for delivering the author's message to the reader. Taking into account the large number of the examples, I will present only some of them according to the types of foregrounding. All the examples are accompanied by the source in the abbreviated form, the name of the author, and the title of the story. To explain my argumentation of identifying one type of foregrounding or another, the short gist of the story is given when necessary.

Let us start with **coupling.** Several examples of coupling presented by parallel constructions can be found in the story by the Welsh writer Leslie Norris "Blackberries": "*He took a sheet from a cupboard on the wall and wrapped it about the child's neck, tucking it into his collar. … He could see the bumps they made in the cloth. He moved his finger against the inner surface of the sheet and made a six with it, and then an eight. He liked those shapes. … He took the sheet off the child and flourished it hard before folding it and putting it on a shelf. He swept the back of the child's neck with a small brush*" (SFI, 1989: 40). More information about the contextual situation in this short story is given below, when defeated expectancy is discussed.

Rhythm as another variety of coupling can be found not only in poetry, but also when we come across the repetitive pattern of certain actions in the short story "On Hope" by Spencer Holst (SFI, 1989: 51-54), in which a trained monkey steals the royal jewellery three times, which a gipsy, her owner, returns to the royal family, understanding the seriousness of this crime. The largest stone in the necklace is named the *Diamond of Hope* making the link with the title. This rhythmicality is further enhanced by the three possible endings of the story offered by the author.

Foregrounding in the text "Important Things" by Barbara L. Greenberg is realized through parallel constructions and anaphoric repetitions, which make the text cohesive and rhythmical ("*You tell your children*", "*You say*…", "*You offer*…" (SF, 1986: 149-150). In fact, the whole text can be considered as suspense or delay: there are many conditions that children demand and "*If you don't, they'll have to resort to torture*" (SF, 1986: 150).

Convergence. In the short story "Love, Your Only Mother" by the American writer David Michael Kaplan, the author's message is foregrounded by the combination of a text salient feature (the title, the beginning, and the ending of the text) and convergence. A woman left her husband; they are not divorced; they are not communicating directly; she sends her daughter postcards with beautiful landscapes from different places in the United States. The postcards find a girl at home, at the apartments she rented as

a student, and finally in her own house where she lives with her husband. Each postcard is signed identically; it is the title of the story. The daughter marked the movement of her mother on the atlas: 63 postcards, 400 lines – "*our life together*". The last paragraph abounds in ordinary and anaphoric repetitions, **emotively charged words**, metaphors and similes: "*But on summer evenings, when the windows are open to the dusk,* I sometimes smell cities… wheat fields…oceans – **strange smells** from far away – all the places you've been to that I never will. I smell them as if they weren't pictures on a post-card, but real, as close as my outstretched hand. *And sometimes in the middle of the night, I'll sit bolt upright, my husband instantly* ***awake and frightened****, asking. What is it? What is it? And I'll say, She's here, she's here, and* ***I am terrified*** *that you are. And he'll say, No, no, she's not, she'll never come back, and he'll hold me until my* ***terror*** *passes. She's not here, he says gently…; she's not – except you are, my strange and only mother: like a buoy in a fog, your voice, dear Mother, seems to come from everywhere*". (SFI, 1989: 85-88).

Another good example of convergence can be found in the short story "The King of Jazz" by Donald Barthelme. It is a very specific story about a battle of jazz musicians: American and Japanese trombone players. Their way of playing is described metaphorically, using colours: "*Playing with lots of rays coming out of it, some red rays, some blue rays, some green rays, some green stemming from a violet center, some olive stemming from a tan center –*" (SF, 1986: 11). Sustained metaphors are concentrated in the very large paragraph of 13 lines at the end, characterizing the way an American trombone player (who won and became the King of Jazz again) was extracting sounds from his musical instrument: "*You mean that sound that sounds like the cutting edge of life? That sounds like polar bears crossing Arctic ice pans? That sounds like a herd of musk ox in full flight? That sounds like male walruses diving to the bottom of the sea? … That sounds like the wild turkey walking through the deep, soft forest? … That sounds like a mule deer wandering a montane of the Sierra Nevada? … That sounds like –*" (SF, 1986: 12-13). This paragraph also contains tautology, parallel constructions, anaphoras (syntactic stylistic devices) and onomatopoeia (phonetic stylistic device).

Semantic repetition. The title of the short story by Stuart Dybek "Death of the Right Fielder" (SFI, 1989: 35-38) as a salient feature is enhanced by semantic repetition. The word '*death*' and words of the same lexico-semantic field (*to kill, a terrorist, a mad sniper, to pull the trigger, a bullet, shooting, a fresh grave,* and *epitaph*), in fact, lose their meaning, because, notwithstanding their repeatability, they lead to nothing, and it is still not clear at the end of the text who killed the baseball player.

In many texts, various types of foregrounding enhance each other, like in the short story "The cliff" by Charles Baxter. Semantic repetition can be found in the signals of addressee-orientation denoting different shades of a blue colour: "*the long line of blue water*", "*faded blue jeans*", "*the boy's blue eyes*", "*the sea*", and "*the blue sky*" (SF, 1986: 43-46). This colour intensifies features of a 15-year-old innocent teenager, because blue has a symbolic meaning of innocence. The events take place near the sea (blue is a typical colour of the sea and the sky). Blue is also associated with magic and it happens. After some magic rituals, the boy steps off the cliff and starts flowing "*in great soaring circles*". This magic, in our case culminating in defeated expectancy, is foregrounded by the title and symbolic meaning of a blue colour.

Salient feature and text strong position. Foregrounding in the short story "The Weather in San Francisco" by Richard Brautigan is vividly realized by a salient feature and a text strong position, i.e. the title is connected with the first paragraph: "*It was a cloudy afternoon with an Italian butcher selling a pound of meat to a very old woman, but who knows what such an old woman*

could possibly use a pound of meat for?" (SFI, 1989: 119). Here the message of the author is quite clear, because the reader comes to know about the protagonists of this story (a butcher and a very old woman), the event (buying meat), and the reason of buying meat ("*Perhaps she used it for a bee hive and she had five hundred golden bees at home waiting for the meat, their bodies stuffed with honey*", ibid.). The customer and the seller discuss weather while choosing a specific sort of meat. Though this signal of addressee-orientation is very strong, anyone hardly believes that the liver is bought for the bees, thus, the stronger the effect of the defeated expectancy is. The ending of the text (again, a text strong position) includes many stylistic devices: "*She opened her purse which was like a small autumn field and near the fallen branches of an old apple tree, she found her keys*" (simile); "*Then she opened the door. It was a dear and trusted friend*" (personification); "*She nodded at the door and went into the house and walked in a long hall into a room that was filled with bees*" (defeated expectancy). Convergency is formed due to anaphoras and parallel constructions: "*There were bees everywhere in the room. Bees on the chairs. Bees on the photograph of her dead parents. Bees on the curtains. Bees on an ancient radio that once listened to the 1930s. Bees on her comb and brush*" (SFI, 1989: 120). The author brilliantly connects the last paragraph with the title of the story: "*The bees came to her and gathered about her lovingly while she unwrapped the liver and placed it upon a cloudy silver platter that soon changed into a sunny day*" (SFI, 1989: 120).

Ann Beattie, the author of the short story "Snow", sends many messages to the reader in the text: a snowy winter is not a perfect period of courting and love; the snow is not eternal and melts bringing changes, another season of the year or new love; white colour is a symbol of innocence. The title, occupying a text strong position, highlights many words and word combinations forming a special lexico-semantic group: "*the big snow*", "*like a crazy king of snow*", "*kneeling in snow*", "*all that whiteness*", "*the newly fallen snow*", "*the cold*", "*winter*", "*snowplow*", "*scraping snow*", etc. (SFI, 1989: 286-288); each element of this group has a different function: descriptive, associative, and symbolic (for more see Panasenko 2019: 136).

The title of the short story "Even Greenland" by Barry Hannah is based on paradox: Greenland is not green. A pilot says: "*Even Greenland. It's fresh, but it's not fresh. There are footsteps in the snow*" (SF, 1986: 8). And the flight is not flight: it is falling down of the airplane with its further explosion, which is described metaphorically: "*The wings were turning red. I guess you'd call it red. It was a shade against dark blue that was mystical flamingo, very spacey like, like living blood. Was the plane bleeding?*" (SF, 1986: 7).

George Garrett in the short story "The Strong Man" describes a pregnant young woman who intends to divorce her unfaithful husband and who stays together with her lover in Italy. She faces many problems and sees no solution to them. To entertain her, Harry, her lover, offers to watch a street performance. The tricks performed by an actor, whom everybody called a strong man, were gradually becoming more and more complicated; finally, he was covered by chains. The young woman "*watched the man in chains and she felt a strange exhilaration. She felt her own body move, tense with the subtle rhythm of his struggle. One arm free, then, slowly, very slowly, the other, and, at last sitting up, he twisted his hurt legs free*" (SF, 1986: 148). The message of liberation through sufferings and great efforts is foregrounded by the title. The very last paragraph constitutes a text salient feature, because symbols of new life, strength, and serenity appear in the heart of the young woman: "*… she saw that there was a new moon and she could see the dark shape of the mountains. They were still there. And she could feel the strength and flow of the river,*

and she could feel her child, the secret life struggling in her womb" (SF, 1986: 148).

One more interesting feature should be mentioned. The foregrounding in this text is enhanced by suspense (Brewer, 1996). For the woman it is mainly emotional tension, whereas for the strong man it is a physical restraint. Following the strong man's efforts, a woman shares his tension and finally, simultaneously with the street actor, feels total relaxation.

Some titles used as foregrounding demand the possession of specific knowledge, otherwise the author's message will not be decoded properly. The short story "Tent Worms" by Tennessee Williams has deep context. A husband and his wife rented a house for summer but it was surrounded by "*the tent worms that were building great, sagging canopies of transparent gray tissue among the thickly grown berry trees*" (SF, 1986: 96). These silvery nets were covered by numerous tent caterpillars, which totally defoliated trees. Billy Foxworth did his utmost to save poor trees burning these nets out with paper torches "*childishly, senselessly, in spite of the fact that there were thousands of them*" (ibid., 97), but he ran out of paper and matches and "*had a defeated look and he had burned himself in several places*". From the talk of his wife Clara and a Doctor we come to know that Billy is lethally ill and his wife realizes that he knows about it. He has given up burning tent worms and they both know that "*they, no, would never return, separately or together*" (ibid., 100) to this place. Billy Foxworth is doomed, nothing will help him and his failure in burning the worms vividly indicates it.

Interesting examples of the **titles** which foreground the author's message are in "A Walled Garden" by Peter Taylor (SF, 1986: 58-61) – isolation and seclusion ("*We've walled ourselves in here with these evergreens and box and jasmine*" (ibid., 58); garden can also be considered as a linguistic cultural symbol (Karasik 2023); "Tickits" by Paul Milenski (SF, 1986: 155-157) – characterizing the pronunciation and spelling of the notes Toby Heckler prepared for any case, which attracted his attention; his notes are written in capital letters ("PRAKING MISTEAK", "PAPUR ON GARSS", "TOO MUSH DIRNKING", "ERVYTHING WORNG!"), etc.

Epigraphs are very scarce in this literary genre. They are used for specific purposes, such as explaining the text, like in the short story "Seven Pieces of Severance" by Robert Olen Butler (NSF, 2007: 131-136):

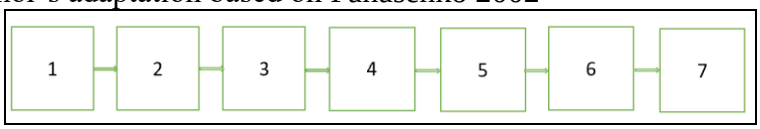
"*After careful study and due deliberation it is my opinion*
the head remains conscious for one minute and a half after decapitation.
Dr. Dassy d'Estaing, 1883"
"*In a heightened state of emotion, we speak at the rate of*
160 words per minute. *Dr. Emily Reasoner, A Sourcebook of Speech, 1975*"

My students made special research and found out that these names are fictitious as well as the information presented in the epigraphs. A Sourcebook of Speech from this date never existed. But these epigraphs are very important, because they foreground the meaning of the whole text, which consists of seven short fragments without punctuation marks, like a stream of consciousness of people who were decapitated. Some of these people were real, like Paul the Apostle, the exact details of whose death are unknown, or Angry Eyes, an Apache warrior, or "*Hanadi Tayseer Jaradat, law student, beheaded by self-detonation of shaheed-belt suicide bomb, 2003*"; some alleged to be common people, like "*Rokhel Pogorelsky, Jewish woman, beheaded in Russian pogrom, 1905*", but again in some cases it was not historically accurate. Without these two epigraphs, the message of the author would have been totally lost: "*breechcloth and moccasins only these things on my body my head bound by a cloth band my face and chest and arms stained but*

I do not know the colors I do not look, my eyes are fixed on the horizon beyond mesquite and pinon and…" (paragraph "Angry Eyes", NSF, 2007: 135).

It is important to mention the type of plot development in this text. Panasenko (2002; 2017: 110) offered four basic types of plot development: a chain, a ring, a fan, and a circle. Later this classification was enlarged by various combinations of these basic models. In this short story, it is obviously a chain, in which we see the description of seven events (see Figure 1).

Рисунок 1. Тип развития сюжета в рассказе "Семь кусочков разрыва" Роберта Олена Батлера. Источник: Собственная обработка по Панасенко 2002
Figure 1. Type of plot development in the short story "Seven Pieces of Severance" by Robert Olen Butler. Source: Author's adaptation based on Panasenko 2002



Epigraphs can also be found in the short stories "I Shot the Sheriff" by Touré (NSF, 2007: 159-163), "The Gold Lunch" by Ron Carlson (NSF, 2007: 281-287), "Twirler" by Jane Martin (SF, 1986: 17-19), "The Artichoke" by Marilyn Krysl (SF, 1986: 217-218) and in some short stories written by non-English-speaking writers.

Discussing **defeated expectancy**, I should state that its (un)predictability depends on the context. Every woman knows that blackberries leave indelible spots on fabric. Thus, the use of a new cap as a container for blackberries with inevitable results is predictable to evoke the irritation of the boy's mother. The father, perhaps, knew nothing about it and his deed brought the situation to the family scandal (Leslie Norris "Blackberries", SFI, 1989: 39-44).

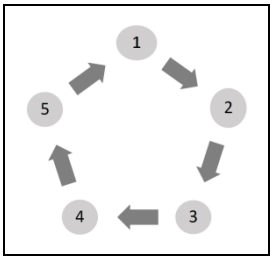
The phrase "Thank You, M'am" is not only the title of a short story by Langston Hughes; it is the salient feature that ends this story. A young boy is caught stealing her purse by Mrs. Jones. The defeated expectancy is also foregrounded by this phrase: instead of taking the boy to the police, the old lady gives him some food and money to buy "*some blue suede shoes*" (SF, 1986: 67).

Interesting examples of defeated expectancy as a type of foregrounding can be found in the following short stories: "Sunday in the Park" by Bel Kaufman (SF, 1986: 20-23); "Song on Royal Street" by Richard Blessing (SF, 1986: 29-32); "Pygmalion" by John Updike (SF, 1986: 33-35); "The Hatchet Man in the Lighthouse" by William Peden (SF, 1986: 109-111); "The Quail" by Rolf Yngve (SF, 1986: 109-213); "Sleepy Time Gal" by Gary Gildner; "The Bank Robbery" by Steven Schutzman (SF, 1986: 94-95), in which the robber is in intensive written correspondence with the teller and finally they leave the bank together carrying the stolen money; "Dog Life" by Mark Strand, where a husband confesses to his wife that he was a dog and gives details of his courting "*a melancholic Irish setter, …a long-coated Chihuahua and black and white Papillon, … a German short-haired pointer*" (SF, 1986: 107); "Thief" by Robley Wilson, Jr., in which a man robbed at the airport was accused of stealing his own wallet with an ID, because, on his request, the thief gave him back somebody else's wallet. The poor man can't prove his identity and innocence to the policeman. Great scandal. In two weeks, he receives his wallet back, "no money is missing, all the cards are in place" (SF, 1986: 171).

The message of the author can be foregrounded by specific **plot development**, as, e.g., in the short story "Reunion" by John Cheever. A young man is eager to meet his father for the first time in three years after his parents' divorce. As he has only an hour and a half, his father invites him for lunch next to a

railway station. The young man was so glad to meet his father; he even expected that "*someone would see us together. I wished that we could be photographed. I wanted some record of our having been together*" (SF, 1986: 14). They visited four restaurants but each time it was a failure, because his father caused a scandal everywhere. Even when he wanted to buy a paper to read on the train for his son at a newsstand, it was not a success. The events start and end at the railway station. I can present the plot development of this short story as a ring of closed rings (see Figure 2).

Figure 2. The model of plot development in the short story "Reunion" by John Cheever.
Source: Author's adaptation based on Panasenko 2002
Рисунок 2. Тип развития сюжета в рассказе " Воссоединение" Джона Чивера.
Источник: Собственная обработка по Панасенко 2002



Each event ending with a scandal is completed. The protagonists return to the starting point of their meeting. Taking into account that the ring is closed, it shows no prospect of their communication in future. It is proved by the very last sentence (text strong position): "*Goodbye, Daddy,*" *I said, and I went down the stairs and got my train, and that was the last time I saw my father*" (SF, 1986: 16). Then the title of the text "Reunion" sounds ironic and sarcastic.

Foregrounding in the short story "Turning" by Lynda Sexson (SF, 1986: 70-73) is based on **intertextuality.** Robert, a four-year old child is visited on his birthday by three elderly ladies whom he calls Louise Dear, Olivia Sweet, and Ruth Love. After the birthday cake, they take turns narrating an extremely bizarre tale. They invent stories about "The Emperor Who Had No Skin". In fact, these stories form a fairy tale with its such obligatory elements, as a prince/emperor, princesses, tasks to complete, and a sacred number three. The prince gives three tasks to his potential brides according to the rules of any fairy tale; these three stories form the recognizable pattern "text in a text", i.e. intertextuality. Physical outlook of the prince and unusual tasks he gives to young women are foregrounded by defeated expectancy.

Three old women together with a little boy invent stories where each ending of the fairy tale leads the reader to surprise, i.e. defeated expectancy.

If in the short story "Tent Worms" by Tennessee Williams mentioned above the message of the author is clear to those who know at least something about the tent worms, the short story "The Rememberer" by Aimee Bender (NSF, 2007: 63-67) needs a thorough comprehensive reading. Let us pay attention to different types of foregrounding in it and try to decode the signals of addressee-orientation in this text. The "rememberer" means a person who remembers several words and phrases from an endangered or moribund language but never becomes fluent in it, because it is difficult to find an interlocutor. In sociolinguistics, it is a person who recalls something from memory. Who is the rememberer in this narrative? Annie tells us a story about her lover Ben who at first changed into "*some kind of ape*". It can be taken for allegory or metaphor, but his reverse evolution continues: a sea turtle, then a salamander. Through the whole text the

heroine repeats the word "*to remember*" and "*memories*" related to it (a case of semantic repetition); she worries if Ben being in a different shape still remembers her and if he remembers where to find her house in case he comes back in a human body.

At the very beginning of the text (its salient feature), the whole gist is rendered in as few as one paragraph: "*My lover is experiencing reverse evolution. I tell no one. I don't know how it happened, only that one day he was my lover and the next he was some kind of ape. It's been a month and now he's a sea turtle*" (NSF, 2007: 63).

Examples of convergence and coupling are found at the end of the text: "*This is the limit of my limits: here it is. You don't ever know for sure where it is and then you* ***b****ump against it and* ***b****am, you're there.* ***B****ecause I cannot* ***b****ear to look down into the water and not be able to find him at all, to search the tiny clear waves with a microscope lens and to locate my lover, the one-celled wonder,* ***b****loated and* ***b****ordered,* ***b****rainless,* ***b****enign, heading clear and small like an eye-floater into nothingness*" (NSF, 2007: 66). Here we also see tautology (*the limit of my limits*) and alliteration. Galperin describes alliteration as "a phonetic stylistic device which aims at imparting a melodic effect to an utterance. The essence of this device lies in the repetition of similar sounds, in particular consonant sounds, in close succession, particularly at the beginning of successive words" (Galperin, 1971: 121).

Let us consider the words starting with 'b', which I marked in bold, from the point of view of phonosemantics. Interesting examples of the meanings of different sounds can be found in "*A Dictionary of English Sound*" by Magnus (*s.a.*), who names sounds or sound sequences and their associated meanings as phonesthemes. She "presents the phonesthemic classification of the most common monosyllabic words in English and shows which associations they evoke" (Panasenko, Mudrochová, 2021: 431). We applied her classification to the advertisement's text analysis and chose suitable meanings of /b/. As it comes from the analysis of the example above, it is obvious that /b/ is associated with water, barriers, interference, emptiness, binding, contact, connection, departure, birth and beginnings, and some other things. Most of these meanings that can be found in this extract and are connected with the whole story.

5. Conclusion

In my textual analysis, different approaches popular in decoding stylistics have been used, the major ones being: **close reading,** which allows to deeply penetrate into the meaning of the text and the choice of the stylistic devices; **intertextuality**, i.e. text in a text presenting quotations and allusions to famous pieces of art, culture, and literature; **contextual analysis,** based on social-cultural, historical, and other types of contexts; **stylistic analysis,** covering all language levels.

In the process of sudden fiction analysis through the lens of **decoding stylistics**, we cannot ignore other types of stylistics. In some texts, we must take into account both the suspense and the readers' emotional response to it, i.e. the domain of **affective stylistics**. Convergence is based on the interrelation of the stylistic devices belonging to different language levels – the object-matter of **literary stylistics** – phonetic (rhythm, onomatopoeia, alliteration, etc.); lexical (metaphor, epithet, personification, etc.), and syntactic (repetition, inversion, polysyndeton, etc.).

It is hardly possible to make any calculation while analysing texts of sudden fiction, though it is obvious that coupling and semantic repetition are not as widely employed by the authors as the other types of foregrounding. Each text has a unique structure, combines various types of foregrounding enhanced by intertextuality, curves of plot development, and suspense.

Out of the numerous types of stylistics, I have chosen decoding stylistics for interpreting sudden fiction texts, because it involves analysing the stylistic choices made

by a writer, while foregrounding specifically looks at intentional highlighting or deviation from the ordinary in linguistic elements. Foregrounding is a key aspect of stylistic analysis, helping readers uncover the nuances and artistic dimensions of language use in texts.

Decoding stylistics is equally strongly connected with information theory, i.e. the continuum "code – message – sign – text". Foregrounding may be considered as an important tool of extracting the signals of addressee-orientation encoded by the author from the text.

Taking into account the specificity of this literary genre, my hypothesis was that defeated expectancy would prevail among the other types of foregrounding. However, my research findings suggest that defeated expectancy plays a less crucial role in sudden fiction texts. The results of my research show that foregrounding in sudden fiction is realized by coupling, convergence, semantic repetition, text salient feature and strong positions, and defeated expectancy. I would give priority to the text salient feature, namely the title, the beginning, and the ending of the text. It is the title, which sends a very important message to the reader and lays the foundation of proper text understanding. Convergence, ranking second, can often be found in concluding paragraphs. Defeated expectancy, taking third place, is often intensified by the title and other types of foregrounding. Though my hypothesis was not justified, defeated expectancy can be considered as a very important signal of addressee-orientation highlighting the features that are of utter importance for proper decoding.

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РАЗДЕЛ II. ПРИКЛАДНАЯ ЛИНГВИСТИКА
SECTION III. APPLIED LINGUISTICS

UDC 81-32 **DOI: 10.18413/2313-8912-2025-11-3-0-3**

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The Evolution of Nabokov's Poetic Style: a Stylochronometric Analysis of Attributive Patterns

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Abstract. The goal of this paper is to investigate attributive constructions in the poetry of Vladimir Nabokov. The material comprises Nabokov's lyric poetry, published by the author himself in collections representing all major creative periods. The focus is on one of the most significant aspects of his style: the set of attributive types and their relationships, which together form a potential system

Beyond categorizing different grammatical types of attributes (adjectives, participial phrases, subordinate clauses, etc.), we quantified more complex phenomena such as attribute inversion and polyfunctional attributes, which were likely subject to strong interference from English.

The analysis reveals two distinct tendencies of stylistic evolution in Nabokov's poetry. The first tendency is defined by the specific processes of divergence and declining inversion. While English-language influence accelerated these changes, it did not alter the essential course. The second tendency involves an oscillating dynamic in the use of polyfunctional attributes that persists throughout all phases of his creative work.

These findings demonstrate that Nabokov's poetic style evolved through gradual transformation rather than radical rupture. External factors such as country of residence and linguistic environment quantitatively modulated the pace and scope of changes but failed to precipitate qualitative shifts in his attribute (adnominal) system.

Keywords: Quantitative analysis of style; Change over time; Attribute types; Poetic text; Nabokov

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Эволюция поэтического стиля Набокова: стилехронометрический анализ атрибутивных структур

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Аннотация. Предлагаемое исследование ставит целью изучить атрибутивную струкуру в поэзии Владимира Набокова. Материалом является стихотворная лирика Набокова, опубликованная самим автором в сборниках и отражающая его стиль во всех основных периодах творчества. В фокусе внимания находится один из важнейших аспектов его стиля – системы атрибутивных типов. Помимо различных грамматических типов атрибутов проведены подсчеты таких более сложных для восприятия явлений как инверсия атрибутов и полифункциональные атрибуты, которые должны были испытать сильную интерференцию со стороны английского языка.

Проведенный анализ показывает, что в стиле Набокова-поэта существовали две модели изменений. Первая проявляется в постепенном увеличении различий между сборниками по совокупности анализируемых параметров и в уменьшении частоты инверсии атрибутов.

Влияние со стороны английского языка ускорило происходящие изменения, однако не изменило их основной характер.

Вторая модель заключается в альтернирующей смене частот полифункциональных атрибутов, которая сохраняется на протяжении всей творческой деятельности Набокова.

Результаты показывают, что изменения в атрибутивной системе Набокова-поэта происходили не в форме резкого скачка, а путем эволюции, на направление и масштаб которой такие внешние факторы, как страна проживания и языковая среда имеют количественное, но не качественное влияние.

Ключевые слова: Квантитативный анализ стиля; Динамика; Типы атрибутов; Стихотворный текст; Набоков

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Introduction

Vladimir Nabokov's brilliant prose has long eclipsed his significant poetic output, though he began as a poet and sustained verse composition throughout his career – persisting in Russian poetry even after adopting English exclusively for prose. While scholars have thoroughly examined the evolution of his literary style in prose, particularly the transformative impact of his linguistic transition, the challenge of systematic

quantitative analysis of stylistic evolution in his poetry has yet to be tackled.

The study of stylistic evolution in Vladimir Nabokov's works remains one of the most intensively researched aspects of his oeuvre. Investigations into the dynamics of his style examine shifts in core motifs and "émigré nostalgia", increasing narrative complexity, the emergence and refinement of readerly gamesmanship, evolving patterns of allusion and self-reflexivity, the growing prominence of intertextuality and metafictional techniques (Johnson, 1979, 1991; Pier, 1992; Scherr, 1995, 2005; Loison-Charles, 2015; Boyd, 1999). A pivotal factor in Nabokov's stylistic transformation is often identified as his transition from Russian to English as a literary language – a shift temporally anchored to his 1940 emigration to America. In 1939, his poem *"To Russia"* famously declared Russian foundation of his being, yet by 1940, following his relocation to the U.S., he asserted his complete adoption of English and proclaimed himself an American writer (Nabokov, 1969, 1990).

The multifaceted nature of Nabokov's linguistic transition has been examined in numerous studies, including monographic works (Borisova and Daineko, 2023; Cornwell, 2005; Mullins, 2016/2017; Morris, 2005/06; Jottkandt, 2024; Loison-Charles, 2022; Raguet, 2017; Shvabrin, 2019). However, many scholars challenge a periodization based exclusively on place of residence and linguistic environment. A. Dolinin (2004) argues that Nabokov's stylistic evolution began long before his American emigration, with significant shifts detectable as early as the late 1920s. M. Malikova (Malikova, 2002: 30) suggests that analogous changes took place in poetry in the mid-1930s. B. Boyd (1991: 70) contends that Nabokov's English novels remain fundamentally Russian in essence, preserving core stylistic and thematic continuities. V. Orlova (2016), through extensive textual analysis, demonstrates that Nabokov's linguistic style remained consistent despite the switch to English, suggesting deeper invariants beneath the surface of language choice.

It should be noted that, in this respect, studies on Nabokov's stylistic evolution have overwhelmingly focused on his prose, paying only marginal attention to his poetic works. This study seeks to address this gap by examining one key aspect of his stylistic transformation through the lens of his Russian-language poetry.

Though overshadowed by his globally celebrated prose, Nabokov's poetry – which both he and scholars acknowledge as the genesis of his creative journey – remains integral to understanding his artistic evolution. Writing under the pseudonym Vladimir Sirin, Nabokov debuted as a poet and continued to compose and publish verse throughout his career. He himself emphasized the intrinsic connection between his poetry and prose, stating: *"I have never been able to see any generic difference between poetry and artistic prose. As a matter of fact, I would be inclined to define a good poem of any length as a concentrate of good prose, with or without the addition of recurrent rhythm and rhyme"* (Nabokov, 1990: 44).

Scholars further note that many images and themes fully realized in Nabokov's prose first emerged in Sirin's poetry (Dolinin, 2004: 31–34).

The first works of the young author appeared in the collection *Poems*, published in Petrograd in 1916 when he was only 17 years old. These were followed in 1918 by new poems in the joint collection *Two Ways* with A.V. Balashov. The next stage of his literary career was the Berlin period (1922–1937), during which Nabokov not only wrote his first novels – *Mary*, *The Luzhin Defense*, *The Gift*, and others – but also published poetry collections: *A Bunch* (1923), *The Empyrean Path* (1923), and *The Return of Chorb. Stories and Poems* (1930). Subsequently, Nabokov continued writing and publishing poetry throughout his career. In 1952, he released *Poems, 1929–1951* and several other collections incorporating verse from periodicals. The analysis demonstrates that

Nabokov's poetic style exhibits its own complex and evolution of attributes, which remained a permanent and integral component of his artistic identity. Therefore, Nabokov's poetry must under no circumstances be underestimated or ignored in any comprehensive study of his creative life (Boyd, 1999; De Vries, 1991; Morris, 2010).

Research Materials and Features

This study examines poems from four collections (Nabokov, 2002) that represent the major phases of Nabokov's Russian-language poetic career: "Two Ways" (TW[1], 1916) – the early Crimean period, "A Bunch" (BN, 1923) – the early Berlin period, "The Return of Chorb. Stories and Poems" (RT, 1930) – the late Berlin period and "Poems, 1929–1951" (PM, 1952) – the American period (Nabokov, 2002). Although PM was published after Nabokov's emigration to America, this collection includes poems written in Germany, England, and France prior to his relocation. For the final collection (PM), which spans both his late European and American periods, our analysis includes only those poems written after his move to the United States. The total volume of the analyzed material across the four collections amounts to 10,112 words (*Two Ways* – 768 words, *A Bunch* – 3,897 words, *The Return of Chorb. Stories and Poems* – 2,956 words, and *Poems, 1929–1951* – 2,491 words).

For statistical analysis, we used the Statistica software package (v. 6.1, StatSoft).

The purpose of the study is to establish the character of the evolution of Nabokov's style in poetry. The primary hypothesis of this study is that Vladimir Nabokov's stylistic evolution was not a sudden rupture caused by his emigration to America, but the culmination of a prolonged and intensifying developmental process that began much earlier in his career.

To investigate Nabokov's stylistic idiosyncrasies, we analyze descriptive patterns –specifically, the types of attributes he employs. This focus is justified by the unique syntactic behavior of modifiers: unlike predicate structures, attributive constructions are independent of verbal valency. They are syntactically (and often semantically) optional and their usage reflects authorial choice rather than grammatical necessity. Consequently, attribute selection serves as a key stylistic marker, revealing an author's descriptive preferences with minimal interference from syntactic constraints (Andreev et al., 2017b).

The use of adnominals (attributive modifiers) in poetic style has been explored in numerous studies, examining aspects such as the distribution of attribute types within texts, diachronic shifts in attributive patterns, cross-author comparisons of modification structures, latent trends in attribute frequency, the interplay of different attribute types across textual segments and other related issues (Khokhlova, 2021; Andreev et al., 2017a; Andreev et al., 2017b; Andreev et al., 2018; Popescu et al., 2013; Popescu et al., 2007; Gu, 2025, etc.).

It should be noted that Nabokov himself regarded attributes as a crucial element of poetry. In his (negative) assessment of his first poetry collection, published in 1916, he specifically criticized his own use of modifiers: "I did not venture far for epithets in those days" (Nabokov, 2000).

This study combines stylochronometry and quantitative linguistics to trace syntactic evolution in Nabokov's Russian poetry. Using a corpus of four collections (1916-1952), we quantify attributive patterns (including inversion and polyfunctional modifiers) via frequency analysis, Euclidean distance, and exponential modeling. The application of quantitative analysis to stylistic research enables objective measurement of attribute frequencies across different periods of Nabokov's poetic career. Specific methodological requirements and limitations are detailed in their respective sections.

The taxonomy of attributes is based on the part-of-speech characteristics of words

[1] In brackets the abbreviated name of the collection and the year of publication are given.

occupying the syntactic position of a modifier. Depending on additional linguistic criteria, this framework can be expanded (through finer subcategorization) or shortened (analyzed at a higher level of feature generalization).

The initial list of attributive types (AT) found in the analyzed poems includes the following categories. Each entry provides: Abbreviation, Attributive type, Definition, Examples from Nabokov's works (with translation in parentheses).

Abbr.	Type	Definition	Examples
A	Adjective	Descriptive modifier agreeing with the noun in gender, number, and case	*"*в *приморском* городке*"* (a *seaside* town); "*железный* улей" (*iron* hive); "*чужими* людьми" (*alien* people)
D	Pronominal adjective	Pronoun functioning as an adjective	«*этим* трепетом» (*this* tremor); «*мой* августовский день» (*my* August day)
G	Genitive	Noun in genitive case modifying another noun	«тень *руки*» (shadow of a *hand*); «гвозди *звезд*» (nails of stars)
PR	Prepositional phrase	Modifier introduced by a preposition	«свиданье *под* тем *каштаном*» (a date *under* that chestnut *tree*)
PT	Participle	Verbal adjective	«*синеющую* мглу» (haze *turning* blue)
SC	Subordinate clause	Relative (adjective) clause	«часы*, что лежат здесь»* (the clock *that is here*); «слова, *что в будущем найдет воспоминанье*» (words *that memory will find*)
AV	Adverbial	Adverb modifying a noun (rare)	«здравствуй, счастье *впереди*!» (Hello, happiness *ahead*!)
AP	Appositive	Noun phrase renaming another noun	«ангел дикий, *полупавлинье существо*» (a wild angel, *a half-peacock creature*)
OBL	Oblique-case noun	Noun in oblique case (non-genitive) without a preposition	«конец *веселью*» (end to *merriment*); «радость *голубям*» (joy to the *pigeons*)

The OBL type proved exceptionally rare and was excluded from separate analysis.

Results and Discussion

The analysis of attributes in the poems from four collections, conducted manually, allowed us to determine their frequency of use.

In the TW collection, the total number of attributes was 169 (22.01% of all words), in BN – 993 (25.48%), in RT – 644 (22.35%), and in the PM collection their count was 509 (20.43%). Overall, the number of attributes remains approximately consistent throughout the author's works, averaging about 1 attribute per 5 words.

Table 1 presents the frequencies of the main types of attributes across all collections. Since the poems vary significantly in length, relative frequencies (calculated per 100

words) will be used henceforth, unless otherwise specified. This means that absolute values are divided by the total number of words in the work and multiplied by 100.

Table 1. Frequencies of Attribute Types across the Four Collections
Таблица 1. Частоты типов атрибутов в четырех сборниках

AT	TW	BN	RT	PM
A	13.54	14.16	11.21	8.03
D	2.47	3.36	3.30	3.61
G	2.47	3.62	2.85	3.45
PR	0.91	1.62	1.11	2.85
PT	1.82	1.85	2.57	0.92
SC	0.52	0.38	0.80	0.68
AV	0.13	0.05	0.03	0.16
AP	0.13	0.44	0.28	0.68

Judging by the table, it can be noted that there are certain changes in attribute frequencies from one collection to another. For instance, attribute A appears with a frequency of 11.21 in the RT collection but only 8.03 in PM. Attribute PR is relatively rare in TW (0.91), while in other collections, particularly in PM (2.85), it occurs more frequently. A chi-square test of independence, performed on the absolute frequency counts, revealed a statistically significant difference in the distribution of attribute types across the four collections, $\chi^2(21, N = 2472) = 110.21$, $p < 0.001$. Post-hoc pairwise comparisons showed that while the distributions between the first two collections (TW and BN) did not differ significantly, all subsequent consecutive pairs (BN-RCH and RCH-POEMS) exhibited significant differences ($p < 0.05$ and $p < 0.001$, respectively).

To assess the degree of variation in the frequencies of AT across collections, the coefficient of variation was used, which is expressed as:

$$V = \frac{\sigma}{M} \times 100\%,$$

where σ is the standard deviation and M is the arithmetic mean.

The results of applying this coefficient are presented in Table 2.

Table 2. Coefficients of variation for various attribute types
Таблица 2. Коэффициенты вариации для различных типов атрибутов

A	D	G	PR	PT	SC	AV	AP
23.7	15.5	17.2	53.7	37.6	30.4	64.5	61.9

There are various approaches to interpreting the magnitude of the coefficient, which appear to largely depend on the subject of analysis (Reed et al., 2002; Warner, 2008, p.100-104). However, in any case, a value of $V < 20\%$ can be considered an indicator of low variability, while $V < 33\%$ suggests moderate variation.

Judging by Table 2 data, the variability in attribute frequencies across different collections proves relatively minor. The most stable patterns emerge in pronouns and

genitives, which maintain remarkably consistent frequency.

Similarly low variation characterizes A and, quite unexpectedly, SC, an infrequent attribute that typically shows greater variability in other writers' works.

The frequencies of extremely rare attributes such as PR, AV, and AP show more significant variation from one collection to another. However, even for these, the coefficient of variation is not as high as might be expected.

The author's stylistic preferences for attribute types demonstrate exceptional stability over time, revealing an attributive system of striking uniformity. A noteworthy observation: when excluding the final "American" collection, variability diminishes for A, PR, PT and AP, while increasing for other ATs (Table 3).

The data in Table 2 indicate that the author's core attributive system is highly stable. While the rarest attributes (PR, PT, AV, AP) understandably show greater dispersion, their degree of variation (37-65%) is not as extreme as is commonly found in linguistic corpora for features of such low frequency. This suggests an underlying uniformity in the author's stylistic choices, even with regard to optional elements.

Table 3. Variability of attribute types excluding the final collection
Таблица 3. Вариативность типов атрибутов без учета последнего сборника

A	D	G	PR	PT	SC	AV	AP
12.0	16.3	19.6	30.0	20.3	37.1	70.8	54.4

To more clearly determine the degree of similarity (or difference) between attributive patterns in the four collections, we can employ Euclidean distance, calculated using the formula:

$$d(p,q) = \sqrt{\sum_{i=1}^{n}(q_i - p_i)^2},$$

where p and q represent the attributive patterns being compared, p_i and q_i are the frequencies of specific attributes in collections p and q. This metric provides a quantitative measure of stylistic divergence, with smaller values indicating greater similarity in attribute usage across collections.

The Euclidean distance metric requires variables measured in comparable units. In this study, we analyze different types of the same parameter (attributive constructions), all of which vary within highly similar ranges. Frequencies of attributive types (AT) across collections are taken from Table 3.

The step-by-step computation process is illustrated in Table 4:

1. **Pairwise Differences**: For each AT type, we calculate frequency differences between collection pairs (e.g., TW vs. BN; Columns 2-4).

2. **Squared Differences**: These values are squared to eliminate directionality (Columns 5-7, upper section).

3. **Aggregation**: The squared differences are summed for each collection pair (Columns 5-7, lower section).

4. **Distance Metric**: The square root of each sum yields the Euclidean distance between collections in the multidimensional feature space (Columns 5-7, lower section).

Table 4. Measuring Euclidean across between collections within the attribute type feature space
Таблица 4. Измерение Евклидова расстояния между сборниками в признаковом пространстве типов атрибутов

	$x_i - y_i$			$(x_i - y_i)^2$		
	TW-BN	BN-RT	RT-PM	TW-BN	BN-RT	RT-PM
1	2	3	4	5	6	7
A	-0.62	2.96	3.18	0.39	8.75	10.10
D	-0.89	0.07	-0.32	0.79	0.00	0.10
G	-1.14	0.77	-0.61	1.31	0.60	0.37
PR	-0.71	0.51	-1.74	0.50	0.26	3.03
PT	-0.02	-0.72	1.64	0.00	0.52	2.70
SC	0.14	-0.41	0.12	0.02	0.17	0.01
AV	0.08	0.02	-0.13	0.01	0.00	0.02
AP	-0.31	0.16	-0.40	0.09	0.03	0.16
Sum of squared differences				3.10	10.32	16.50
Distance (square root)				1.76	3.21	4.06

The distance between the first two collections (TW and BN) is the smallest observed, indicating their high degree of similarity. The scale of divergence increases significantly between BN and RT, reaching its maximum between RT and PM. Notably, the distance between the "American" collection (PM) and the "Crimean" collection (TW) is even greater (6.13).

To capture the distribution patterns of AT, we employed an exponential function plus one, as proposed in several studies (Mistečký & Altmann, 2019; Kelih, 2024):

$$y = 1 + a * e^{-b*x},$$

where a and b – parameters.

The coefficient a represents the magnitude of the most frequent feature. Of greater analytical interest is coefficient b, which serves as an individualized characteristic reflecting the steepness of decline between high-frequency and low-frequency units. The goodness-of-fit is evaluated using the r^2 coefficient, where values approaching 1 indicate stronger correspondence between modeled predictions and empirical observations.

The distribution of attributive types frequencies, ranked in descending order, was fitted using the aforementioned function. The fitting results are presented in Table 5.

Table 5. Fitting an exponential function plus one to the distribution of attributive types
Таблица 5. Аппроксимация распределения атрибутивных типов с помощью экспоненциальной функции плюс один

TW			BN			RT			PM		
AT	Obs	Exp	AT	Obs	Exp	AT	Obs	Exp	AT	Obs	Exp
A	13.54	13.51	A	14.16	14.03	A	11.21	11.05	A	8.03	7.85
D	2.47	2.88	G	3.62	4.53	D	3.30	4.17	D	3.61	4.45
G	2.47	1.28	D	3.36	1.96	G	2.85	2.00	G	3.45	2.74
PT	1.82	1.04	PT	1.85	1.26	PT	2.57	1.32	PR	2.85	1.88
PR	0.91	1.01	PR	1.62	1.07	PR	1.11	1.10	PT	0.92	1.44
SC	0.52	1.00	AP	0.44	1.02	SC	0.80	1.03	SC	0.68	1.22
AV	0.13	1.00	SC	0.38	1.01	AP	0.28	1.01	AP	0.68	1.11
AP	0.13	1.00	AV	0.05	1.00	AV	0.03	1.00	AV	0.16	1.06
r^2 = 0.97 a =83.14 b = 1.89			r^2 = 0.97 a =48.15 b = 1.31			r^2 = 0.95 a =31.85 b = 1.15			r^2 = 0.92 a =13.59 b = 0.69		

Figures 1-4 visually present the fitted curves (exponential function +1) approximating the frequency distributions of attributive types in each poetry collection. The r^2 values range from 0.92 to 0.96 across collections (see Table 5), indicating excellent goodness-of-fit for this function.

Figures 1-4. Graphical representation of fitting frequency distribution of attributive types. Solid lines show fitted exponential curves, dots represent observed frequencies
Рисунки 1-4. Графическое изображение аппроксимации распределения частот атрибутивных типов. Сплошные линии – графики экспоненциальных функций, точки – наблюдаемые частоты

Figure 1. TW
Рисунок 1. Два пути

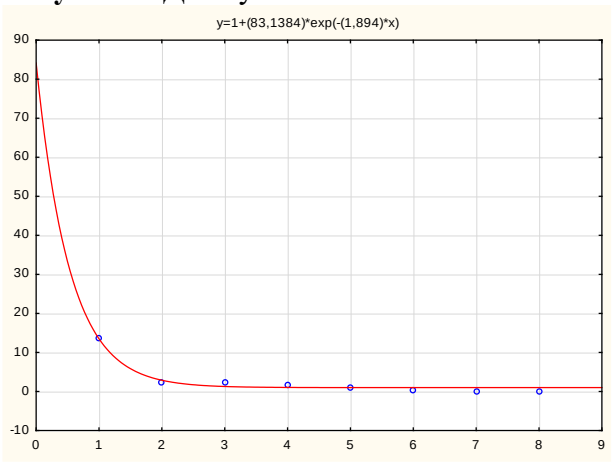


Figure 2. BN
Рисунок 2. Гроздь

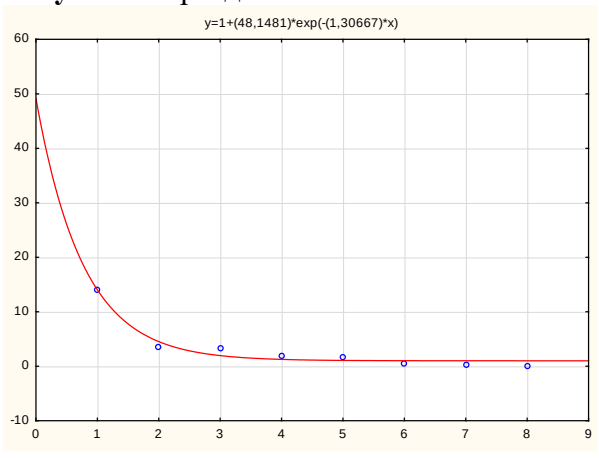


Figure 3. RT
Рисунок 3. Возвращение Чорба

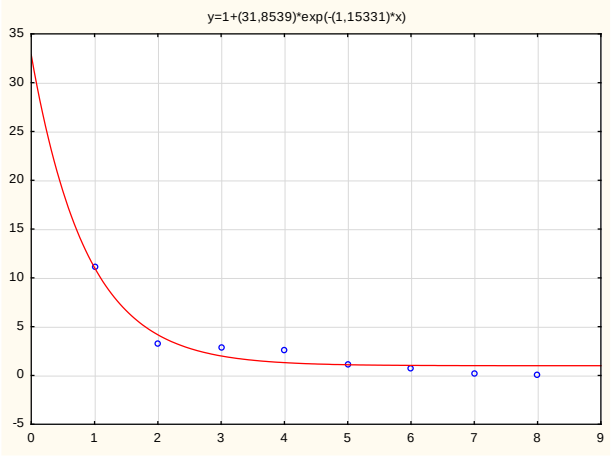
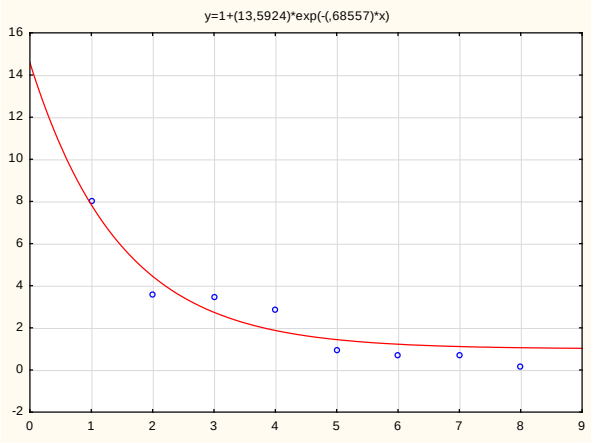


Figure 4. PM
Рисунок 4. Стихотворения, 1929–1951



As shown in Table 5, parameter b (the function's decay rate) exhibits cross-collection variability and demonstrates a consistent downward trend. The lowest value occurs in PM (Figure 4), with gradual decline between initial collections and a marked drop by PM. Consistent with previous patterns, we observe gradual progression across all collections, with notably accelerated divergence in the American corpus.

Attribute Inversion

The attributive system contains a special aspect closely tied to authors' individual characteristics – inversion. Along with enjambment, syntactic inversion serves as a primary method for modifying text structure and shifting the informational focus of utterances through deviation from syntactic canons (Chen, 2003). This syntactic device is unique in its capacity to alter text structure by departing from canonical word order.

While Russian permits considerable word order flexibility, empirical studies reveal systematic constraints on attribute-noun positioning Deviations from these patterns, perceptible to native readers as inversion, acquire stylistic salience (Gasparov, 2012). The markedness of inverted structures creates a double stylistic effect: high frequency establishes an idiosyncratic pattern, while low predictability enhances foregrounding (Chen, 2003; Shen, 2007).

In this study, we classify the following cases (examples drawn from the collections) as inversion:

Adjective in postposition (A-R), i.e., following the modified noun:

"платочком машет *изумрудным"* (Waves a handkerchief *emerald*); "особенный привкус *анисовый*" (a distinctive aftertaste *aniseed*).

Determiner in postposition (D-R):

"Не согрешу пред музою *твоей*" (I will not sin before muse thine); "на престолах *своих* матерых" (*upon grizzled thrones *their*).

Genitive in preposition (G-L):

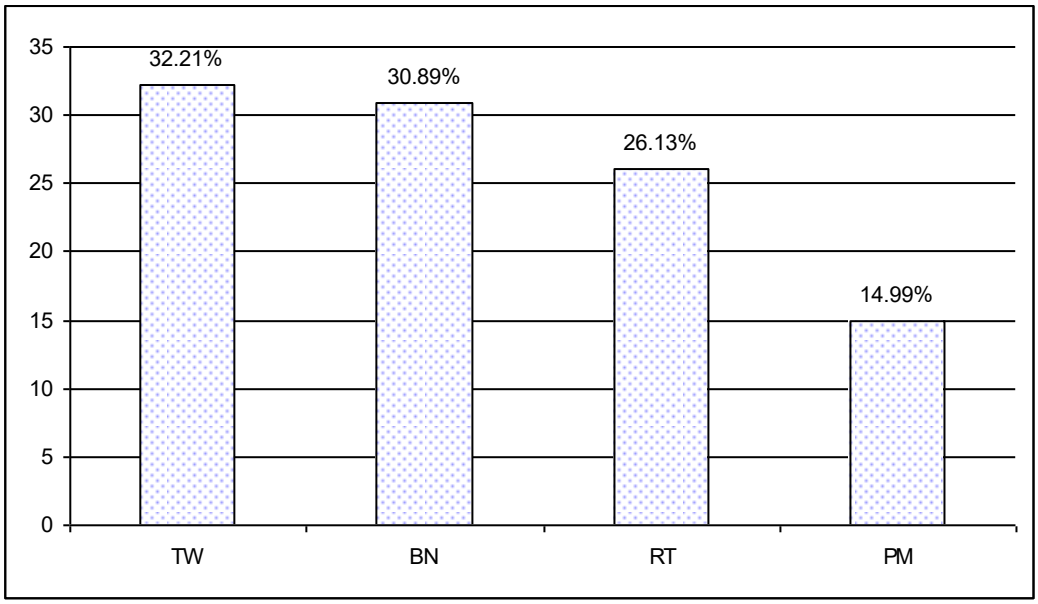
"вокзалов призраки" (*of stations ghosts); "сонных *мыслей* и *умыслов* сводня" (of drowsy *thoughts* and *schemes* a bawd".

Prepositional phrase in preposition (PR-L):

"*в* балканской *новелле* влиянье" (**in* the Balkan *tale* an influence).

Quantitative analysis yielded data on the frequency of inverted attributes. Figure 5 illustrates the percentage of inverted constructions relative to all attribute types in the texts.

Figure 5. Histogram showing the distribution of inverted ATs as a percentage of total attributive type
Рисунок 5. Гистограмма распределения инвертированных атрибутов в процентах от общего числа атрибутов



First and foremost, what stands out is the gradual decline in inversion frequency across successive collections. A particularly sharp drop occurs in the "American" collection, where inversion rates are more than twice as low compared to the first and second collections (the Crimean and early Berlin periods). That said, the late Berlin period remains closer to its early phase (26.13% in RT and 30.89% in BN) than to the American period, which records only 15% inversions. The distribution of inversions by individual attribute types is shown in Table 6.

Table 6. Proportion of inverted attribute types (expressed as percentages relative to all attributes in the collection)
Таблица 6. Доля инвертированных атрибутивных типов в процентах к общему числу атрибутов в данном сборнике

Collections	Types of Inverted Attributes (%)			
	A-R	D-R	G-L	PR-L
TW	26.17	2.01	3.36	0.67
BN	24.13	4.51	1.47	0.79
RT	20.49	4.14	1.13	0.38
PM	11.63	2.68	0.45	0.22

All AT types except PM exhibit a significant decrease in inversion frequency within the final (“American”) collection. Gasparov’s (2012) research established that adjective inversion in attributive position occurs at a rate of 25-26% in canonical Russian poetry. While the TW and BN collections align with these norms, the latter

two diverge significantly, with PM dropping below the boundary of this range.

Analysis of adjectival attributes distribution reveals progressive strengthening of canonical adjective positioning across collections, evidenced by the growing ratio of non-inverted to inverted forms:

• TW: 1.7 : 1 ratio **(**indicating **a** relative balance with a slight preference for canonical position)**.**

• BN: 1.6 : 1 ratio **(**near-identical distribution, maintaining the balance)**.**

• RT: 2 : 1 ratio (marking an emerging normative preference for the canonical structure)**.**

• PM: 2.8 : 1 ratio (demonstrating a strong canonical bias)**.**

This demonstrates a 64.7% increase in standard word order preference from TW to PM.

The pronounced reduction of inversions in the American collection may manifest Nabokov's stylistic shift toward English-influenced syntactic norms. This trajectory culminates in his English verse (e.g., *Pale Fire*), where inversion frequency drops to merely 3% of attributive constructions (predominantly adjective inversions). These quantitative patterns position inversion as a sensitive metric for cross-linguistic poetic adaptation, as evidenced by comparative analysis of Keats' *The Eve of St. Agnes* and its Russian translations. In their Russian translations of this poem, S. Sukharev, E. Vitkovsky and T. Klado meticulously preserve most of the original's syntactic features, yet their use of inversion differs significantly:

Keats's original: 9.5% A inversions
Translations:
Vitkovsky: 19%
Klado: 23%
Sukharev: 27%

The systematic growth of inversion frequencies in translation – despite otherwise faithful syntactic preservation – underscores Russian poetic conventions' gravitational pull.

Attributes with dual syntactic roles

The attributive system's evolution in our study further involves "polyfunctional" attributes – substantive units serving dual modifier-modified roles – performing modification while retaining nominal properties and thus revealing new dimensions of stylistic change (an alternative approach to polyfunctionality is given in Wang et al. (2021).

The following excerpt contains three instances of syntactic embedding (a cascade of attributive relationships), marked in bold. Definitions referring to these polyfunctional attributes are indicated in italics:

Там в доме *с радужной* **верандою**,	There in the house with a *rainbow-colored* veranda,
С **березой** *у дверей,*	with a birch *at the doors*,
в халате старом проваландаю	in an old robe will idly spend
остаток **жизни** *сей.*	the remainder of *this* life.
(*"The Pilgrim"*)	

The prepositional phrase "с верандою" (with a veranda) modifies "дом" (house), while is modified itself by the adjective "радужной" (rainbow-colored). Similarly, "с березой" (with a birch) modifies "дом" (house), its own modifier being another prepositional phrase "у дверей" (by the doors). The genitive "жизни" (of life) modifies "остаток" (remainder), being modified by the demonstrative pronoun "сей" (this).

The use of polyfunctional attributes introduces significant descriptive complexity by adding multidimensional layers to syntactic and semantic relations. This layering of syntactic functions contributes to the textural density of Nabokov's verse, allowing compact semantic packing while maintaining

grammatical coherence. The aforementioned phrase "ряды лиловых кирпичей" (The rows of purple bricks) creates a semantic cascade: the bricks' purple hue implicitly colors the entire row structure, demonstrating how syntax mirrors perceptual layering.

Nabokov's works exhibit distinct categories of polyfunctional attributes, which operate simultaneously as both modifiers and modified elements within nominal constructions. Primary types include:

Genitive (G-PF): Сохнут чинно ряды *лиловых* **кирпичей** (The rows of *purple* **bricks** dry demurely). The noun "bricks" (G-PF) modifies the word "rows", and at the same time is modified by the adjective *"лиловых" (purple).* A similar example is "шум *тихой* **родины** *моей*" (the sound of *my quiet* **homeland**), in which "родина" performs two functions: "шум – родины" (the sound of homeland") – *Modifier*, and "родины – тихой + моей" (homeland – quiet + my) – *Head*.

Prepositional phrase (PR-PF): И женщина ***у*** *круглого* ***фонтана*** ***(****And a woman beside the circular fountain).* "*У фонтана"* – attribute (PR – prepositional phrase), is modified by the adjective "круглый" (circular).

Apposition (AP-PF): Мы будем спать, *минутные* ***поэты***. (*We'll sleep, we poets of the minute).* The noun "поэты" (poets) functions as an appositive to the pronoun "мы", while being modified by the attributive "минутные" (of the minute) – a syntactic doubling that merges identification and qualification.

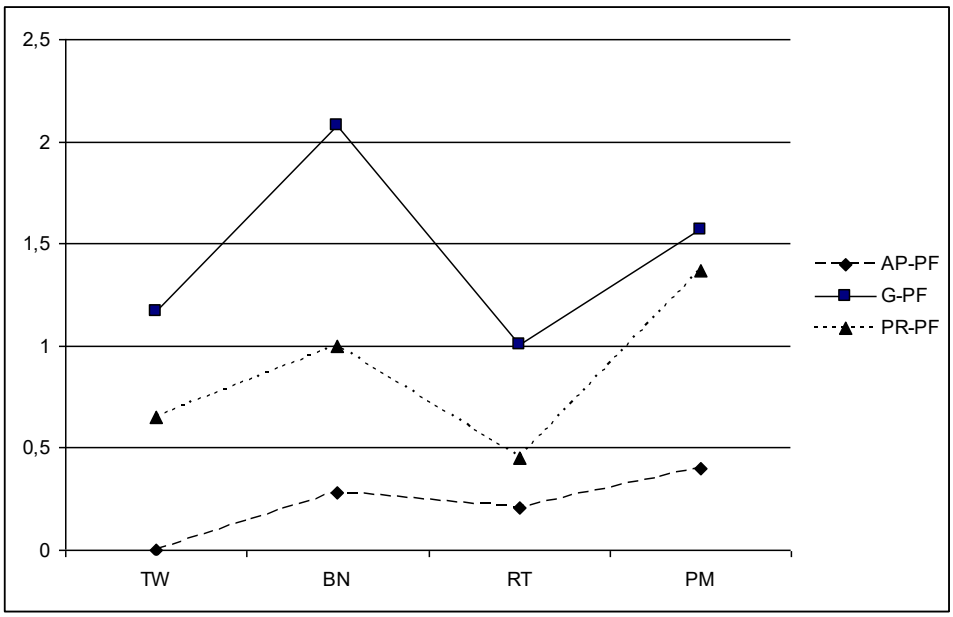
The quantitative analysis of these polyfunctional attributes yielded the results presented in Table 7 with corresponding graphic representation in Figure 6. Frequencies were normalized relative to the total number of nominal attributive types.

Table 7. Frequency distribution of polyfunctional attributes
Таблица 7. Распределение частот полифункциональных атрибутов

Сборник	AP-PF	G-PF	PR-PF	TOTAL	Relative to the total number of nominal attributive types (%)
TW	0	1.17	0.65	1.82	51.85
BN	0.28	2.08	1.00	3.36	59.28
RT	0.21	1.01	0.45	1.67	37.50
PM	0.40	1.57	1.36	3.33	48.28

As evidenced by the dataset, polyfunctional unit distribution follows an alternating pattern: frequency increases from Collection 1 to Collection 2, declines in Collection 3, and rises again in Collection 4.

Figure 6. Distribution of polyfunctional AT frequencies across four collections
Рисунок 6. Распределение полифункциональных атрибутивных типов в четырех сборниках



Structural complexity peaks in the final collection while remaining equally pronounced in BN (marking the onset of the 'Berlin period'). Following this phase, the author deliberately attenuates such complexity, only to later revisit the experimental approach characteristic of the first Berlin-period collection.

Discussion

The quantitative analysis of attributive patterns reveals a complex picture of stylistic evolution in Nabokov's poetry, characterized by both stability and gradual change. Our findings demonstrate that while the core inventory of attribute types remained remarkably stable, their configuration and the use of specific stylistic devices like inversion underwent significant transformation.

These findings align with Dolinin's (2004) observations regarding Nabokov's prose, where changes in the composition of his novels became noticeable by 1929, prior to his American emigration. This parallel suggests the existence of a deep stylistic shift affecting Nabokov's poetry, which began in the late Berlin period rather than being triggered solely by his geographic and linguistic transition. The pronounced reduction of inversions, commencing in the late Berlin collection (RT) and intensifying dramatically in the American collection (PM), supports this hypothesis. This trend likely reflects a confluence of two factors: the long-term internal evolution of Nabokov's style toward a more canonical syntactic structure and the accelerating influence of English linguistic norms after his emigration. The fact that the decline began before 1940 indicates that the emigration acted as a catalyst for an existing process rather than its sole cause.

The oscillating dynamics observed in the use of polyfunctional attributes further corroborate the notion of Nabokov's style as a dynamic system. The peak of complexity in the early Berlin collection (BN), followed by a decline and a subsequent resurgence in the American period (PM). Thus, the evolution of Nabokov's poetic style emerges not as a series of abrupt ruptures but as a continuous process of adaptation and recalibration. External factors like country of residence and linguistic environment quantitatively modulated the pace and scope of these changes.

Conclusion

This study has undertaken a quantitative analysis of attributive patterns across four collections of Vladimir Nabokov's Russian-language poetry, spanning his major creative periods.

The structure of attributive types in Nabokov's poetry demonstrates a high degree of stability in the frequency of individual attribute types (AT), indicating a consistent structural framework throughout his career.

Multivariate analysis, however, reveals gradual stylistic divergence. While the early collections (TW and BN) are highly similar, a process of differentiation begins in the late Berlin period (RT) and culminates in a very different profile of the American collection (PM).

The analysis of inversion shows a progressive decline that began in the late Berlin period and sharpened dramatically in the American collection.

The distribution of polyfunctional attributes exhibits a non-linear, oscillating pattern, suggesting a complex process of compensatory adaptation within the author's stylistic system.

Nabokov's stylistic evolution in poetry resulted from a prolonged and intensifying internal developmental process rather than an abrupt transformation caused by his emigration. While his transition to an English-language environment accelerated certain pre-existing trends, it did not alter their fundamental trajectory. The poet's attributive system avoided radical restructuring, exhibiting instead a pattern of gradual evolution.

The prospects for further research include a cross-genre analysis of attributive constructions in Nabokov's prose and poetry, a contrastive analysis of his Russian and English-language poetic systems, and a comparative study with other poets who influenced his work.

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Аннотация. В представленном исследовании осуществлен корпусный и параметрический анализ 785 наименований референтов культурного кода России в текстах 30 учебников по русскому языку, литературе и истории для учащихся 5 – 9 классов РФ. Общий объем корпуса исследования превышает 1.5 млн. словоупотреблений. В качестве источников наименований референтов культурного кода России использовались валидированные данные лингвистических, культурологических и социологических исследований. Список классифицирован по 13 тематическим группам: История, Государство и социальное устройство, Литература, География, Религия Традиционный быт, Природа, Наука, Русский язык, Искусство, Пословицы и поговорки, Календарь и праздники, Единицы измерения. Анализ выявил системность и тематическую гомогенность зафиксированного в текстах учебников культурного кода: в каждой из предметных коллекций учебников наиболее репрезентативными являются тематические группы «История», «Искусство», «Литература» и «География (пространство)». Общая доля наименований объектов российской культуры в учебных текстах варьируется в диапазоне от 1.8 % до 5.04% текста (в словоупотреблениях): минимальное количество вхождений зафиксирована в учебниках по русскому языку, максимальные значения – в учебниках литературы. Частотность наименований референтов культурного кода в учебниках растет от 5 к 9 классу за счет преимущественного увеличения в группах «История», «Литература», «Государственное устройство». Выявленные эмпирические данные и диапазоны плотности НРКК могут использоваться для

совершенствования алгоритмов автоматизированной оценки языка учебного текста и моделирования языковой картины мира в текстах различных жанров.
Ключевые слова: культурный код, учебный дискурс, корпусный и параметрический подходы, системность, гомогенность, частотность
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Cultural code in academic discourse: corpus and parametric approaches

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Abstract. The study presents a corpus and parametric analysis of 785 nominations of Russian cultural code referents in academic discourse. The dataset amounting 1.5 mln. tokens comprises a collection of 30 textbooks used in the 5th - 9th grades of general secondary schools in Russia to teach Russian, Literature and History. The nominations of cultural code referents were sourced from validated linguistic, cultural and sociological studies, and were classified into thirteen thematic groups, including: History, State and Social Structures, Literature, Geography, Religion, Traditional Life, Nature, Science, Russian Language, Art, Proverbs and Sayings, Calendar and Holidays, Units of Measurement. The research revealed systematicity and thematic homogeneity of the cultural code nominations employed in the

textbooks: the most representative in each of the grade collections are the following thematic groups: “History”, “Art”, “Literature” and “Geography (space)”. The share of nominations of Russian cultural code referents in textbooks varies from 1.8% to 5.04% (in tokens): the smallest number of instances is registered in the textbooks of Russian, the highest – in Literature textbooks. The frequency of Russian cultural code referents nomination increases across grades predominantly due to the growth in groups “History”, “Literature”, and “State structures”. The revealed empirical data and ranges of the NRCC frequency can be used to improve algorithms for automated assessment of the language of educational texts and modeling linguistic worldview in texts of various genres.

Key words: Cultural code; Academic discourse; Corpus and Parametric approaches, Consistency; Homogeneity; Frequency

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Введение

Культурный код как результат «преобразования языковой компетенции в культурную» отражает специфику интерпретации народом отдельных референтов, т.е. объектов, событий, и дат (Телия, 1996: 227). Значимость культурного кода состоит в его способности обеспечивать этнос закодированной в нем информацией о внутренних и внешних для данной культуры объектах (D’Andrade 1984, 88-89). «Высшая ступень семиотического освоения реальности» этносом реализуется при превращении знака в символ, приобретающем «прямое, эмблематическое и аллегорическое осмысление информации» (Карасик, 2013: 15). Например, *Пушкин* как символ русской поэзии, *Хатынь* – символ вечной памяти и скорби.

Ученые подчеркивают многоэтапность формирования системы культурных кодов «как совокупности знаков и их комбинаций внутри историко-культурного периода <…> в процессе освоения человеком мира» (Гудков, Ковшова, 2007: 9). Исторический характер культурного кода также проявляется в его способности изменяться под влиянием внешних факторов. Типичным примером такого рода изменений может служить отношение носителей языка и культуры к ряду референтов (см. Тишин, 2019 об *орде*). В переломные для этноса периоды особую значимость приобретает «интерпретативная устойчивость [культурного кода – *вставка авторов*] в пространственно-временном континууме» (Симбирцева, 2016: 161), используемая носителями культуры при оценке вновь появившихся объектов и событий в качестве своеобразной «системы координат». Именно поэтому актуальность изучения культурного кода и его средств выражения особенно возрастает в свете продолжающихся изменений в России, сопровождающихся трансформацией ценностей российского общества и мира в целом (Трубина, Миркушина, 2022, Цацановска, Благоевич, 2021). Ученые пишут о необходимости «выработки Российским государством и обществом новых защитных механизмов в виде системы ценностных ориентиров, отвечающих вызовам времени в реалиях геополитического противостояния» (Стеценко, 2024: 208), когда Россия стремится не только сохранять, но и развивать многовековое культурное

наследие, а переосмысление прошлого и настоящего расценивается как необходимое условие выхода из кризиса. Однако феномен культурного кода России, активно изучавшийся российскими и зарубежными исследователями, до сих пор сохраняет ряд исследовательских ниш. В частности, малоизученной остается проблема трансляции культурного кода в учебной литературе. Немногочисленные исследования в данной области, опубликованные в рамках современной научной парадигмы, используют в качестве материала либо тексты для изучающих русский как иностранный (далее РКИ), либо тексты обязательной и внеклассной литературы для школьников, т.е. художественных произведений (см. Велилаева, 2021; Худолей, 2014). Культурный код учебников для русскоязычных школьников РФ, насколько нам известно, изучался весьма спорадически, при этом авторы немногочисленных статей в данной области указывают на особую роль учебника в трансляции культурных ценностей (см. Аристова, 2022). Сложность и актуальность изучения культурного кода современной России определяется также многообразием способов его реализации и неоднозначностью исторических традиций внутри самого учебного дискурса (см. Hyatt, Simons, 1999). Таким образом, **целью** представленного исследования является выявление специфики спектра и плотности наименований объектов культурного кода в современном учебном дискурсе РФ.

Исследовательскими вопросами являются следующие:

1. Каков диапазон плотности номинаций референтов культурного кода в современном учебном дискурсе?

2. Присутствуют ли различия в степени «культуроносности» учебников социально-гуманитарного блока: История, Русский язык, Литература?

Обзор литературы

Культурный код как объект науки

Понятие «культурный код», на котором в последнее время сфокусировано внимание ряда ученых, является по своей сути весьма многогранным феноменом. В философии коды культуры трактуются как объекты, способные управлять «её языком, её схемами восприятия, её обменами, её формами выражения и воспроизведения, её ценностями, иерархией её практик» (Фуко, 1977: 37). В социологии культурный код (далее КК) определяется как упорядоченная система маркеров, демонстрирующих принадлежность языковой личности или социума к определенной культуре (Николайчук и др., 2023: 50), своеобразный «генотип», определяющий многообразие культуры и способный «создавать преграды для взаимодействия между различными цивилизациями» (Старостин, 2017: 1). Способность КК элиминировать коммуникацию, в том числе частично, в контексте современного положения общества имеет высокую степень значимости. Наиболее часто к понятию КК обращаются культурологи, рассматривающие «культурные коды как вторичные знаковые системы, использующие разные средства для кодирования содержания, сводимого к картине мира» (Толстая, 2007: 24). Объективируясь в различных областях действительности, КК доступен для восприятия органами чувств: в пейзажах, явлениях природы, фауне, флоре, артефактах (хозяйственной утвари, орудиях труда, оружии, предметах одежды, жилищах, картинах, кинофильмах, объектах архитектуры, художественных произведениях и т. д.), в действиях, ассоциациях, стереотипах, поведенческих нормах, речевых характеристиках, а также в языке (Любавин, 2002, Савицкий, Гашимов, 2005). Типичной сферой реализации КК являются сакральные тексты, метафоры, паремии и фразеологизмы, поскольку данные формы

обладают высокой степенью символичности, отражая национальную специфику дискурса (Ковшова, 2016, Телия, 1999).

Современная лингвистическая парадигма трактует культурный код как «языковые маркеры национально-культурного сознания», включенные не только в денотативно-коннотативную структуру языкового знака, но в структуру языка и его единиц в виде пропозиций и фоновых знаний этнолингвокультурного сознания языковой личности» (Привалова, 2004: 94)[1]. Отдельно описан в современной лингвистической литературе образный характер культурного кода, в основе которого лежат культурные реалии (Савицкий, Гашимов, 2005). Эксперты указывают на способность КК выступать в качестве «таксономического субстрата ее [культуры – *вставка авторов*] текстов. Этот субстрат представляет собой совокупность окультуренных представлений о картине мира того или иного социума — о входящих в нее природных объектах, артефактах, явлениях, выделяемых в ней действиях и событиях, ментофактах и присущих этим сущностям их пространственно-временных или качественно-количественных измерениях» (Телия, 1999: 20).

Особо укажем на «эмпиричность» культурного кода, т.е. его способность использоваться в качестве основы прогнозирования и нормирования поведения индивидуума или социальных групп, а также формирования систем культурных кодов: от глобальных до индивидуальных (Николайчук и др., 2024).

Всеми научными школами признается наличие внутренних связей, объединяющих знаки КК, т.е. системность или когерентость (Rapaille, 2006: 10–11, 22). Ядро данной системы конвенционально, поскольку оно «прочитывается» носителями языка одинаково. Например, ядерными и поэтому однозначными для россиян являются *Александр Невский, хохлома, Илья Муромец.* При этом для кодирования одного и того же содержания может использоваться широкий спектр форм и средств. Например, *могила неизвестного солдата, минута молчания, письмо-треугольник, Георгиевская лента, Вечный огонь, белые журавли* как символы памяти о павших (см. Батыршин, 2025). Гетерогенность, свойственная культурному коду России как полиэтническому государству, объективирована в его системе региональными объектами (ср. *башня Сююмбике* для татарстанцев, см. Галимуллина, Галимуллин, 2022).

Единство взглядов ученых на КК как систему объективируется в множестве классификаций его единиц, в основу которых положены преимущественно формы и средства реализации КК. Например, Н.И. Толстой разделяет КК на три группы объектов: «вербальные (словесные – слова), реальные (предметные – предметы, вещи) и акциональные (действенные – действия)» (1995: 23). М.В. Пименова выделяет «природный, растительный, зооморфный, перцептивный, соматический, антропоморфный, предметный, пищевой, метеорологический, химический, цветовой, пространственный, временной, духовный, теоморфный (божественный), галантерейный, игровой, математический, медицинский, музыкальный, этнографический, экологический, экономический» культурные коды (2007: 80). Одной из наиболее признанных классификаций объектов культурного кода является классификация В.В. Красных, в составе которой ученый выделяет соматический, пространственный, временной, предметный, биоморфный, духовный КК (2002: 233). В Лингвострановедческом словаре «Россия» (2007) объекты культурного кода классифицированы по следующим

[1] Под пропозициями при этом понимается «отражающие некие онтологически существующие отношения между предметами или предметом и его свойством и осмысленные как таковые в голове человека» (Привалова, 2004: 96).

категориям: география (Алтай, Волга, тундра, Сибирь, Москва и др.). История (Великая Отечественная Война, Петр I, Кирилл и Мефодий, Крещение Руси и др.), искусство (матрёшка, Шаляпин, Эрмитаж, Мариинка, Щелкунчик и др.), литература (Дядя Стёпа, Обломов, Пушкин А. С., Незнайка, Толстой Л.Н. и др.), фольклор (Баба Яга, Змей Горыныч, Дед Мороз, Кикимора, Снегурочка и др.), флора и фауна (медведь, щука, берёза, калина, хрен и др.), наука и образование (кириллица, Ломоносов, Менделеев, Даль, азбука, букварь и др.), общество и государство (барин, дворянин, СНГ, Совет и др.), быт (баня, изба, печь, валенки, водка, шуба и др.), праздники и традиции (Иван Купала, Новый год, масленица, крещение и др.). Таким образом, в современной науке КК трактуется как своеобразная матрица, обеспечивающая синтез знаний, координацию поиска и интеграцию различных теорий и фактов о мире. КК есть всеобъемлющий и изменяющийся, конкретный, транслируемый, очевидный, понятный, одобряемый, но при этом всегда осознаваемый носителями феномен, сохраняющий элемент(ы) скрытности и «парольности» для внешнего мира, т.е. его предназначенности исключительно для посвященных (Доброхотов, 2001: 532; Rapaille, 2006: 10–11, 22).

Трансляция КК из поколения в поколение осуществляется через художественные произведения, фольклорные и учебные тексты. При этом учебнику как нормативно-научному тексту принадлежит в данном процессе особая роль: целенаправленный характер формирования его содержания обеспечивает способность учебника избирательно влиять на аккультурацию языковой личности, передавая молодому поколению не только научную, но и социально-значимую информацию. «Роль той нити, которая связывает эпохи, реалии, личности, события национальной истории и культуры» (Максимчук, 2024: 842) выполняют аксиологически значимые наименования, маркеры единого культурного пространства. Именно поэтому интертектуальность учебника, реализуемая в его сквозной цитатности (Оксенчук, 2013), крайне важна при апелляции к наследию прошлого и формировании ценностей.

Для выявления спектра аксиологически значимых единиц, а также степени их воздействия на лингвокультурные интенции языковой личности важны частотные характеристики элементов в корпусе и их дистрибуция (Ляшевская, Шаров, 2015). Данные параметры имеют высокую степень корреляции с внедрением знака в сознание носителя языка (entrenchment), возрастом/периодом освоения слова (age of acquisition), скоростью извлечения слова из памяти, а также с количеством дериватов (Gries, 2011). Перечисленные факторы определяют значимость определения частотности и области лексического покрытия наименований референтов культурного кода в учебниках.

Материалы и алгоритм исследования

Представленное исследование осуществлено в рамках проекта «Культурный код России: автоматизация извлечения» по валидированному в более ранних исследованиях алгоритму (см. Андреева и др., 2024).

Корпус исследования включает 30 учебников для школьников 5–9 классов средней общеобразовательной школы (Учебный корпус русского языка, 2020) и входящих в Федеральный перечень учебников, одобренных Министерством просвещения (до 2018 г. – Министерство образования и науки) в период с 2006 по 2023 гг. (см. Федеральный перечень учебников). Общий объем корпуса составил 1558472 словоупотребления (Таблица 1). Сбалансированность корпуса обеспечена равным количеством учебников, предназначенных для пяти возрастных уровней трех предметных областей.

Таблица 1. Корпус исследования
Table 1. Research Corpus

Класс	Количество словоупотреблений						Итого
	Русский язык		Литература		История		
5	R_5_Ku_32052[2]	R_5_By_80486	L_5_Ko_24117	L_5_Me_34348	H_5_Ni_60624	H_5_Da_53018	284645
6	R_6_By_78437	R_6_Ba_50348	L_6_Po_35686	L_6_Sn_36466	H_6_Ag_34728	H_6_Ab_40868	276533
7	R_7_By_63144	R_7_Ba_36003	L_7_Ko_25041	L_7_Gu_73741	H_7_Yu_75427	H_7_Ty_47284	320640
8	R_8_Pi_44891	R_8_Ba_42976	Lt_8_Me_44054	Lt_8_Ko_35230	H_8_Da_57542	H_8_An_38105	262798
9	R_9_Ni_55378	R_9_Ba_58616	L_9_Zi_63606	L_9_Ko_103508	H_9_Ly_69620	H_9_Ar_63128	413856
Итого	542331		475797		540344		**1558472**

Выбранные предметные линейки – русский язык, литература, история – a priori ориентированы на преемственность и трансляцию нравственных ценностей, национальных традиций, оценку исторического прошлого страны, а, следовательно, и аккумуляцию в себе системы культурных кодов РФ. Объединяющей основой содержания данных предметов является реализованный в них культурно-исторический подход к представлению материала, т.е. ориентация на тематические блоки, отражающие духовную и материальную культуру русского народа (Стратегия государственной национальной политики Российской Федерации на период, 2029).

Список наименований референтов культурного кода России первоначально формировался на основе словаря «Россия. Большой лингвострановедческий словарь» (2007), позднее список был расширен наименованиями данных лингвистических, культурологических (Культурные коды, 2023, Лаптева, 2024, Маслова, 2001, Дуктова, 2023 и др.) и социологических исследований (Исследование аналитического центра НАФИ, 2022)[3]. Составление Списка включало (а) извлечение слов из текста источников при помощи библиотек python-docx и striprtf, а также (б) последующую лемматизацию. В финальный список референтов культурного кода вошли 785 слов[4], объединенных в 13 укрупнённых групп и 23 подгруппы: литературные персонажи, фольклорные произведения, научные и общественные деятели, исторические и религиозные личности, природные и географические объекты, единицы измерений, социальные слои, государственные институты, предметы быта и национальной кухни, пословицы и поговорки, прецедентные тексты и культурные архетипы (см. Таблицу 2).

[2] Каждый учебник исследовательского корпуса имеет уникальный код. Например, R_5_Ku_32052 маркирует учебник по русскому языку для 5 класса – «Русский язык. Практика. 5 кл.: учеб. для общеобразоват. учреждений / А.Ю. Купалова, А.П. Еремеев, Г.К. Лидман-Орлова и др.; под ред. А.Ю. Купаловой. - М.: Дрофа, 2012. – 272 с.». Число 32052 – объем текста учебника в словоупотреблениях.

[3] Исследование проводилось аналитическим центром НАФИ в 2022 г. в виде онлайн-опроса. Выборка наименований отражает мнение всех социально-демографических групп населения РФ старше 17 лет.

[4] Список наименований референтов культурного кода как часть продолжающегося проекта непрерывно пополняется. Слова общей тематики, зафиксированные в словаре «Россия. Большой лингвострановедческий словарь» (2007), например, *профессор, грибы, вишня, школа* и ряд др., на данном этапе реализации проекта не изучались.

Таблица 2. Наименования референтов культурного кода России (фрагмент)
Table 2. Names of Russian cultural code referents (part)

	Группа	Подгруппа	Примеры наименований референтов культурного кода
1	История		Россия, Русь, царь, князь, Пётр I, Ледовое побоище
2	Государство и социальное устройство	Социальные слои	Крепостной, дворянин, крестьянин
		Государственные институты	Совет, СНГ, ЧК
3	Литература	Художественная литература	Пушкин, Лермонтов, Толстой, Война и мир, Мастер и Маргарита
		Литературные персонажи	Евгений Онегин, Чичиков, Василий Тёркин
		Фольклор	Сказка, былина, Илья Муромец, Снегурочка
4	География	География	Сибирь, Кавказ, Волга,
		Города	Москва, Петербург, Новгород, Зимний дворец
5	Религия		Монастырь, душа, церковь, библия, собор
6	Традиционный быт	Традиционный быт	Двор, село, изба, печь, самовар
		Кухня	Чай, хлеб, молоко, уха, щи
7	Природа	Флора	Лес, берёза, дуб, сосна, василёк
		Фауна	Собака, лошадь, медведь, волк
		Огород, сад	Поле, лук, пшеница, яблоко, репа
8	Наука		Школа, Ломоносов, Менделеев, двойка
9	Русский язык		Грамота, букварь, Кирилл и Мефодий, кириллица
10	Искусство	ИЗО	Васнецов, Репин, Айвазовский, Шишкин, Эрмитаж, «Бурлаки на Волге», «Грачи прилетели».
		Музыка	Чайковский, Шаляпин, Рахманинов, Могучая кучка
		Театр, кино	Станиславский, Щелкунчик, Михалков, Рязанов, Большой театр
		Народное искусство	Матрёшка, гармонь, хохлома, скоморох
11	Пословицы, поговорки		Не покладая рук, За двумя зайцами погонишься, ни одного не поймаешь, ни рыба ни мясо
12	Календарь, праздники		Свадьба, Крещение, Новый год, День рождения
13	Единицы измерения		Пуд, верста, копейка, рубль, пядь

Далее при помощи инструментов платформы RuLingva (rulingva.kpfu.ru) из каждого текста корпуса были (а) извлечены и (б) лемматизированы наименования референтов культурного кода России, также было (в) установлено количество вхождений, т.е. абсолютная частота, каждого отдельного наименования (F_a). Например, слово *Пушкин* в учебнике литературы за 6 класс (L_6_Po) использовано 81 раз. *Поле* зафиксировано в учебнике русского языка 7 класса (R_7_By) 43 раза (см. Таблицу 3). 98 единиц Списка имеют не более одного вхождения в исследуемом корпусе: *копейка, фунт, Снегурочка, Калашников, Т-34, Троцкий Жигули* и др., оставаясь на периферии данного блока лексики. Преимущественная часть слов и словосочетаний в составе списка имеют большое количество вхождений: *товарищ* – 250, *Александр Невский* и *Совет* – по 370, *князь* – 633.

Для объективности последующего сравнения частотности наименований референтов культурного кода (далее НРКК) первичные данные были нормализованы на 10000 словоупотреблений по формуле $F_n = F_a/V*10000$, где F_n[5] – нормализованная на 10000 словоупотреблений частота; F_a –

[5] n – количество вхождений на 10000 словоупотреблений.

количество вхождений, т.е. абсолютная частота, каждого отдельного НРКК; V – количество слов в учебнике. Нормализация позволила не только сравнить документы разного объема, но и получить списки «значимой лексики», наиболее типичные слова для каждой изучаемой коллекции текстов (см. Ляшевская, Шаров, 2015): текстов изучаемых уровней сложности (классов) и предметных областей. Например, слово *деревня* в учебнике по литературе 6 класса (L_6_Po_35686), как и в учебнике по истории для 8 класса (H_8_Da_57542) имеет 20 вхождений, однако их объемы различны: более 35 тыс. слов в учебнике по литературе и свыше 57 тыс. в учебнике по истории. Значения нормализованной частоты выявляют значимость отдельных слов в сравниваемых коллекциях текстов. В учебниках L_7_Ko_25041 и R_8_Pi_44891 почти одинаковое количество вхождений слова Пушкин, 59 и 56, но в значительной степени отличающаяся нормализованная частота: 23.5 и 12.4 (Таблица 3).

Таблица 3. Количество вхождений (Fa) и нормализованная частота слов ($F_{n)}$ (*Пушкин* и *поле*) (фрагмент)
Table 3. Absolute and normalized Frequency of the words *Pushkin* and *pole* (field)(part)

Слово	***Пушкин***		***поле***	
Учебник	**F_a**	**F_n**	**F_a**	**F_n**
L_6_Po_35686	81	22.6	15	4.2
L_6_Sn_36466	82	22.4	25	6.8
H_6_Ag_34728	0	0	13	3.7
H_6_Ab_40868	0	0	13	3.1
R_7_By_63144	14	2.2	43	6.8
R_7_Ba_36003	36	9.9	37	10.2
L_7_Ko_25041	59	23.5	7	3.6
L_7_Gu_73741	88	11.9	30	4.0
H_7_Yu_75427	0	0	14	1.8
H_7_Ty_47284	0	0	12	2.5
R_8_Pi_44891	56	12.4	18	4.0

Результаты

Результаты представленного исследования плотности наименований культурного кода в учебных текстах демонстрируют высокую степень системности и гомогенность состава НРКК, а также положительную динамику частотности изучаемых единиц в учебных текстах от 5 к 9 классу.

Тематическая классификация

Ядро культурного кода в учебном дискурсе составляют следующие наиболее частотные слова (по убыванию): *Россия* (F_n = 15.9), *Пушкин* (11.4[6]), *крестьянин* (8.3), *душа* (6.8), *царь* (6.1), *лес* (6.2), *сказка* (5.4), *Лермонтов* (4.6), *Москва* (4.3), *Гоголь* (4.4). При этом в коллекциях отдельных классов и предметов нормализованная частотность (F_n) может быть еще более высокой и достигать 32.1 (Россия, 9 кл.) (Таблица 4).

Тематическая плотность и предметная дистрибуция НРКК (см. Рис. 1 и 2) демонстрируют гомогенность и ориентацию изучаемого дискурса на прошлое: во всех предметных областях и классах тематическая группа «История» занимает одно из первых трех мест. Данный фактор является свидетельством

[6] В скобках указана нормализованная частота, F_n.

не только высокой ценности и акцентирования важности исторических традиций в российском учебном дискурсе, но также его типичности в культуре, имеющей тенденцию к долгосрочной ориентации (по Хофштеде).

Таблица 4. Лексическое ядро культурного кода учебных текстов (F_n)
Table 4. Lexical core of Cultural Code in academic texts (F_n)

	5 класс	6 класс	7 класс	8 класс	9 класс
Россия	2.4	3.7	6.8	28.8	32.1
Пушкин	6.1	7.6	6.1	15.8	18.5
Крестьянин	1.8	6.4	7.5	11.8	12.5
Царь	14.4	2.1	2.6	8.3	4
Душа	2.7	3.8	5.6	4.4	14
Лес	8.2	7	6.1	5.7	3.4
Сказка	16.3	5.2	3.2	1.6	1.3
Лермонтов	2.1	3.4	3	5.1	7.9
Москва	2.2	2.2	2.3	7.1	6.8
Гоголь	2.3	2	4	5.1	7.1

Рисунок 1. F_n НРКК по предметным областям
Figure 1. F_n of NRCC by subject area

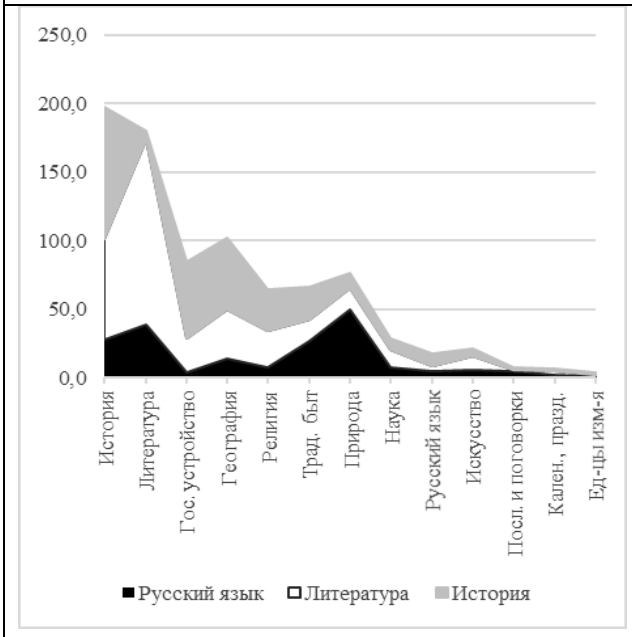
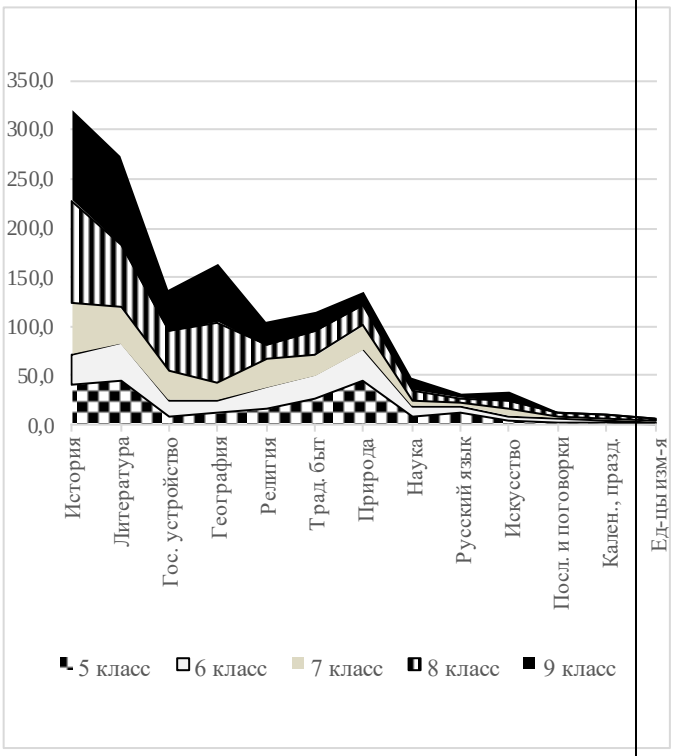


Рисунок 2. F_a по классам (уровням сложности)
Figure 2. F_a of NRCC by Grades (complexity levels)



Показательно, что в ядро изучаемого корпуса вошли единицы тематической подгруппы «Социальные слои» (по убыванию индекса частотности): *крестьянин* (F_a=1296, F_n=8,3), *царь* (935, 6,0[7]), *князь* (633, 4,1), *крепостной* (486, 3,1), *гражданин* (370, 2,4), *барыня* (23, 0,1). Слова советского периода значительно менее частотны: *товарищ* (370, 2,4), *товарищ* (215, 3,1).

Демонстрацией преемственности исторических и духовных традиций следует признать и ядерное положение в изучаемом корпусе слов *душа* (F_n=2.5), *храм* (5.8), *церковь* (4.0), *монастырь* (1.9), *пост* (1.4), *колокол* (0.2).

Корпус фиксирует более 300 онимов, наиболее многочисленную группу которых составляют антропонимы (187) и топонимы (144). Список антропонимов включает имена государственных деятелей (*Николай I*, F_a=120), военачальников (*Нахимов*, 5), ученых (*Ломоносов*, 238), деятелей искусства (*Третьяков*, 5), персонажей художественных произведений (*Василий Теркин*, 5). Топонимы отражают взаимосвязь исторических и географических феноменов: *Бородинское поле, Валаам, Владимир, Золотое кольцо, Кавказ, Казань, Куликовская битва, Кремль, Петропавловская крепость и др*.

Коллекции текстов 5-9 классов

Количество вхождений и нормализованная частота НРКК постепенно растут в текстах от 5 к 9 классу, некоторое снижение зафиксировано только в учебниках 6 класса. Наибольшее количество НРКК содержится в учебниках 9 класса (10751 – русский язык, 17376 – литература, 16454 – история), при этом их совокупные нормализованные частоты не сильно разнятся: они находятся в диапазоне от 210 до 372, составляя в среднем от 2 % до почти 4% текста (см. Таблицу 5). Данный показатель, очевидно, можно трактовать как типологически значимый для данной коллекции текстов, однако его валидация требует привлечения большего корпуса текстов, включающего другие предметные области и уровни сложности

Таблица 5. Общее количество вхождений и совокупная нормализованная частота НРКК в корпусе
Table 5. The absolute and normalized frequencies of NRCC in corpus

Класс	Русский язык	Литература	История	Итого	% в корпусе
5	2273/ 202.0[8]	2289/ 391.5	1768/ 155.6	6330/ 222.4	2.22/284645
6	2277/ 176.8	2109/ 292.3	1425/ 188.5	5811/ 210.1	2.10/276533
7	2001/ 201.8	3773/ 382.0	1789/ 145.8	7573/ 235.8	2.36/320640
8	1831/ 208.4	2882/ 363.5	**4774/ 499.1**	9469/ 360.9	3.61/262798
9	2387/ 209.4	6323/ 278.4	**6698/ 504.6**	15408/ 372.3	3.72/413856
Итого	10769/ 198.6	17376/ 365.2	16454/ 304.4	44595/ 286.1	2.8/ 1558472
% в корпусе	1.99 /542331	3.65 / 475797	3.04 / 540344	2.8 / 1558472	

[7] Первое число указывает количество вхождений (Fa), Второе – нормализованную частоту (Fn).
[8] В таблице указаны общее количество вхождений и совокупная нормализованная частота: Fa =2273, Fn =202.

Наименьшее разнообразие НРКК выявлено для учебников 5 – 7 классов по истории, что, в силу репрезентативности корпуса, позволяет рассматривать данный факт как специфику текстов изучаемого предметного блока. Наиболее «культуроносными» из изучаемых предметных блоков следует признать учебники по литературе, в среднем содержащие большее количество НРКК на 10000 словоупотреблений – 365.2. При этом частотность НРКК в отдельных учебниках по истории 8 и 9 классов значительно выше данного показателя – 499.1 и 504.6 единиц на 10000 словоформ соответственно (см. Таблицу 5). Диапазон плотности наименований культурного кода колеблется в диапазоне от 1.8 % (учебники 6 класса по истории) до 5.04% (учебники 9 класса по истории).

В учебниках по русскому языку наиболее частотными являются следующие лексемы, зафиксированные во всех документах корпуса*: лес* (12.8), *Пушкин* (9.3), *поле* (5.1), *школа* (3.9), *душа* (3.8). В коллекции учебников литературы высокочастотными следует признать слова *Пушкин* (25.9), *душа* (15.1), *Россия* (12.7), *сказка* (12.1), *Гоголь* (12.1). В список наиболее частотных лексем в учебниках истории вошли *Россия* (31.5), *крестьянин* (20.5), *царь* (13.0), *церковь* (9.7), *рабочий* (8.1). Каждая из указанных лексем объединяет вокруг себя тематическую подгруппу, создавая особое своеобразие предметного корпуса. Например, группа «Социальные слои», в составе которой присутствуют лексемы *крестьянин* (20.5), *рабочий* (8.1), *крепостной* (7.3), *гражданин* (6.1), *дворянин* (5.8), *купец* (3.8), *князь* (3.8), *интеллигенция* (2.0), *господин* (1.5), содержит и немногочисленную подгруппу «Цари», объединяя слова *царь* (13.0) и имена царственных особ: *Николай I* (3.0), *Александр II* (2.8), *Александр I* (2.7), *Александр III* (2.1), *Петр I* (1.9) и др. В тематической группе «Религия» обнаружены четыре слова, обозначающие «место для богослужения»: *церковь* (9.7), *храм* (5.8), *собор* (2.3), *монастырь* (1.9). Наибольшую частотность в подгруппе «Города» имеют *Петербург* (4.4) и *Москва* (3.8). Таким образом, анализ состава НРКК продемонстрировал специфику культурно-географических, литературных, фольклорных, бытовых, религиозных и исторических реалий, на основе которых осуществляется конструирование образа России в текстах современных учебников.

Дискуссия

Представленное исследование в значительной степени расширяет понимание специфики культурно-исторической памяти и ценностных установок, реализованных в современных учебниках социально-гуманитарного блока. Выявленная система наименований референтов культурного кода представляет собой ключ к пониманию ценностей фрагмента современной российской культуры, а дистрибуция и частотность отдельных языковых единиц отражает их значимость для общества. Показательны в этой связи высокие индексы ядерных лексем *крестьянин* (F_n=8.3), *поле* (F_n=3.04), *хлеб* (F_n=1.9), отражающие культурно-цивилизационную самобытность России, «теллурократичность» ее цивилизации (ср. Дугин 2011). В учебниках социально-гуманитарного блока средней школы, аналогично учебникам начальной школы (см. Лапошина и др., 2019), зафиксирована высокая частотность лексемы *лес* (F_n=5.84), в том числе в многословных наименованиях: «В лесу родилась елочка», «Утро в сосновом лесу» и др. (см. Приложение. Рисунки а.-д.).

Материал исследования уточняет вывод Н. А. Максимчук (2024) о специфике дистрибуции онимов в российских учебниках, свидетельствуя об объективной взаимосвязи и проникновении исторического и географического знания. Среди наиболее частотных НРКК – имена собственные, идентифицирующие историческую

перспективу значимых для России географических регионов и имен: *Пушкин (1778[9]), Лермонтов (711), Гоголь (679), Москва (669), Толстой (625), Чехов (470), Петербург (443), Тургенев (377), Кавказ (228), Сибирь (147), Петр I (135), Владимир (143), Николай I (120), Александр I (162), Александр II (162), Александр III (116), Дон (127), Пугачев (109), Екатерина II (101).*

Выявлены отличия от текстов РКИ, состоящие в значительно более низкой частотности номинаций референтов культурного кода (до 20% в текстах РКИ), меньшей доли слов, обозначающих традиционный быт, но (в) высокой плотности лексики религиозной тематики (см. Андреева и др., 2024, Небера, Шерина, 2024, Терских, Зайцева, 2024).

Ограничения представленного исследования

Многозначность и парольность изучаемой системы единиц диктует необходимость их семантического анализа или анализа тональности их контекстов, позволяя таким образом преодолеть ограничения данного исследования. «Расшифровка ключей культуры» и развертывание смыслов контекстов, содержащих наименования референтов культурного кода, рассматривается авторами как перспектива исследования.

Заключение

Изучение плотности и специфики наполнения учебных текстов наименованиями объектов культурного кода показало системность как на внутрипредметном (русский язык, литература и история отдельно), так и межпредметном уровнях. Различия в степени «культуроносности» учебников социо-гуманитарного блока, включающего учебники по истории, литературе и русскому языкы, минимальны.

Лексическое ядро номинаций объектов культурного кода представлено единицами нескольких основных групп: «Государственное устройство», «Природа», «Искусство», «Религия». Анализ подтвердил и высокую «насыщенность» учебного дискурса прецедентными онимами, детерминированную российской традицией апелляции к авторитетным именам (антропонимам) и героическому прошлому (тематические группы «Пространство», «История», «Искусство», «Государственное устройство», «Религия»).

Лексическое разнообразие носителей культурного кода постепенно увеличивается от 5 к 9 классу. Установленный диапазон плотности номинаций референтов культурного кода варьируется от 1.8 % до 5.04%, в среднем оставаясь на уровне 2–4 % текста.

Значимость полученных результатов определяется возможностью их применения в алгоритмах анализа культурного кода и моделирования языковой картины мира. Отдельную ценность для типологии культурных кодов различных этносов имеет список референтов культурного кода. Эмпирические данные, полученные в ходе исследования, могут использоваться при изучении проблемы универсализации современного учебного дискурса, роли культурного кода как эталонной системы, обеспечивающей оценку материального мира, а также при разработке учебных программ, ориентированных на традиционные российские ценности.

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Приложение

Таблица А

Лексическое ядро культурного кода учебных текстов Fr (n)

Учебники, Русский язык		Учебники, Литература		Учебники, История	
Лес	12,8	Пушкин	25,9	Россия	31,5
Русский язык	9,3	Душа	15,1	Крестьянин	20,5
Пушкин	9,0	Россия	12,7	Царь	13,0
Поле	5,1	Сказка	12,1	Церковь	9,7
Школа	3,9	Гоголь	12,1	Рабочий	8,1
Душа	3,8	Лермонтов	11,3	Крепостной	7,3
Сказка	3,8	Князь	8,3	Гражданин	6,1
Толстой	3,4	Толстой	7,9	Дворянин	5,8
Россия	3,2	Русь	7,3	Храм	5,8
Лермонтов	3,0	Москва	6,9	Совет	4,7
Горький	2,9	Чехов	6,3	Школа	4,7
Чехов	2,9	Печорин	5,1	Петербург	4,4
Тургенев	2,5	Тургенев	4,6	Москва	3,8
Товарищ	2,4	Онегин	4,1	Купец	3,8
Москва	2,4	Царь	4,0	Князь	3,8
Деревня	2,4	Крестьянин	3,5	Деревня	3,6
Береза	2,2	Есенин	3,4	Поле	3,0
Русские	1,9	Школа	3,4	Александр II	2,8
Хлеб	1,9	Петербург	3,3	Александр I	2,7

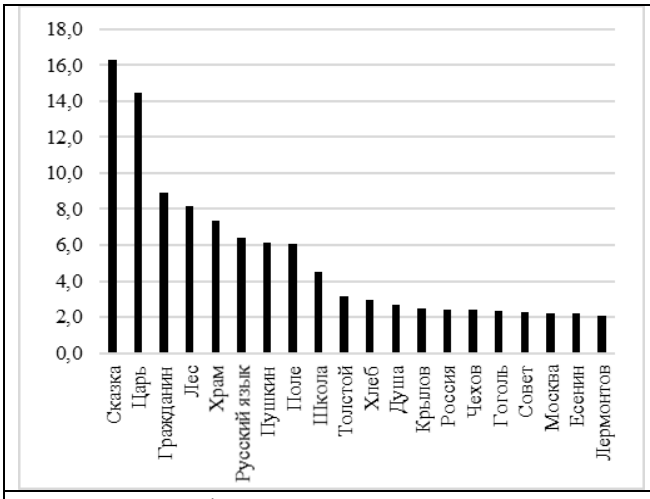
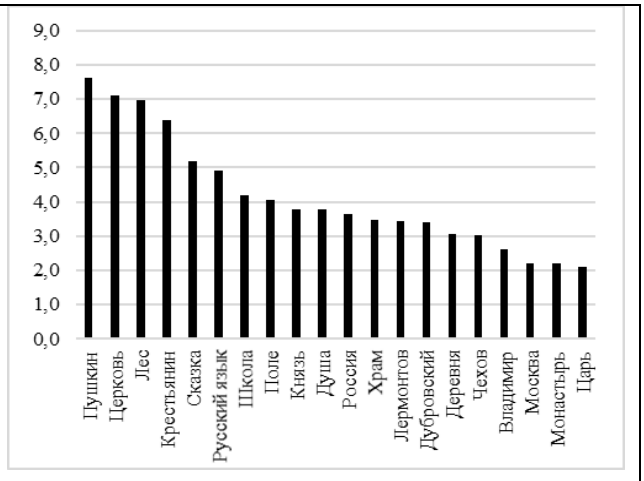


Рисунок а. Референты культурного кода, 5 класс



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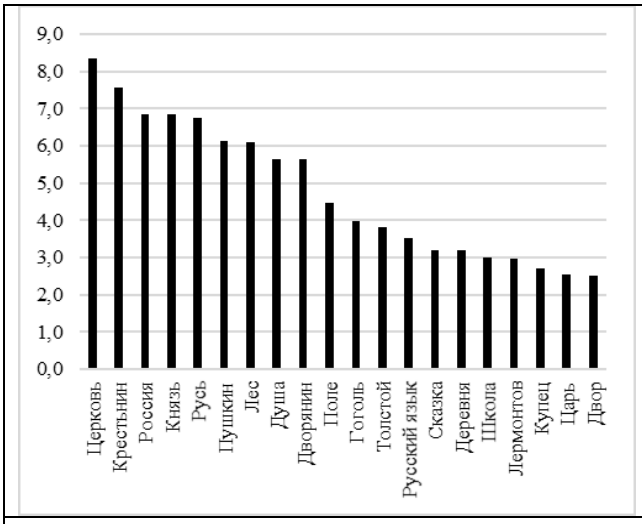

Рисунок в. Референты культурного кода, 7 класс

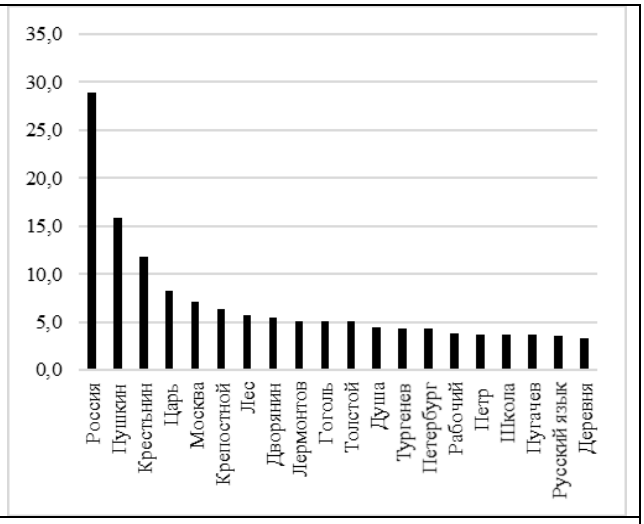

Рисунок г. Референты культурного кода, 8 класс

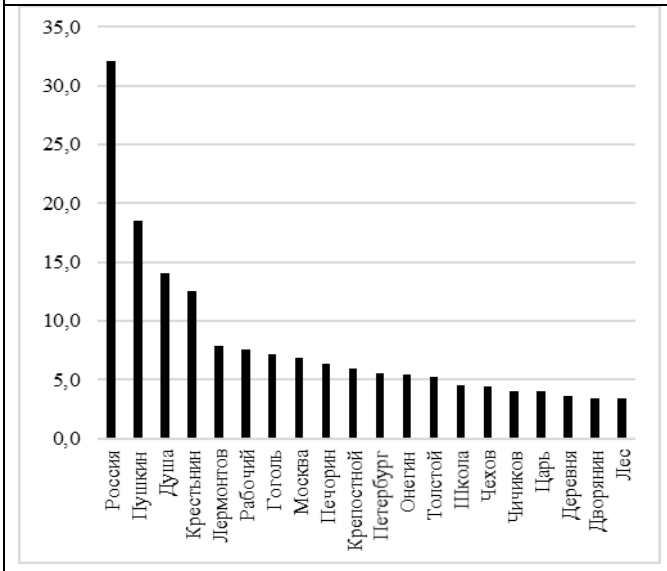

Рисунок д. Референты культурного кода, 9 класс

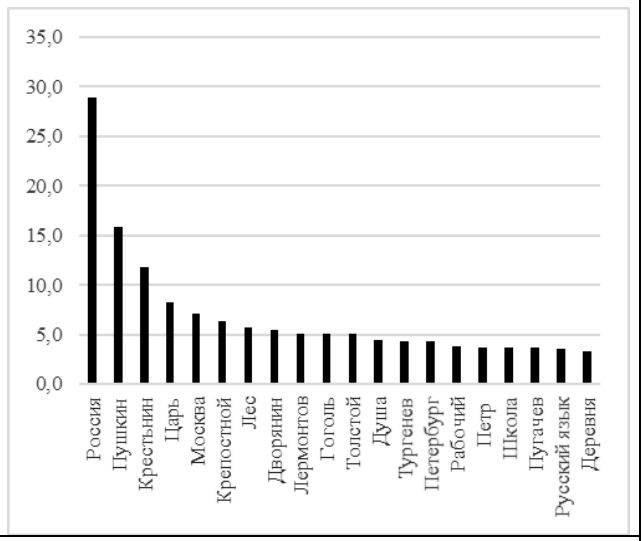

Рисунок е. Референты культурного кода, Русский язык

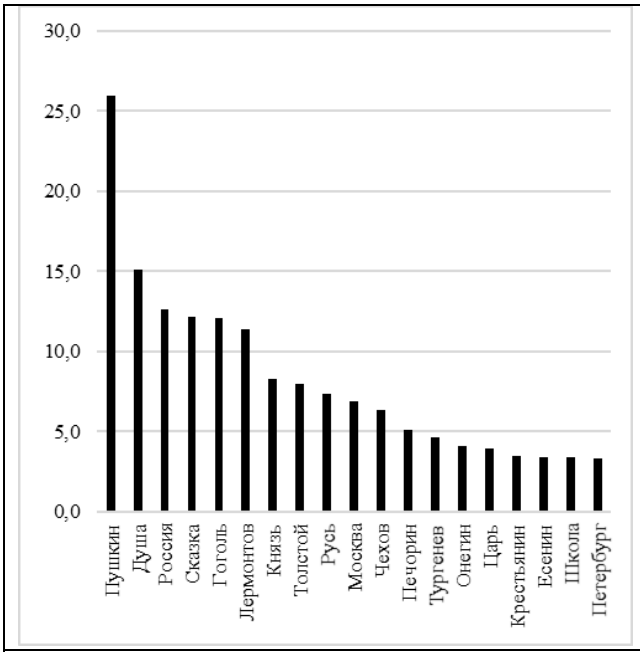

Рисунок ж. Референты культурного кода, Литература

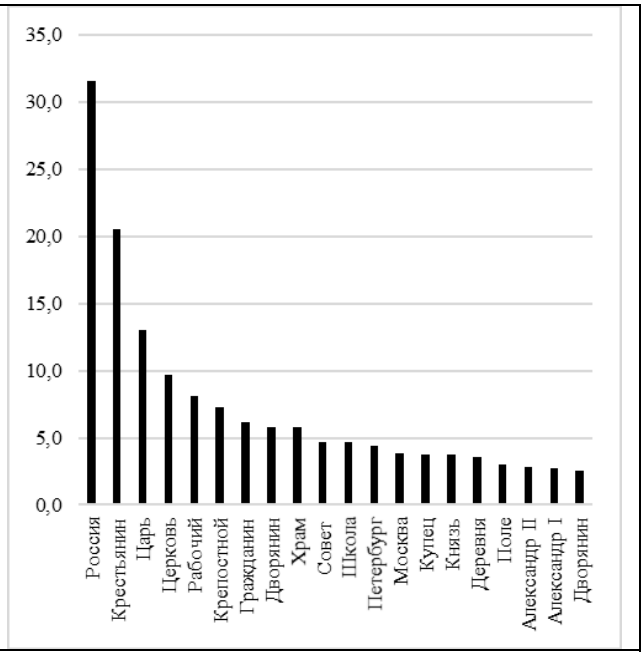

Рисунок з. Референты культурного кода, История

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From STM to GPT: A Comparative Study of Topic Modeling Methods for AI in Dentistry

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Abstract: This study presents a comprehensive topic modeling analysis of scientific abstracts in the field of artificial intelligence (AI) applied to dentistry. We compiled and analyzed 3,170 peer-reviewed abstracts published between 2019 and 2025 from the Dimensions and Scopus databases. Three complementary approaches were compared: (1) Structural Topic Modeling (STM), a probabilistic framework incorporating publication year as a covariate to enable temporal trend analysis; (2) embedding-based clustering using the Leiden algorithm on OpenAI text embeddings; and (3) zero-shot GPT-based topic modeling, in which GPT-4o generated topics, descriptions, and keywords directly from batches of abstracts without model training. Topic quality was evaluated using compactness, distinctiveness, silhouette scores, and label redundancy. STM consistently produced the most compact and well-separated topics, embedding-based clustering excelled in identifying discrete semantic groupings, and GPT-based modeling provided interpretable, human-readable labels but exhibited greater thematic overlap. To ensure comparability across methods, we introduced a two-layer alignment framework that integrates topic-level similarity with document-level consensus, enabling robust cross-model comparison. Using this framework, we identified stable topics consistently recovered across methods (e.g., caries detection, radiographic AI diagnostics) as well as method-specific themes. Temporal trend analysis in this shared space revealed a clear shift from foundational AI methods (e.g., image segmentation, image enhancement) toward applied and integrative areas, including large language model applications, patient-facing tools, and AI in clinical education. Our results underscore the value of combining classical probabilistic models with modern large language model (LLM) tools for optimal topic modeling performance. While GPT-4o enhances interpretability, it should not be used in isolation for mapping thematic structures in

scientific literature, at least not without pre-screening and prompt experimentation. Overall, our findings demonstrate the importance of hybrid topic modeling for mapping thematic structures in fast-evolving scientific domains, with dentistry serving as a case study.

Keywords: Topic Modeling; Structural Topic Model; GPT-4; Large Language Models; Dentistry; AI in Dentistry; LLM in Dentistry; Scientometric Analysis; Embedding-Based Clustering; Zero-Shot Topic Modeling; Bibliometric methods.

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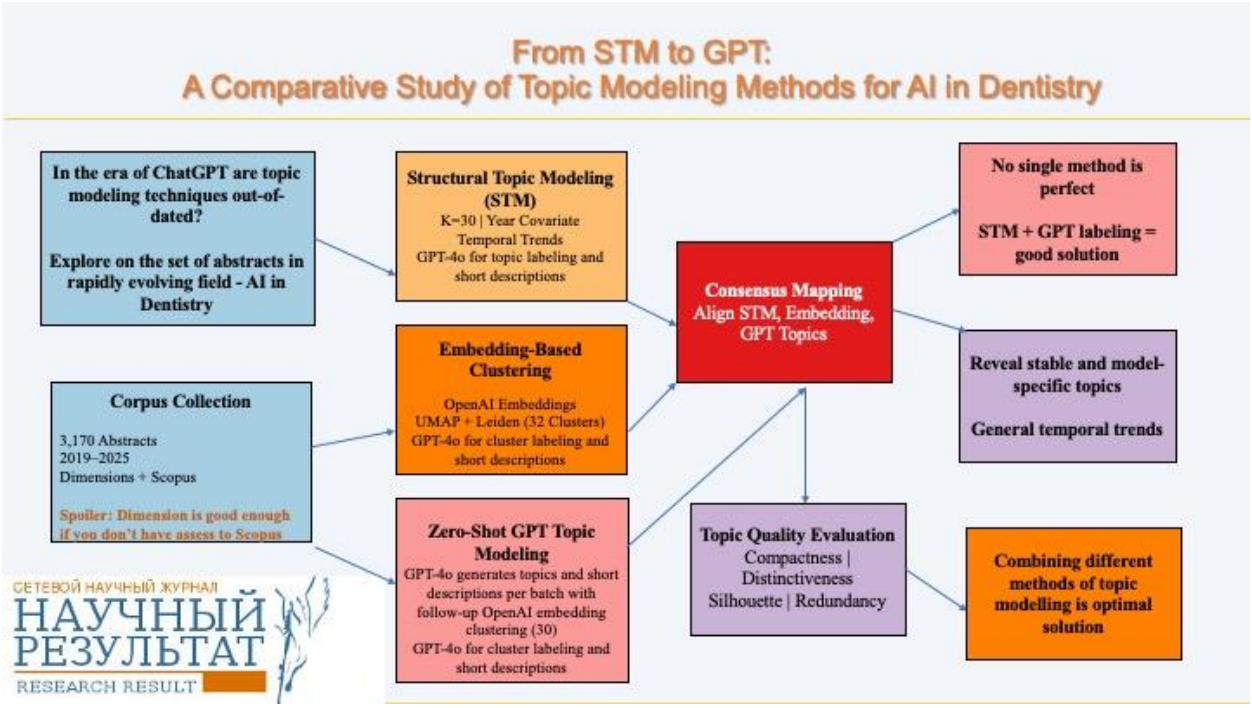

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Аннотация: Исследование представляет собой анализ научных аннотаций в области применения искусственного интеллекта (ИИ) в стоматологии с использованием различных методов тематического моделирования. Мы сформировали и проанализировали корпус из 3170 аннотаций научных статей, опубликованных в 2019–2025 гг. в изданиях, индексируемых в базах данных Dimensions и Scopus. Были сравнены три подхода к тематическому моделированию: структурное тематическое моделирование (STM) вероятностная модель, позволяющая анализировать временные тенденции; кластеризация на основе эмбеддингов с использованием алгоритма Leiden – стабильная альтернатива BERTopic; моделирование с использованием GPT-4o без обучения модели. Для оценки качества тем была применена совокупность метрик. Показано, что алгоритм STM дает наиболее компактную и чётко разделённую структуру тем; GPT оказался эффективным для создания названий тем и кратких описаний, но показал большее тематическое перекрытие и менее чёткие границы между темами. Мы также выполнили согласованное выравнивание тем в едином GPT-пространстве и выявили как стабильные, так и специфичные для моделей темы, а также общие временные тренды. Полученные результаты подчёркивают ценность комбинирования классических вероятностных моделей с возможностями LLM для достижения оптимального качества тематического моделирования. Хотя GPT-4o повышает интерпретируемость, его не следует использовать как единственный метод для анализа тем. Предложенный гибридный подход является масштабируемой и воспроизводимой стратегией для проведения обзоров литературы в быстро развивающихся областях исследований.

Ключевые слова: Тематическое моделирование; структурное тематическое моделирование; GPT-4; Большие языковые модели; ИИ в стоматологии; Выравнивание тем; Кластеризация на основе эмбеддингов; Извлечение тем с использованием больших языковых моделей; Анализ научной литературы
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1. INTRODUCTION

In recent years, the exponential growth of scientific publications has created unprecedented opportunities and challenges for understanding the thematic landscape of research. The volume, diversity, and interdisciplinarity of modern scholarly output render traditional narrative-based literature reviews insufficient for mapping the breadth and evolution of research topics, particularly in specialized and rapidly developing domains (Torres et al., 2025). One such domain is artificial intelligence (AI) in dentistry, where AI applications in diagnostic imaging, segmentation, risk prediction, and treatment planning have attracted considerable scholarly attention. AI is considered to represent a paradigm shift in this field (Cosola et al., 2025), and transformation of the modern dental practice workflow through AI is anticipated in the next decade (Silveira, 2024). The rapid expansion of this literature (Shirani, 2025) mirrors the accelerating adoption of AI in clinical workflows; however, the thematic organization and temporal development of the field remain incompletely characterized.

Topic modeling has become a powerful computational technique for uncovering hidden themes within large collections of text.

By examining patterns of word co-occurrence and semantic relationships, it allows researchers to identify coherent groups of documents, measure the prevalence of themes, and track how topics evolve over time. Beyond descriptive analysis, topic modeling provides a scalable and replicable alternative to manual coding, facilitating systematic reviews in fields where the volume of publications exceeds the capacity of traditional synthesis methods. With advances in computational power and big data, topic modeling has been widely applied across various domains, including text classification, information retrieval, and recommendation systems, establishing itself as a fundamental technology in natural language processing and text mining (Hu et al., 2025).

Various algorithmic paradigms have been developed for topic modeling, each grounded in different linguistic and computational principles. Probabilistic models such as Latent Dirichlet Allocation (LDA) (Blei et al., 2003) and Structural Topic Modeling (STM) (Roberts et al., 2019) represent topics as distributions over words and documents as mixtures of topics. STM advances this approach by incorporating document-level covariates, such as publication year, enabling the explicit modeling of temporal trends and the impact of metadata on topic prevalence. These models are valued for their interpretability, reproducibility, and strong statistical foundation. However, they require manual interpretation of topic-word distributions, careful selection of the number of topics, and domain expertise to ensure meaningful labeling (Lee et al., 2025; Sbalchiero and Eder, 2020).

Embedding-based clustering offers an alternative approach to topic extraction. By leveraging advances in transformer-based language models, such as BERT and its domain-specific variants, this method transforms documents into high-dimensional semantic vectors that capture contextual meaning beyond simple lexical similarity. Clustering algorithms are then applied to these embeddings to group documents based on semantic proximity. Methods like BERTopic (Grootendorst, 2022), kBERT (Islam, 2025), and other implementations often produce fine-grained, semantically coherent clusters that can identify subtopics overlooked by probabilistic approaches. For instance, BERTopic (Grootendorst, 2022) utilizes transformer-based embeddings, dimensionality reduction (UMAP), and clustering (HDBSCAN) to discover topics and is widely used in scientific literature analysis. However, embedding-based methods have some limitations: they do not inherently model temporal dynamics and typically assume each document belongs to a single topic, which may not fully capture multi-topic documents (Islam, 2025).

A third, rapidly evolving approach leverages large language models (LLMs) such as GPT-4, which can perform topic induction and labeling in a zero-shot setting. These models are trained on vast text corpora using transformer architectures, enabling them to generate topic descriptions and thematic summaries directly from raw text without requiring training on the target corpus. The strength of LLMs lies in their ability to produce linguistically fluent and contextually rich topic labels. However, concerns persist regarding their stability, transparency, and vulnerability to biases inherited from training data, as well as their tendency to generate hallucinations (Mu et al., 2024a). Additionally, their outputs may exhibit greater topical overlap and weaker structural separation compared to probabilistic or embedding-based methods (Mu et al., 2024a). Other challenges introduced by LLMs include API costs, rate limits, and the dependence of topic extraction quality on prompt accuracy.

Despite the widespread adoption of topic modeling across various disciplines, few studies have systematically compared these methodological approaches specifically in the context of analyzing scientific literature. Most existing evaluations focus on general-purpose datasets or single modeling families, limiting our understanding of how different methods

perform on domain-specific corpora. Furthermore, although AI in dentistry represents a promising case for thematic mapping due to its interdisciplinary nature and rapid growth, it has yet to be examined through a comprehensive, multi-method topic modeling analysis.

To address these gaps, this study applies and compares three topic modeling approaches to a curated corpus of 3,170 peer-reviewed abstracts on AI in dentistry, published between 2019 and 2025. The methods include: 1) structural topic modeling (STM) to analyze topic prevalence and temporal trends; 2) embedding-based clustering using the Leiden algorithm to group semantically similar documents in high-dimensional space; and 3) zero-shot GPT-based topic modeling, which generates topics and their brief descriptions directly without requiring model training.

To evaluate and compare the outputs of these methods, we developed a blended similarity framework for aligning topics across models and assessing their quality. At the topic level, this framework combines two complementary similarity measures: TF-IDF-based cosine similarity, which quantifies lexical overlap between topics by weighting terms according to their frequency and distinctiveness within the corpus; and embedding-based semantic similarity, which captures contextual and conceptual relationships between topics by comparing their vector representations in a high-dimensional semantic space. By integrating these measures, we account for both surface-level lexical matches and deeper semantic connections, enabling more robust cross-model topic alignment.

At the document level, we introduce a consensus score that evaluates how consistently different models assign documents to corresponding topics. This metric combines structural overlap measured by the Jaccard index of document sets with semantic fit, assessed through embedding-based similarity between shared documents and candidate centroids. This approach ensures that topics deemed "aligned" at the lexical-semantic level also demonstrate coherence in their document memberships.

This comparative design enables us to evaluate not only the internal coherence and distinctiveness of topics produced by each method but also their ability to capture temporal trends and domain-specific themes. The AI-in-dentistry corpus serves as a practical testbed for methodological insights with broader implications for topic modeling in specialized scientific fields. This study is guided by the following research questions:

1. How do probabilistic, embedding-based, and LLM-based topic modeling methods differ in the thematic structures they generate from domain-specific scientific abstracts?

2. Which methods are most effective for producing compact, distinct, and interpretable topics in the context of AI applications in dentistry?

3. To what extent do the topics identified by different methods overlap or diverge, and how can cross-model alignment of these models contribute to a consensus view of the field's thematic landscape?

4. How do the identified topics evolve over time?

2. LITERATURE REVIEW

Topic modeling methods such as Latent Dirichlet Allocation (LDA), Non-negative Matrix Factorization (NMF), and Structural Topic Models (STM) are fundamental techniques in natural language processing (NLP). These methods have long been employed to automate literature reviews by identifying thematic structures within large corpora, enabling the rapid detection of research topics and their evolution over time. They offer scalable alternatives to manual coding, which is particularly valuable when analyzing hundreds or thousands of documents. Introduced by Blei et al. (2003), LDA remains one of the most widely used techniques, especially in systematic literature reviews and bibliometric analyses (Ogunleye et al., 2025).

One of the most popular traditional approaches to topic modeling is the Structural Topic Model (STM), which enhances LDA by incorporating document-level covariates (e.g., year, metadata) to model how topic prevalence and word usage vary across groups (Roberts et al., 2019). STM is actively used for trend analysis, which is especially important for scientific literature reviews (Şakar and Tan, 2025; Ogunleye et al., 2025).

BERTopic is widely used for topic modeling in scientific literature (Wu et al., 2024). Benz et al. (2025) compared the results of LDA and BERTopic applied to the same dataset of scientific articles (n = 34,797) and found that, despite differences in their methodologies, both LDA and BERTopic generate topic spaces with a similar overall structure. However, significant differences emerge when examining specific multidimensional concepts. Additionally, Jung et al. (2024) evaluated four topic modeling methods (LDA, Nonnegative Matrix Factorization, Combined Topic Models, and BERTopic) and demonstrated that the BERT-based model outperformed the others in terms of both topic diversity and coherence.

However, manual labeling of topics remains a bottleneck in scaling such reviews. Topic models generate outputs as keyword lists, which require manual interpretation for labeling. This process is labor-intensive, subjective, and difficult to scale, especially for dynamic corpora like scientific literature.

In response, researchers have explored LLM-powered summarization and topic assignment, demonstrating improved labeling quality and reduced subjectivity. For example, Kozlowski (2024) proposes assessing the reliability of three LLMs (Flan, GPT-4o, and GPT-4 Mini) for topic labeling in scientific literature. His findings indicate that both GPT models can accurately and precisely label topics based on the models' output keywords. Additionally, three-word labels are preferred to better capture the complexity of research topics.

With advancements in natural language processing and artificial intelligence, large language models, such as OpenAI's ChatGPT, have opened new avenues for analyzing extensive scientific literature. Numerous methods for topic extraction have been developed based on LLMs (for example, GPTopic by Reuter et al. (2024)). These tools facilitate the efficient extraction and analysis of information from publications, including the identification of study areas, research topics, and methodological approaches (Hu et al., 2025; Lee et al., 2024; Sharma and Wallace, 2025).

Riaz et al. (2025) compare LDA with advanced transformer-based models such as BERT and GPT. They propose integrating BERT with extra long-term memory networks, specifically XLNet, as a promising approach. Similarly, Mathis et al. (2024) evaluate the effectiveness of an open-source LLM against traditional human thematic analysis in processing qualitative interviews within a psychiatric context. Their study demonstrates that open-source LLMs can effectively generate robust themes from qualitative data, achieving a high degree of similarity to those produced by human analysts.

Despite growing interest, there remains limited research comparing the use of LLMs in thematic analysis compared to human coding and traditional topic modeling techniques. Furthermore, while LLMs, including those employed in GPTopic, offer flexibility and zero-shot capabilities, they often struggle to maintain topic granularity and tend to produce overlapping or redundant topics. In contrast, traditional methods, such as LDA and the BERT-based models remain consistent and reliable, generating coherent topics without hallucinations. This makes them highly adaptable across various domains without requiring extensive fine-tuning (Mu et al., 2024b).

Since no single method can fully capture the topical structure of a text collection, combining traditional and LLM-

based topic modeling techniques can be advantageous. However, this integrated approach remains underutilized in studies analyzing scientific abstracts. For instance, Meng et al. (2024) integrated LLMs and topic modeling methods, including GPT and BERTopic. Mahmoud et al. (2025) developed a method to identify trends in a large dataset of 76,689 research papers by first embedding the texts using SBERT, followed by dimensionality reduction with PCA and UMAP, and then hierarchical clustering. Subsequently, LDA was applied to detect topics, which were automatically labeled using the ChatGPT API. This combined approach produced semantically meaningful topics. A similar method was employed by Tarek et al. (2024), who used HDBSCAN on SBERT embeddings, followed by LDA applied to each cluster. The OpenAI "gpt-3.5-turbo-0125" model was utilized to summarize the abstracts.

In summary, integrating LLMs into topic modeling workflows marks a significant advancement in tackling the longstanding challenges of interpretability, consistency, and human validation. However, it is essential to compare their performance with traditional topic modeling methods in the analysis of scientific abstracts, as only a limited number of studies have focused on this type of text.

The volume of literature on AI in dentistry is rapidly increasing (Shirani, 2025; Xie et al., 2024); however, to our knowledge, no study has yet applied topic modeling analysis to this expanding field. Numerous systematic reviews exist – for example, Shirani (2025) showed that 244 out of 1,368 studies in his dataset are reviews – but most are general and do not focus on specific AI applications within particular disciplines (ibid.). These reviews are typically narrative in style and cover several decades of publications. A few bibliometric reviews have been conducted in this area (Shirani, 2025; Xie et al., 2024; Zatt et al., 2024), but they generally employ simple NLP methods, such as keyword co-occurrence analysis using VOSviewer (see also Allani et al., 2024; de Magalhães and Santos, 2025), combined with manual coding (Shirani, 2025), or primarily analyze publication metadata like authorship, citations, and keywords. Traditional bibliometric approaches often struggle to effectively manage and analyze the vast volume of literature, especially when identifying specific research domains. In contrast, advanced techniques – including large language models and topic modeling – can better reveal evolving research patterns and priorities (Hu et al., 2025).

To the best of our knowledge, no prior study has systematically applied topic modeling methods to a curated dataset of scientific abstracts on AI in dentistry. In this context, dentistry offers a well-defined and timely testbed for evaluating topic extraction methods in a rapidly evolving applied domain. Our study contributes methodologically by demonstrating how various approaches – structural topic model (STM), embedding-based clustering, and GPT zero-shot topic extraction – can be employed to uncover key research themes and temporal trends within a specialized corpus. To ensure comparability across these diverse methods, we further introduce a two-layer alignment framework that integrates topic-level similarity with document-level consensus, enabling robust cross-model comparison. Although the empirical focus is on dentistry, the comparative framework we develop is generalizable to other fields facing similar challenges in mapping the thematic landscape of AI research.

3. MATERIALS AND METHODS

3.1. Dataset construction

To investigate the thematic structure and research trends in the application of artificial intelligence within dentistry, we compiled a domain-specific corpus by merging data from two major bibliographic databases: Scopus and Dimensions. This approach differs from most previous reviews in the field, which typically focus on a single database such as Web of Science (WoS) or Scopus. Scopus was selected for its status as one of the largest

peer-reviewed abstract and citation databases, providing high-quality metadata and abstracts. Dimensions, on the other hand, is a widely used open-access bibliometric platform that offers exportable metadata, including citation counts, affiliation details, and full abstract information.

The search strategy involved a comprehensive query incorporating common AI terms, with an emphasis on the most recent deep learning and NLP methods (e.g., “deep learning”, “large language model”, “multimodal fusion”) and dental research keywords (e.g., “oral health”, “implant dentistry”). Only English-language documents published between 2019 and 2025 were included. The search was conducted on July 23, 2025.

We selected 2019 as the starting point because, according to our preliminary analysis and other researchers who conducted bibliometric studies using WoS, most papers in this field were published after this year (Shirani, 2025; Xie et al., 2024). These studies reported a modest annual growth rate in publications from 2000 to 2018, followed by explosive growth beginning in 2019 (Xie et al., 2024).

The query used for both databases was designed to comprehensively capture literature intersecting AI and dentistry: ***("deep learning" OR "natural language processing" OR NLP OR "large language model" OR "LLM" OR "transformer model" OR "BERT" OR "GPT" OR "chatGPT" OR "multimodal model" OR "multimodal fusion" OR "multimodal learning" OR "vision language model" OR "image based AI" OR "3D reconstruction" OR "segmentation model" OR "object detection" OR "representation learning" OR "self-supervised learning") AND ("dentistry" OR "dental" OR "oral health" OR "oral cavity" OR "periodontology" OR "periodontitis" OR "prosthodontics" OR "endodontics" OR "orthodontics" OR "dental caries" OR "tooth decay" OR "implant dentistry" OR "dental diagnosis" OR "dental radiology" OR "dental imaging").***

The Scopus dataset was exported as a CSV file with UTF-8 encoding, and the Dimensions data were similarly exported using the platform’s metadata export tools. All records were imported into R and cleaned using the readr, dplyr, and stringr packages. The two datasets were deduplicated based on DOI strings, which were normalized by converting to lowercase, trimming whitespace, and removing common prefixes (e.g., https://doi.org/) using regular expressions. Records without abstracts were excluded, and documents were filtered to include only those containing more than 50 words to ensure semantic richness.

It is important to highlight that Dimensions offers a valuable alternative for researchers without access to subscription-based databases. In our dataset (see Table 1), 1,857 abstracts (approximately 60.5%) were found in both Scopus and Dimensions, while 659 (about 21.3%) were unique to Scopus and 752 (around 24.5%) were unique to Dimensions. Based on these figures, we estimate that Dimensions covers roughly 73.8% of the content indexed by Scopus, whereas Scopus includes approximately 71.2% of the content indexed by Dimensions. These findings emphasize the complementary nature of the two sources and support their combined use to achieve a more comprehensive retrieval of AI-related literature in dentistry.

After deduplication and filtering, the resulting dataset contained 3,170 unique abstracts, each linked to its unique DOI, title, source, and publication year. It is freely available in the accompanying GitHub repository[1].

[1] https://github.com/Litvinova1984/Topic-Modeling-for-AI-in-Dentistry/tree/main (accessed on August 10, 2025).

Table 1. Summary Statistics of the Combined Dataset
Таблица 1. Статистика объединенного датасета

Source	Initial Records	With Abstracts	After Filtering for DOI	After Merging and Deduplication	After final filtering
Dimensions	2710	2629	2609	3191	3170
Scopus	2649	2649	2514		

This corpus serves as the foundation for all subsequent topic modeling analyses. It contains 478,257 tokens, with a mean document length of 143 tokens and a median length of 138 tokens.

It is should be noted that abstracts were selected rather than full texts because they are uniformly available across publishers, provide comparable summaries of research contributions, and allow for the construction of a large, consistent dataset suitable for systematic topic modeling comparison.

3.2. Topic modelling approaches

To thoroughly investigate and assess the underlying thematic structures in the literature on AI in dentistry, we utilized and compared three distinct topic modeling techniques. Each method is based on a different algorithmic framework, ranging from probabilistic generative models to neural embeddings and large language models. A detailed description of each approach is provided below.

3.2.1. Structural Topic Modeling

To analyze topic prevalence and content variation over time, we employed Structural Topic Modeling (STM) using the stm R package. We selected STM over other topic modeling methods because it integrates metadata, enabling us to examine how these factors influence topic prevalence. Additionally, incorporating metadata ehnhances the interpretability of the topics (Roberts et al., 2019). The publication year was included as a covariate in the prevalence model.

Before conducting topic modeling, all abstracts were thoroughly preprocessed to ensure consistency and improve the interpretability of the model. The entire workflow was performed in R, using the quanteda, stringi, and text2vec packages.

Abstracts were tokenized and cleaned through several steps. First, all text was converted to lowercase, and numerical tokens were removed. Stopwords were eliminated using the standard English stopword list provided by quanteda, which we enhanced with a domain-specific list of high-frequency terms that do not aid in topic discrimination.

To better capture the multi-word expressions common in our dataset, we identified and combined collocations (bigrams) using the textstat_collocations function from the quanteda.textstats package. Bigrams were selected based on a minimum frequency of 50 and a lambda value greater than 3, resulting in 252 compound terms. Examples include deep learning (n = 3,071, λ = 7.55), neural network (n = 717, λ = 6.45), and panoramic radiographs (n = 558, λ = 6.13). These were incorporated into the token stream using the tokens_compound function from quanteda.

We deliberately avoided stemming and lemmatization to preserve domain-specific terminology, particularly technical compounds and clinical expressions that are essential for accurate topic interpretation.

The final document-feature matrix (DFM) for STM modeling was generated from the compounded token object, including only features (unigrams and bigrams) that appeared in at least 20 documents. This frequency threshold yielded 2,623 unique terms, striking a balance between vocabulary richness and model sparsity.

We experimented with various numbers of topics (K = 10 to 50), selecting the optimal

value of K based on semantic coherence and exclusivity metrics.

The key outputs of the STM analysis include a ranked list of high-probability words for each topic, a set of FREX words that balance frequency and exclusivity to improve interpretability, and a list of ten representative abstracts most strongly associated with each topic.

The posterior document–topic probability matrix (θ) was used to assign each abstract to the topic with the highest probability.

We also calculated the average prevalence of each topic across the corpus, providing insights into their overall thematic prominence.

To enhance topic interpretability and reduce the need for manual labeling, we implemented GPT-based topic labeling, which has proven to be an effective strategy (Kozlowski, 2024). For each topic in the final STM model, we provided the language model (GPT-4o) with the top 10 FREX terms and the three most representative abstracts for that topic (as output by STM), along with a prompt requesting a short topic label (1–3 words) and a brief description (one sentence).

The labeling process employed a structured prompt to ensure consistency and clarity (see Figure 1). For reproducibility, the exact prompts and representative model outputs are available in the accompanying repository.

Figure 1. Prompt for topic labeling via GPT-4o (STM)
Рисунок 1. Промт для наименования топиков с использованием модели GPT-4o (STM)

```
get_stm_gpt_label <- function(topic_id, top_words, abstracts, total_topics = 30) {
  prompt <- paste0(
    "You are a scientific expert reviewing STM topic models in dentistry and AI.\n\n",
    "Your task is to assign:\n",
    "1. A short, highly specific label (1–3 words) that uniquely describes this topic, avoiding generic phrases like 'AI in Dentistry'.\n",
    "2. A distinctive one-sentence description of what this topic is about.\n\n",
    "This is topic ", topic_id, " out of ", total_topics, ". Your labels must not overlap in meaning with other topics.\n\n",
    "Top terms: ", top_words, "\n\n",
    "Here are representative abstracts:\n", paste(abstracts, collapse = "\n\n"),
    "\n\nFormat your reply as:\nTopic Label: <LABEL>\nDescription: <ONE SENTENCE>"
  )
```

3.2.2. Embedding-Based Topic Modeling Using Leiden Clustering

To complement the STM approach and offer an alternative embedding-based clustering method, we applied Leiden community detection to document embeddings. Each abstract was embedded using OpenAI's text-embedding-3-small model, producing a 1,536-dimensional vector per abstract. The embeddings were retrieved via API and cached locally. These embeddings capture semantic relationships and offer a high-dimensional representation ideal for clustering and similarity analysis.

To construct a neighborhood graph for clustering, we used Uniform Manifold Approximation and Projection (UMAP) with n_neighbors set to 15, min_dist set to 0.1, as these parameters effectively balance the preservation of local structure with global interpretability.

We performed Leiden clustering using the leidenbase package, accessed via the igraph and uwot UMAP interfaces, on a k-nearest neighbor graph constructed from the reduced embeddings. This approach parallels the BERTopic pipeline in structure but employs a graph-based clustering method instead of the density-based HDBSCAN algorithm used in BERTopic. The Leiden method offers improved resolution control and yields more stable clusters, particularly in high-dimensional spaces.

This method, similar to BERTopic, involves three stages: (i) grouping semantically similar documents within the embedding space, (ii) clustering these groups, and (iii) extracting representative keywords using class-based TF-IDF. The key difference

lies in the clustering step: while BERTopic utilizes density-based clustering (HDBSCAN), the Leiden algorithm identifies communities within a graph representation. This approach offers greater control over resolution and stability, particularly in high-dimensional spaces with varying density. Additionally, the Leiden method integrates seamlessly with our R-based workflow and enables direct comparison with STM by using the same GPT-generated topic labeling technique.

We chose Leiden clustering over BERTopic because it provides greater stability and better resolution control, especially when handling variable densities in high-dimensional embedding spaces (Shapurian, 2024).

While STM assigns each document a probabilistic mixture of topic proportions across 30 latent topics, the Leiden clustering method partitions the corpus into distinct groups, with each document assigned to exactly one semantically coherent cluster based on its position in the UMAP-projected embedding space. STM topics are model-derived latent themes optimized to explain word co-occurrence patterns within the corpus, whereas Leiden clusters represent semantic proximity in the contextual embedding space, highlighting how documents relate to one another based on large language model representations.

Overall, Leiden clustering complements STM by providing an embedding-level perspective on document similarity that is independent of word frequency modeling. This approach facilitates the comparison and cross-validation of topics and offers an alternative framework for downstream tasks such as zero-shot labeling, cluster-level summarization, and alignment with GPT-generated topic descriptors.

We also performed GPT-based cluster labeling. For each topic in the final model, we provided GPT with the top 10 representative keywords calculated using class-balanced TF-IDF, three abstracts, and a prompt requesting a short label (1–3 words) along with a brief description (one sentence) for each cluster (see Figure 2).

Figure 2. Prompt for topic labeling via GPT-4o (embedding-based model)
Рисунок 2. Промт для наименования топиков с использованием модели GPT-4o (кластеризация эмбедингов)

```
get_gpt_label_distinct <- function(cluster_id, top_words, abstracts, total_clusters = 32) {
  prompt <- paste0(
    "You are a scientific expert reviewing scientific document clusters in dentistry and AI.\n\n",
    "Your task is to assign:\n",
    "1. A short, highly specific label (1–3 words) that uniquely describes this cluster, avoiding generic phrases like 'AI in Dentistry'.\n",
    "2. A distinctive one-sentence description of what this topic is about.\n\n",
    "You are working on cluster ", cluster_id, " out of ", total_clusters, ". Your labels must not overlap in meaning with other clusters.\n\n",
    "Top terms: ", top_words, "\n\n",
    "Here are representative abstracts:\n", paste(abstracts, collapse = "\n\n"),
    "\n\nFormat your reply as:\nTopic Label: <LABEL>\nDescription: <ONE SENTENCE>"
  )
```

3.2.3. Zero-shot LLM-based Topic Modeling

Inspired by TopicGPT (Pham et al., 2024), we utilized GPT-4o in a zero-shot setting to generate interpretable topics directly from the corpus without requiring predefined topics or model training. The corpus was divided into 159 batches, each containing 20 abstracts, and each batch was submitted to GPT-4o using a structured prompt (Figure 3).

Figure 3. Prompt for topic exraction via GPT-4o
Рисунок 3. Промт для извлечения топиков с использованием модели GPT-4o

```
# === STEP 2: Make GPT prompt from abstracts ===
make_prompt <- function(texts_batch) {
  joined_texts <- paste(texts_batch, collapse = "\n\n")
  prompt_text <- paste(
    "You are a scientific topic modeling assistant.",
    "Analyze the following research abstracts and extract  3 coherent but diverse topics that best describes them.",
    "Provide:\n1. Topic label (max 5 words)\n2. A brief 1-2 sentence description\n3. 5-10 representative keywords\n\nAbstracts:\n\n",
    joined_texts
  )
  list(list(role = "user", content = prompt_text))
}
```

A total of 417 local topics were extracted. To minimize redundancy and facilitate comparison across methods, we embedded each GPT-generated topic profile (including label, keywords, and description) using 1,536-dimensional OpenAI embeddings. We then applied k-means clustering (k = 30) to these embeddings to consolidate them into global topics. Each resulting cluster was labeled by GPT and stored as a topic profile by combining the final label, keywords, and description.

Topic labels generated by each of the three approaches were independently evaluated by three human annotators (the authors). All labels received high ratings (4-5 on 1-5 scale) from each annotator and were retained for downstream analysis.

3.2.4. Cross-Approach Comparison

To facilitate cross-model comparison and downstream interpretation, we mapped topics from the STM and embedding-based clusters into a common GPT topic space. This approach enabled unified labeling, visual alignment, and consistent topic tracking across models. To compare and consolidate topic assignments from STM, GPT-extracted topics, and embedding-based clusters, we employed a two-stage process: (1) topic alignment and (2) document-level consensus labeling.

In the first stage, we focused on aligning the topics themselves, independent of document assignments. Using STM topics as the reference set, each topic was compared to all topics from GPT and embedding-based clustering through three complementary similarity measures: TF-IDF cosine similarity, embedding-based cosine similarity, and a blended similarity score, as described below.

1. Topic Representation Construction. Each topic, derived from STM, Embeddings, and GPT, was represented in two ways: a) a textual profile, which combined the topic label, top keywords (such as FREX words or TF-IDF terms), and a description; and b) a semantic embedding profile, generated by computing a 1,536-dimensional OpenAI text-embedding-3-small vector based on the textual profile. This approach enables the calculation of high-dimensional semantic similarity between topic descriptions.

2. Similarity Metrics. To compare topic pairs across models, we calculated two types of similarity measures: (1) TF–IDF cosine similarity, where we constructed TF–IDF vectors for all topic profiles using a shared vocabulary and computed pairwise cosine similarities between each pair of approaches; and (2) embedding cosine similarity, where we used OpenAI embedding vectors for the topic profiles to compute semantic cosine similarities between topics. For each pair of approaches (STM↔GPT, STM↔EMB, GPT↔EMB), we computed the full all-pairs matrices of TF-IDF cosine and embedding cosine similarities between topic textual profiles and combined them into the Blended Topic Similarity Score (BlendSim) (Equation 1):

$$S_{\text{topic}}(t_i^{(A)}, t_j^{(B)}) = \tfrac{1}{2}\left(\cos_{\text{TF-IDF}}(t_i^{(A)}, t_j^{(B)}) + \cos_{\text{Embedding}}(t_i^{(A)}, t_j^{(B)})\right) \quad \text{(Equation 1)}$$

where $t_i^{(A)}, t_j^{(B)}$ are topics *i* and *j* from approaches **A** and **B**, $\cos_{\text{TF–IDF}}$ is a cosine similarity between TF–IDF vectors of the textual profiles, $\cos_{\text{Embedding}}$ is a cosine similarity between embedding vectors of the textual profiles. The factor 1/2 indicates equal weighting of the two components.

While Equation (1) provides a topic-level alignment score based solely on textual profiles, it does not guarantee agreement at the document level. Two topics may appear lexically and semantically similar, yet group different sets of documents. To establish a document-level consensus, we therefore define a second metric, the **Document Consensus Score (DocCons) S_{blend}**, which combines structural overlap, measured by the Jaccard index of document sets, with semantic fit, measured as the mean cosine similarity between shared documents and the candidate topic's centroid (Equation 2):

$$S_{\text{blend}}(A,B) \;=\; w_J \cdot J(A,B) \;+\; w_{\cos} \cdot \overline{\cos}(A,B), \qquad \text{(Equation 2)}$$

Here, J(A,B) denotes the Jaccard index of the document sets assigned to topics **A** and **B**. The semantic component **cos(A,B)** is the mean cosine similarity between the L2-normalized embeddings of documents in the intersection $C_A \cap C_B$ and the centroid of topic **B** (defined as the normalized mean of its document embeddings). If no documents overlapped, the cosine term was set to zero. We fixed $w_J = w_{\cos} = 0.5$ to weight both components equally, and each STM topic was aligned to the candidate topic with the highest score; documents then inherited this aligned label.

Importantly, Eq. (2) serves not only as a similarity measure but also as the operational basis for consensus topic assignment: it determines which candidate topic provides the best match, and all documents inherit this unified label for further analysis.

We then assessed the consistency of consensus topics across the three modeling approaches. At the document level, we identified three categories of alignment: topics were considered stable if the STM, GPT, and embedding-based assignments all converged on the same GPT-space label for a document; partially aligned topics were those where STM agreed with exactly one other model (either GPT or embedding-based), but not both; and method-specific topics were those related to documents for which no alignment was observed across the methods.

To evaluate model performance, we employed several quantitative metrics to assess both internal quality and inter-topic distinctiveness. Compactness was measured using the mean Euclidean distance to each topic's centroid (mean_own_dist), representing the average distance between each document and its assigned topic centroid—lower values indicate tighter topic clusters. Additionally, we calculated the mean cosine similarity to the assigned centroid (mean_own_cos), where higher values reflect greater semantic coherence within topics. To assess topic separation (distinctiveness), we computed the mean nearest-neighbor centroid distance (mean_nn_other_dist), which is the average Euclidean distance from each topic centroid to its closest neighboring centroid; higher values suggest better topic separation. We also measured the mean margin (mean_margin), defined as the difference between a document's distance to its own topic centroid and to the nearest other centroid—higher margins indicate that documents are both close to their own topic and well separated from competing topics. Furthermore, we included standard metrics such as the Davies–Bouldin Index (DB) and the Dunn Index, which capture the ratio of intra-topic compactness to inter-topic separation.

In this context, a "centroid" does not represent a geometric figure with a homogeneous or symmetric shape but simply the average vector of all document representations assigned to a topic. Each topic thus corresponds to a cloud of points in high-dimensional space, which may be heterogeneous and anisotropic. The centroid serves as a representative point to summarize this set and to compute compactness and separation metrics. Distances were measured using Euclidean norms on L2-normalized vectors, which are directly related to cosine similarity. This approach provides an interpretable and computationally efficient approximation of intra-topic cohesion and inter-topic distinctiveness without assuming geometric symmetry of the clusters.

This multi-metric evaluation framework enabled us to objectively compare STM, embedding-based, and GPT-based topics in terms of both internal coherence and semantic distinctiveness.

3.2.5. Trend analysis across models

To evaluate how the research focus evolved over time, we applied a consistent procedure across all three modeling approaches: STM, embedding-based clustering, and GPT-derived topics.

For STM topics, we determined the number of documents in which each topic was dominant for each publication year, defining dominance as the highest STM probability within a document. For each topic, we constructed yearly time series of (i) dominant document counts and (ii) mean STM probabilities. Temporal changes were quantified by fitting simple linear regressions of each metric against publication year, with slope coefficients extracted as trend estimates. Trends were classified as increasing (↑), decreasing (↓), or stable (–) depending on whether slopes exceeded predefined thresholds (±0.0005 for probability; ±0.5 documents per year).

These thresholds were selected to capture changes that are small enough to be statistically detectable over our time span, yet large enough to be practically meaningful (e.g., an average shift of at least half a document per year or a consistent increase of ≥0.5 percentage points in topic probability over a decade). A topic was defined as emergent if both STM probability and the dominant document counts exhibited positive slopes exceeding the threshold.

For embedding-derived clusters, topic prevalence was measured as the mean cosine similarity between each document and the centroid of its assigned cluster for each publication year, along with the number of documents assigned to each cluster. Cosine similarity captures the semantic alignment of documents with the cluster core, analogous to STM topic probabilities. Yearly averages of both metrics were regressed on publication year, and the slope coefficients provided quantitative estimates of temporal trends. Unlike STM probabilities, cosine similarities do not sum to one across clusters; however, their changes over time (Δ) are interpretable in parallel with STM prevalence.

For GPT-derived topics, we used two indicators: the mean document-centroid cosine similarity per year and document frequency. Regression-based slope estimates of these annual metrics allowed us to classify GPT topics as increasing, decreasing, or stable.

For the visualization and interpretation of thematic trends, we based the analysis on STM→GPT blended mapping.

For visualization, yearly proportions were smoothed using locally estimated scatterplot smoothing (LOESS) with a span of 0.75. LOESS provides a nonparametric regression fit that highlights overall temporal patterns while reducing noise from year-to-year fluctuations.

4. RESULTS

4.1. Structural topic modeling

We experimented with a range of topic numbers (K = 10 to 50) and selected K = 30 as optimal based on three criteria: 1) plateaus in held-out likelihood and residuals, both of which stabilize around K = 30; 2) stabilization

of semantic coherence and exclusivity, noting that semantic coherence declines sharply from K = 10 to 20 but remains relatively stable after K = 30, indicating no benefit in increasing K further; and 3) qualitative interpretability of topics (see Figure 1S). This model serves as the baseline for comparison with newer methods.

All metrics yexpressing dynamic trends of STM topics were tabulated in a dynamic trend table (Table 2) and visualized (Figure 2S) to enable direct comparison between model-based prevalence and observed document-level dominance.

Table 2. Top 10 Most Dynamic STM Topics
Таблица 2. 10 наиболее динамичных тем (модель STM)

Rank	Topic Label	Δ Doc Count	Δ STM Prob	STM Prob Slope	Doc Count Slope	STM Prob Trend	Doc Count Trend	Emergent
1	AI Integration Challenges	92	0.21	0.066	34.1	↑	↑	TRUE
2	Dental Caries Detection	61	0.052	0.003	6.214	↑	↑	TRUE
3	Deep Learning Model Performance	56	0.093	-0.014	9.657	↓	↑	FALSE
4	Systematic AI Review	52	0.07	0.008	7.571	↑	↑	TRUE
5	Multi-View Segmentation	48	0.08	-0.009	8.5	↓	↑	FALSE
6	Panoramic Radiograph Analysis	46	0.104	-0.006	5.286	↓	↑	FALSE
7	Tooth Segmentation Techniques	45	0.172	0.025	7.929	↑	↑	TRUE
8	Chatbot Response Evaluation	42	0.223	0.028	8.786	↑	↑	TRUE
9	Dental AI Applications	40	0.086	-0.005	3.929	↓	↑	FALSE
10	Dental Image Detection	27	0.159	0.008	4.107	↑	↑	TRUE

The topics highlighted in red (Panel A) and green (Panel B) in Figure 2S can be classified as emergent, as they exhibit consistent upward trends in both STM topic prevalence and real-world document dominance. Notably, ***AI Integration Challenges, Chatbot Response Evaluation, Dental Image Detection, and Tooth Segmentation Techniques*** show clear concurrent increases in both dimensions, indicating rapidly growing attention in the field. These topics, with synchronized growth in both measures, may represent emerging research frontiers in AI applications in dentistry, according to STM classification. Additionally, ***Dental Caries Detection and Systematic AI Review*** demonstrate an increasing number of documents and a slight rise in topic prevalence.

Some topics exhibit a mismatch between their model-based importance and actual publication activity, unlike clearly

emerging topics. For instance, ***Deep Learning Model Performance*** and ***Panoramic Radiograph Analysis*** demonstrate an increasing number of documents over time, yet their average importance is slightly declining. This indicates that while more papers mention these topics, they are often used in a supporting or technical capacity rather than as the primary focus of the study.

4.2. Embedding-based clustering

To identify the optimal number of semantic clusters within the UMAP-projected embedding space, we applied Leiden clustering across a range of resolution values from 0.5 to 1.5, resulting in 24 to 38 clusters. As illustrated in Figure 3S, lower resolution settings (e.g., 0.5) produced overly coarse groupings, with some clusters covering broad and visually heterogeneous regions. In contrast, higher resolutions (e.g., 1.5) caused excessive fragmentation, generating numerous small or marginal clusters with limited separation and semantic distinctiveness.

A resolution of 1.0, which generated 33 clusters, provided the optimal balance between granularity and interpretability. At this setting, the clusters appeared visually compact and well-separated in the UMAP space, exhibiting minimal overlap and strong internal cohesion. This configuration prevented over-partitioning while effectively capturing meaningful thematic distinctions throughout the corpus. Additionally, a resolution of 1.0 aligned with the natural semantic structure of the data, facilitating cluster-level labeling and trend analysis without introducing excessive noise or sparsity in cluster sizes.

Therefore, we chose the 33-cluster solution as the most stable and interpretable representation of the embedding-based semantic structure, which serves as a foundation for downstream topic labeling and comparison with STM-derived topics.

To analyze topic dynamics in the embedding-based model, we calculated the average cosine similarity between each document and its assigned cluster centroid for each publication year. This metric measures the semantic closeness of a document to its cluster, with higher cosine similarity values indicating a stronger alignment with the core semantics of the topic.

This approach is conceptually similar to how STM-derived topic probabilities indicate the degree of association between a document and a topic. While STM probabilities are normalized outputs from a probabilistic generative model, embedding-based cosine similarities measure angular closeness in a high-dimensional semantic space. Both metrics capture topic-document relevance, and averaging them over time offers an effective proxy for tracking topic prevalence trends in the literature.

It is important to note that cosine similarities do not sum to 1 across all clusters, unlike STM topic probabilities. Therefore, although the absolute values of these metrics are not directly comparable, the direction and magnitude of their temporal changes (Δ) can be meaningfully interpreted in parallel.

This approach enables us to consistently evaluate and compare semantic topic trends across different modeling methods by analyzing the evolution over time of the mean document-level cosine similarity per cluster (similar to STM prevalence) and the number of dominant documents per cluster (see Table 3 and Figure 4S).

Dental LLM Evaluation and ***Dental AI Chatbot Evaluation*** have shown significant increases in both the average topic probability and the number of dominant documents from 2022 to 2023. This trend highlights the rapid emergence of new focus areas within LLMs and conversational AI applications in dentistry. The simultaneous rise observed in both evaluations suggests that these topics are gaining popularity as well as conceptual coherence.

AI-Enhanced Orthodontics and ***CBCT Segmentation Accuracy*** have shown a steady increase in the number of documents over time, accompanied by gradual but consistent improvements in cosine similarity. These

trends highlight a growing interest and a clearer conceptual understanding of imaging-based AI topics. The simultaneous rise suggests that these areas are becoming both more prevalent and better defined.

Caries Detection Models exhibits a significant rise in the number of documents, yet the average cosine similarity shows only modest or minimal change. This likely indicates a wider range of coverage within this topic across diverse subfields, resulting in less concentrated semantic clustering.

CBCT Artifact Reduction demonstrates relatively stable or even declining semantic alignment, accompanied by a plateau in the number of documents. This trend may suggest that the research area is reaching maturation or saturation, resulting in fewer novel contributions.

Topics such as ***Radiographic AI Diagnostics, Panoramic Tooth Segmentation,*** and ***Periodontal AI Diagnostics*** demonstrate consistent, gradual growth across both panels. These areas likely represent well-established fields with steady progress rather than sudden, breakthrough trends.

Table 3. Top 10 Most Dynamic Embedding Topics
Таблица 3. 10 наиболее динамичных тем (модель эмбедингов)

Rank	Embedding Topic Label	Δ Doc Count	Δ_ Emb_cos	Δ Emb_cos (Slope)	Δ Doc Count Slope	Emb Cos Trend	Doc Count Trend	Emergent
1	Periodontal AI Diagnostics	66	0.028	0.004	11.68	↑	↑	TRUE
2	AI-Enhanced Orthodontics	56	0.038	0.007	8.25	↑	↑	TRUE
3	Caries Detection Models	55	0.029	0.003	6.29	↑	↑	TRUE
4	CBCT Segmentation Accuracy	54	0.02	0.002	9.39	↑	↑	TRUE
5	Dental LLM Evaluation	48	0.102	0.023	9.28	↑	↑	TRUE
6	Dental AI Chatbot Evaluation	44	0.12	0.018	7.75	↑	↑	TRUE
7	Dental Implant Diagnostics	42	0.06	0.007	5.79	↑	↑	TRUE
8	Radiographic AI Diagnostics	40	0.014	0.001	6.36	↑	↑	TRUE
9	Panoramic Tooth Segmentation	37	0.018	0.001	5.46	↑	↑	TRUE
10	CBCT Artifact Reduction	30	0.032	0.003	-0.13	↑	–	FALSE

These trends indicate that embedding-based clustering effectively captures both emerging innovations and established subfields. Notably, topics related to large language models and interactive AI tools, such as chatbots, are exhibiting clear signs of rapid thematic consolidation and increasing publication volume. At the same time, imaging-related topics like cone-beam computed tomography (CBCT) and segmentation remain prominent and stable, although some may be approaching saturation.

As shown in Panel A of Figure 4S, several embedding clusters exhibit increasing average cosine similarity over time, reflecting patterns observed in STM topic probabilities. This suggests a growing thematic convergence in both modeling approaches. It is important to note that while the embedding model reveals some fine-grained clusters compared to STM, it also occasionally separates semantically similar topics into different clusters.

4.3. GPT-based topic extraction

To complement the STM and embedding-based topic models, we employed a zero-shot, LLM-based topic modeling approach using GPT-4o to generate topics directly from scientific abstracts. Abstracts were organized into batches of 20 documents each, and GPT was prompted to produce three distinct topic descriptions per batch. Of the 159 total batches, 139 (88%) were successfully processed, yielding 417 batch-level topics that summarize 2,780 abstracts.

To minimize semantic redundancy among GPT-generated topics such as paraphrased labels representing similar themes, we embedded each topic's label and description using OpenAI's embedding model. Since graph-based Leiden clustering yielded only a few communities (6-7) at reasonable resolutions (0.5–1.5), we applied K-means clustering with k=30 to achieve a higher-resolution partition better suited for downstream comparison. Each global cluster was then labeled and summarized using GPT, resulting in unified topic labels, descriptions, and representative keywords for easier interpretation.

To assess thematic trends in GPT-derived topics, we analyzed changes over time in both average topic prevalence measured as the mean cosine similarity between each document and its assigned cluster centroid for each publication year and document frequency, defined as the number of documents assigned to each topic (see Table 4 and Figure 5S).

Table 4. Top 10 Most Dynamic Embedding Topics (GPT-based)
Таблица 4.10 наиболее динамичных тем (модель GPT)

Rank	GPT Topic Label	Δ Doc Count	Δ_Cos	Δ Document Count (Slope)	Δ Mean Cos (Slope)	GPT Cos Trend	Doc Count Trend	**Emergent**
1	Advanced Dental Image Segmentation Techniques	45	0.042	10.607	0.006	↑	↑	TRUE
2	AI-Enhanced Dental Imaging and Diagnostics	43	0.022	9.429	0.003	↑	↑	TRUE
3	AI in Dental Diagnostics and Treatment	43	-0.021	7.571	-0.001	↓	↑	FALSE

4	AI-Driven Dental Disease Diagnostics	40	0.04	10.214	0.006	↑	↑	TRUE
5	AI Integration in Dental Education and Practice	40	0.012	7.59	0,003	↑	↑	TRUE
6	Deep Learning in Dental Imaging and Diagnostics	35	0.004	6.214	0.002	↑	↑	TRUE
7	AI-Driven Dental Diagnostics and Treatment	32	0.089	6.893	0.015	↑	↑	TRUE
8	AI-Driven Oral Cancer Detection and Diagnosis	30	0.002	8.5	0.001	↑	↑	TRUE
9	AI in Orthodontics and Maxillofacial Analysis	25	0.029	5.393	0,009	↑	↑	TRUE
10	Automated Orthodontic and Forensic Image Analysis	21	-0.078	6.464	-0.003	↓	↑	FALSE

Several topics demonstrated a consistent increase in both prevalence and frequency, including ***Advanced Dental Image Segmentation Techniques***, ***AI in Dental Diagnostics and Treatment***, and ***Deep Learning in Dental Imaging and Diagnostics***. These patterns suggest sustained and expanding interest. Other topics, such as ***Automated Orthodontic and Forensic Image Analysis***, exhibited high average relevance despite fewer documents, indicating a more specialized yet focused research trajectory. ***AI-Driven Dental Disease Diagnostics*** showed strong topic probability with several document frequency peaks, reflecting a maturing area that retains scientific relevance.

Fluctuating trajectories were observed for topics such as ***AI in Orthodontics and Maxillofacial Analysis***, which peaked around 2023–2024, and ***AI-Driven Oral Cancer Detection and Diagnosis***, which showed recent increases in document count but less consistent prevalence trends. Notably, ***AI Integration in Dental Education and Practice*** emerged prominently post-2022 in both metrics, underscoring the growing interest in educational and clinical adoption of AI technologies.

Together, these results highlight both expanding thematic areas and focused research niches within AI applications in

dentistry, as captured by GPT-based zero-shot topic modeling.

4.4. Topic Model Quality

To evaluate the internal quality of topic assignments, we systematically assessed the compactness, distinctiveness, and redundancy of the clusters generated by three different topic modeling approaches.

Across all quantitative clustering metrics, STM outperformed the other methods in terms of topic compactness, coherence, and separation. It achieved the lowest mean Euclidean distance to centroids (mean_own_dist = 0.225) and the highest cosine similarity (mean_own_cos = 0.775), indicating the most internally consistent topics. Additionally, STM recorded the highest positive separation margin (mean_margin = 0.013) and the best silhouette score (mean_sil = 0.056), demonstrating an optimal balance between within-topic cohesion and between-topic distinctiveness. Its Davies–Bouldin (8.40) and Dunn (0.063) indices further confirmed the robustness of the cluster quality.

The embedding-based Leiden clustering method ranked second on most metrics, generating moderately compact topics (mean_own_cos = 0.765) while preserving positive separation (mean_margin = 0.004), albeit with slightly more overlap compared to STM.

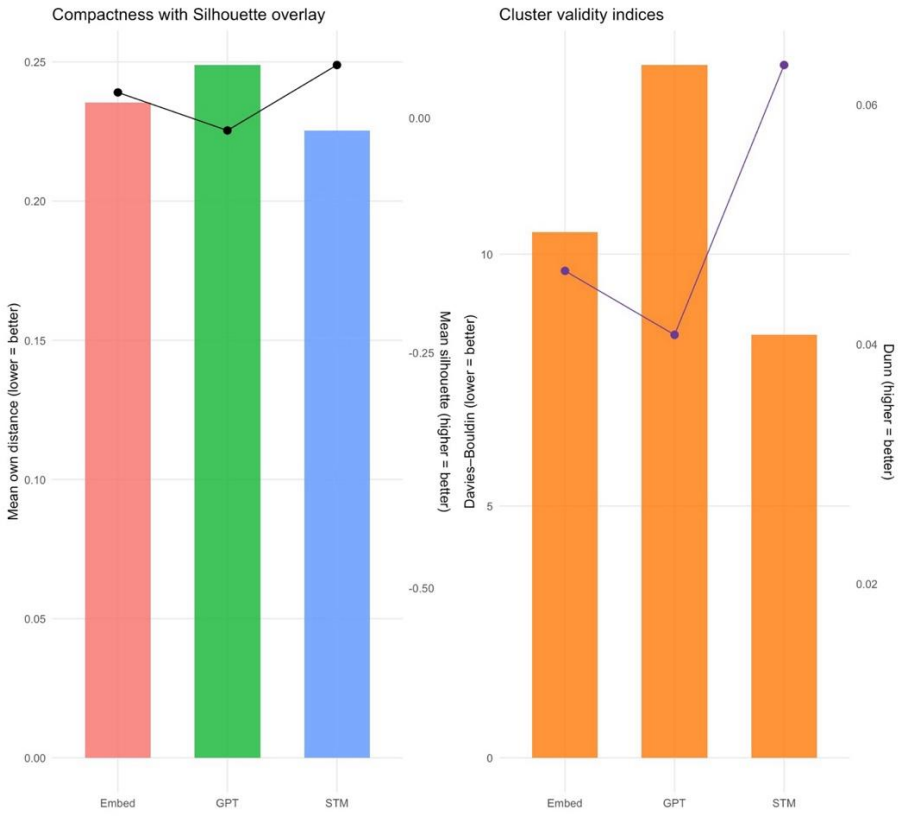
In contrast, zero-shot GPT-based topic modeling demonstrated weaker internal cohesion (mean_own_cos = 0.751) and a negative separation margin (mean_margin = –0.005), indicating that, for some topics, documents were closer to a different centroid than their own. This was reflected in its lowest silhouette score (–0.014) and the poorest cluster validity indices (DB = 13.75; Dunn = 0.041), suggesting significant overlap among GPT-generated topics despite their interpretive clarity.

Overall, these metrics show that STM generated the most compact and well-separated topic structures, followed by the embedding-based approach. In contrast, GPT-based clustering was less structurally distinct and more susceptible to thematic redundancy. These findings are visually summarized in Figure 4, which compares compactness (mean document–centroid distance and silhouette), and distinctiveness (DB and Dunn indices) across models. Together, the results support STM as the most robust model for delineating clear, compact topics in this domain.

To statistically assess differences in clustering quality across approaches, we performed one-way ANOVAs for each evaluation metric (mean document–centroid cosine, Euclidean distance, margin, silhouette, Davies–Bouldin, and Dunn indices), treating modeling approach (STM, GPT, Embed) as the grouping factor. Post hoc pairwise comparisons were adjusted using the Benjamini–Hochberg false discovery rate (FDR) procedure. These tests confirmed that STM outperformed GPT on all core compactness and separation metrics (adjusted $p < 0.05$), with embedding clusters occupying an intermediate position.

Thus, STM generates the most compact and distinct topic structures, making it an excellent choice for applications that require non-overlapping and easily interpretable topics. The embedding model falls in the middle, producing coherent but somewhat broader themes. GPT, on the other hand, produces the loosest and most overlapping partitions, which may be more suitable for exploratory synthesis rather than precise topic delineation.

Figure 4. Compactness and distinctiveness of topic assignments across methods
Рисунок 4. Компактность и разделимость результатов моделирования по методам



4.5. Cross-Approach Topic Correspondence

Heatmap comparisons of topic label similarity (Figure 5) revealed both strong one-to-one matches and notable divergences among STM, embedding-based clustering, and GPT-labeled topics. TF–IDF similarity highlighted alignments driven by lexical overlap in topic keywords and descriptions. In STM–Embed comparisons, several topics exceeded 0.50 similarity, indicating consistent terminology use across methods. However, STM–GPT and Embed–GPT pairs showed low levels of lexical matches, reflecting GPT's tendency to generate more narrative-style labels.

Embedding-based similarity revealed a different pattern: many topic pairs had similarity scores exceeding 0.90 despite low TF–IDF values. This was especially noticeable in STM–GPT matches, where semantically equivalent topics were described using different terms (e.g., "Dental Caries Detection" vs. "AI-Driven Dental Disease Diagnostics").

The Blended Topic Similarity score, which combines TF–IDF and embedding similarity measures, provides a balanced perspective (see Table 5).

Overall, STM and embedding-based clustering achieved the highest levels of both lexical and semantic alignment. In contrast, GPT-labeled topics exhibited greater variability in expression but still demonstrated semantic alignment with several STM and embedding clusters. As clearly shown in Table 5, GPT topics tend to be more semantically broad.

Figure 5. Topic Label Similarity
Рисунок 5. Близость названий тем

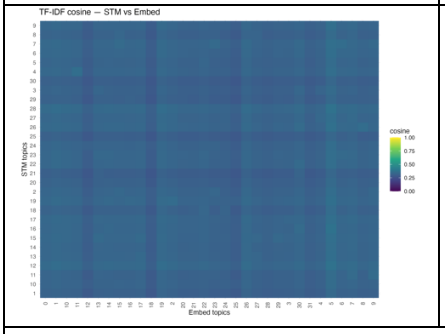
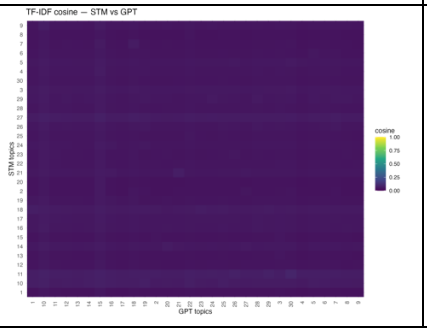
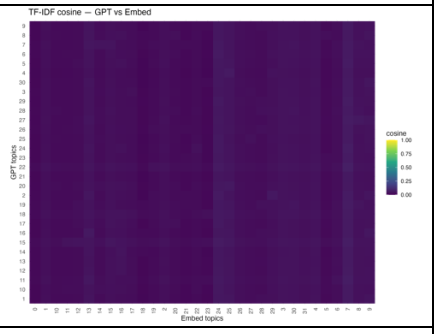
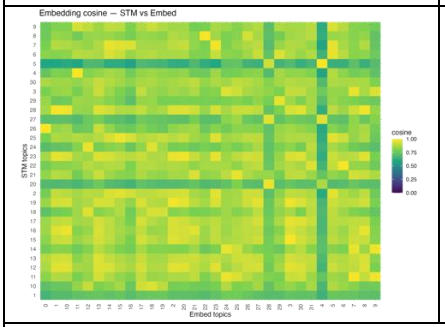
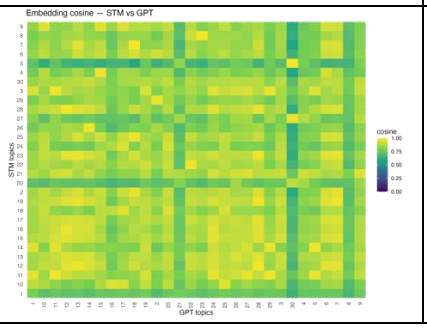
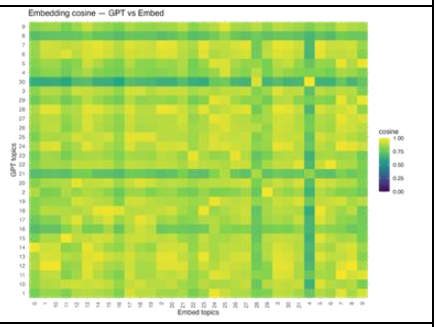
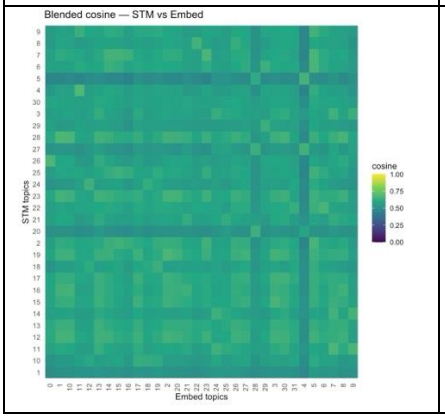
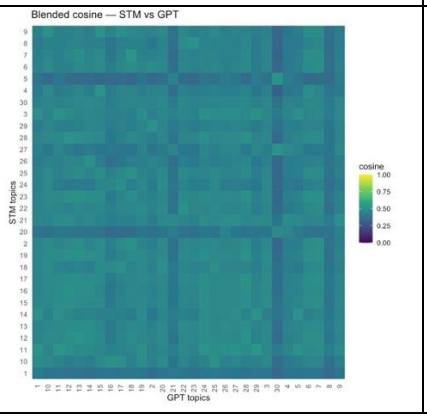
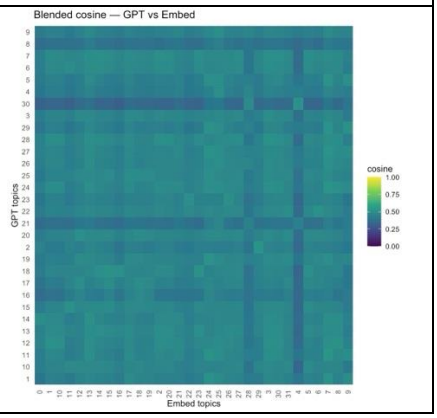
TF-IDF similarity		
STM - Embed	STM-GPT	Embed-GPT
		
Semantic similarity		
STM - Embed	STM-GPT	Embed-GPT
		
Blended Topic Similarity		
STM - Embed	STM-GPT	Embed-GPT
		

Table 5. Topic alignment via approaches
Таблица 5. Соответствие тем между подходами

Label_Embed	**BlendSim (STM-embed)**	**Label_STM**	**BlendSim (STM_GPT)**	**Label_GPT**	**BlendSim (EMB_GPT)**	**Label_Embed**
Periodontal AI Diagnostics	0.667	AI Integration Challenges	0.528	AI Integration and Ethics in Dental Care	0.507	AI-Enhanced Orthodontics
Panoramic Tooth Segmentation	0.662	Tooth Segmentation Techniques	0.524	Advanced Dental Image Segmentation Techniques	0.496	Dental Image Segmentation
Dental AI Chatbot Evaluation	0.655	Chatbot Response Evaluation	0.521	AI Integration in Dental Education and Practice	0.514	Dental AI Chatbot Evaluation
CBCT Artifact Reduction	0.677	Metal Artefact Reduction	0.517	Advanced Image Processing in Dental Imaging	0.51	CBCT Artifact Reduction
Dental Caries Detection	0.672	Dental Caries Detection	0.515	AI-Driven Dental Disease Diagnostics	0.504	Dental Caries Detection
Cephalometric Landmark Detection	0.661	Automated Cephalometric Landmark Detection	0.515	Automated Orthodontic and Forensic Image Analysis	0.506	Cephalometric Landmark Detection
AI-Driven Dental Innovations	0.654	Dental AI Applications	0.514	AI in Medical Imaging and Diagnostics	0.5	AI-Driven Dental Innovations
Panoramic Radiograph AI	0.669	Panoramic Radiograph Analysis	0.513	Deep Learning in Dental Imaging and Diagnostics	0.495	Panoramic Tooth Segmentation
Dental Age Estimation	0,652	Forensic Dental Age Estimation	0.512	AI in Forensic and Orthodontic Dentistry	0.499	Forensic Dental AI
Mandibular Third Molar AI	0.633	Deep Learning Model Performance	0.511	Deep Learning in Dental Imaging	0.495	Panoramic Tooth Segmentation
Oral Cancer Detection	0.668	Oral Cancer Detection	0.511	AI-Driven Oral Cancer Detection and Diagnosis	0.494	Oral Cancer Detection
Dental Implant Diagnostics	0.625	Digital Implant Surgery	0.5	3D Printing Innovations in Dentistry	0.47	Alveolar Ridge Techniques
Radiotherapy Auto-Segmentation	0.635	Head-Neck IMRT Automation	0.5	AI-Enhanced Cancer Diagnostics and Radiotherapy	0.52	Radiotherapy Auto-Segmentation
CBCT Segmentation Accuracy	0.652	CBCT Image Enhancement	0.5	Advanced Dental Imaging Technologies	0.482	CBCT Segmentation Accuracy
Caries Detection Models	0.656	Pediatric Plaque Detection	0.5	AI-Driven Dental Diagnostics and Treatment	0.483	Caries Detection Models
3D Tooth Segmentation	0.647	Tooth Segmentation	0.5	AI-Enhanced Dental Imaging and Diagnostics	0.502	Dental Image Segmentation
Dental Crown	0.631	AI Crown Design	0.495	Innovations in	0.486	Dental Crown

Automation				Digital Dental Technologies		Automation
AI-Enhanced Orthodontics	0.625	Systematic AI Review	0.493	AI-Driven Innovations in Dental Treatment Planning	0.478	Dental Implant Diagnostics
Dental Object Detection	0.651	Dental Image Detection	0.492	AI-Enhanced Dental Imaging and Analysis	0.485	Dental Object Detection
Plaque Detection Automation	0.618	Oral Health Disparities	0.491	AI Innovations in Dentistry and Oral Health	0.486	Caries Detection AI
Dental Anatomical Studies	0.641	Maxillofacial Reconstruction	0.491	Advanced 3D Dental Modeling and Reconstruction	0.489	3D Tooth Segmentation
Caries Detection AI	0.63	Dental Image Classification	0.49	AI and Machine Learning in Dentistry	0.475	Osteoporosis Detection AI
Radiographic AI Diagnostics	0.658	Radiographic Lesion Detection	0.488	AI in Dental Diagnostics and Treatment	0.527	Periodontal AI Diagnostics
Osteoporosis Detection AI	0.643	Deep Learning Diagnostics	0.487	Medical Innovations and Diagnostic Challenges	0.492	Radiographic AI Diagnostics
Dental Image Segmentation	0.622	Multi-View Segmentation	0.476	Advanced Dental Structure and Evolution Analysis	0.495	Dental Anatomical Studies
Dental AI Knowledge Extraction	0.574	AI Diagnostic Tools	0.471	Explainable AI and Sentiment Analysis in Healthcare	0.458	Plaque Detection Automation
Dental Image Segmentation	0.634	Deep Learning Segmentation	0.461	AI in Orthodontics and Maxillofacial Analysis	0.485	Cervical Maturation AI
Dental LLM Evaluation	0.636	GPT in Medical Exams	0.448	NLP and Text Mining in Dental Marketing	0.498	Dental AI Knowledge Extraction
Dental Lesion Deep Learning	0.606	Pathological Speech Analysis	0.418	AI-Driven Innovations in Sustainable Chemistry	0.419	Dental Lesion Deep Learning
Forensic Dental AI	0.533	Authorship Corrections	0.4	Social Media's Impact on Dental Health Information	0.44	Dental LLM Evaluation

Next, we identified conceptual overlaps between topics across different methods via the Document Consensus Score (DocCons) (Eq. 2). This involved evaluating both the overlap in document membership, using Jaccard similarity, and the semantic relatedness of topic labels and keywords. For each STM topic, we determined the most semantically aligned topic in the GPT and embedding models by combining the document-level and label-level similarities. These pairwise mappings enabled us to trace how topics corresponded across methods. Using these mappings, we assigned each document a unified consensus label that reflected the closest matched topic across models (Eq. 2).

To demonstrate how model outputs converge through our alignment procedure, we present three examples in Table 6. In each instance, STM, embedding-based clustering, and GPT generated related yet differently

phrased topics. The STM→GPT blended alignment score which combines Jaccard document overlap and the mean per-document cosine similarity to the candidate topic was used to identify the GPT topic closest to the STM reference topic. Subsequently, the document adopted that consensus GPT label for downstream analyses.

Table 6. Examples of topic alignment
Таблица 6. Примеры соответствия тем

Doc	STM assignment (prob)	Embed assignment (cos)	GPT assignment (cos)	STM→GPT consensus (DocCons)	Emb→GPT consensus (DocCons)
1	Panoramic Radiograph Analysis (0.264)	Tooth Segmentation Techniques (0.212)	AI-Driven Dental Disease Diagnostics (0.06)	Deep Learning in Dental Imaging and Diagnostics (0.513)	Medical Innovations and Diagnostic Challenges (0.492)
2	Dental Caries Detection (0.31)	Caries Detection AI (0.121)	AI-Driven Dental Diagnostics and Treatment (0.141)	AI-Driven Dental Disease Diagnostics (0.516)	AI Innovations in Dentistry and Oral Health (0.486)
3	Tooth Segmentation Techniques (0.212)	Panoramic Radiograph AI (0.076)	AI-Enhanced Dental Imaging and Diagnostics (0.154)	Advanced Dental Image Segmentation Techniques (0.525)	Deep Learning in Dental Imaging and Diagnostics (0.5)

For Document 1, all models highlight imaging-centric diagnostics but differ in scope ranging from a panoramic focus to a broader disease diagnostic. The STM→GPT Document Consensus Score of 0.513 identifies **Deep Learning in Dental Imaging and Diagnostics** as the closest semantic match, while EMB→GPT Document Consensus Score of 0.492 selects **Medical Innovations and Diagnostic Challenges**.

For Document 2, both the STM and Embedding models emphasize caries detection, whereas GPT adopts a broader diagnostics and treatment perspective. The Document Consensus Score STM→GPT match favors GPT's **AI-Driven Dental Disease Diagnostics** (0.516), producing a consensus label that encompasses caries within a wider diagnostic framework. Meanwhile, the EMB→GPT consensus label is even broader semantically, titled **AI Innovations in Dentistry and Oral Health** (0,486).

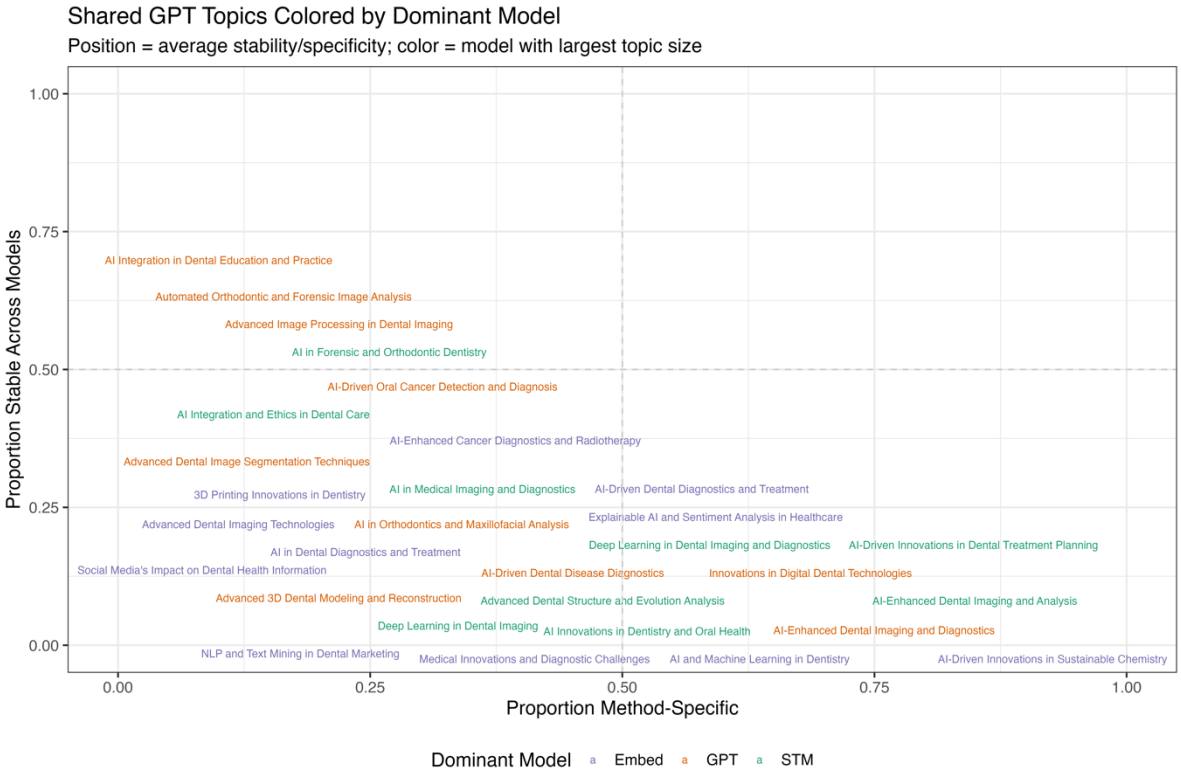
For Document 3, STM focuses on tooth segmentation, GPT on imaging and diagnostics, and Embeddings on the panoramic modality. The Document Consensus Score STM→GPT (0.525) selects **Advanced Dental Image Segmentation Techniques**, aligning the document most directly with the segmentation theme, while the EMB→GPT blended label does not consider segmentation.

Figure 6 displays each consensus topic as a point within a two-dimensional space that illustrates both the level of agreement among the three models and which model primarily "owns" the topic. The y-axis, labeled stability, represents the proportion of documents that all three methods (STM, Embed, GPT – all mapped into GPT space, i.e., STM→GPT, EMB→GPT) consistently assign to the same

conceptual group. Higher values indicate strong agreement across models in terms of both topic identity and membership. The x-axis, labeled specificity, measures how exclusive a topic is to a single method: lower values suggest that multiple models identify the topic, while higher values indicate it is mainly captured by one approach. The color of each point corresponds to the model that dominates the topic, determined by the largest share of mapped documents. Only topics with at least 20 documents are shown, and labels are positioned to avoid overlap.

Figure 6. Landscape of shared GPT-derived topic labels positioned by model agreement and specificity

Рисунок 6. Темы, сгруппированные по согласованности и специфичности



The upper-left quadrant (high stability, low specificity) includes the most robust, cross-method themes, i.e., topics that all three approaches identify using similar document sets. These topics are strong candidates for anchoring temporal analyses and domain summaries, as conclusions drawn from them are unlikely to be influenced by the choice of modeling method. The most stable topics in our analysis are ***Metal Artefact Reduction*** (STM)/ ***CBCT Artifact Reduction*** (Embed)/***Advanced Image Processing in Dental Imaging*** (GPT)**;** ***Chatbot Response Evaluation*** (STM)/***Dental AI Chatbot Evaluation***(Embed)/***AI Integration in Dental Education and Practice*** (GPT)**;** ***AI Integration Challenges*** (STM)/***AI Integration and Ethics in Dental Care*** (GPT); ***Forensic Dental Age Estimation*** (STM)/ ***AI in Forensic and Orthodontic Dentistry*** (GPT); ***Automated Cephalometric Landmark Detection*** (STM)/ ***Cephalometric Landmark Detection*** (Embed)/***Automated Orthodontic and Forensic Image Analysis*** (GPT)**;** ***Oral Cancer Detection*** (STM)/ ***Oral Cancer Detection*** *(Embed)*/ ***AI-Driven Oral Cancer Detection and Diagnosis*** (GPT)**;** ***AI Diagnostic Tools*** (STM)/ ***Dental***

AI Knowledge Extraction (Embed)/***Explainable AI and Sentiment Analysis in Healthcare*** (GPT).

The upper-right quadrant (high stability, high specificity) includes topics that are widely agreed upon and most distinctly represented by a single model—for example, a method that defines a slightly sharper boundary around a shared theme. These topics are absent from our analysis. In contrast, the lower-left quadrant (low stability, low specificity) contains diffuse or boundary topics: multiple models identify related content, but there is weak agreement across documents. These topics often lie at conceptual intersections, such as between methods and applications. Examples include ***Deep Learning Segmentation*** (STM)/ ***AI in Orthodontics and Maxillofacial Analysis*** (GPT); ***Dental LLM Evaluation*** (Embed)/ ***NLP and Text Mining in Dental Marketing*** (GPT); ***Tooth Segmentation Techniques*** (STM)/ ***Advanced Dental Image Segmentation Techniques*** (GPT); ***Dental AI Applications*** (STM)/ ***AI in Medical Imaging and Diagnostics*** (GPT).

Finally, the lower-right quadrant (low stability, high specificity) highlights model-specific themes, where one approach clusters documents that others assign differently. These cases often result from differences in granularity such as broader GPT labels versus narrower STM or Embed clusters and modality-specific phrasing. Examples include: ***Dental Image Classification, Tooth Segmentation, Deep Learning Model Performance, Dental Image Classification, Deep Learning Diagnostics, Dental Image Detection, Pathological Speech Analysis*** by STM; ***Dental Caries Detection, Caries Detection AI, Dental Lesion Deep Learning, Dental Image Segmentation, Dental Object Detection, Plaque Detection Automation, Panoramic Tooth Segmentation, Dental AI Knowledge Extraction, Osteoporosis Detection AI*** by Embeddings, ***AI and Machine Learning in Dentistry***, ***AI-Driven Dental Diagnostics and Treatment*** (GPT).

It should be noted that STM is most often associated with stable topics, while the output of embedding models is linked to low stability and high specificity, and GPT is characterized by low specificity and low stability.

4.6. Temporal Trends in Consensus GPT Space

To examine how research focus has evolved over time in the field of AI in dentistry, we performed a temporal analysis of GPT-labeled topic prevalence from 2019 to 2025. Figure 7 displays LOESS-smoothed curves showing the proportion of publications each year for each topic, normalized by the total annual output. This approach enables comparison of the relative importance of topics over time, independent of changes in overall publication volume.

Curves represent proportions based on the consensus GPT label obtained through the STM-to-GPT blended mapping.

We based temporal trend estimation on the STM→GPT mapping rather than on raw GPT or Embed→GPT assignments for three key reasons. First, STM offers the most reliable document–topic structure within our corpus, demonstrated by the highest compactness and separation metrics. In contrast, GPT topics showed less structural distinctness, while embedding clusters fell in between. Anchoring on STM reduces noise in the yearly counts. Second, STM explicitly models topic prevalence as a function of publication year, which minimizes label switching and enhances comparability over time. GPT labels are then applied to these stable STM topics to improve interpretability. Third, the STM→GPT mapping is a deterministic one-to-one function at the topic level, establishing a fixed label space for aggregation and preventing volatility caused by prompt sensitivity or run-to-run variability in zero-shot large language model outputs.

Each panel in the figure represents a different GPT-labeled topic, the n values indicate the overall size of each topic across 2019–2025, while the proportion curves

capture its changing relative importance within each publication year. The topics are color-coded based on their overall trend from 2019 to 2025, which is determined by the slope of their LOESS fit.

Across the study period, the annual proportions of most GPT-labeled topics remained below 0.1. This reflects the highly fragmented structure of the field: the corpus is distributed across roughly thirty distinct topics, each of which represents only a few percent of the total publication volume. When broken down by year, this dispersion means that individual topics contribute only a small share of the annual output, even if their absolute counts across the whole period are substantial. The consistently low proportion values therefore reflect the broad spread of research activity across many domains.

Several important patterns emerge. Notable growth is observed in areas that reflect recent shifts in both research focus and applied practice. ***AI Integration in Dental Education and Practice (Chatbot Response Evaluation)*** shows a steady and strong increase, indicating rising interest in incorporating AI/LLM into dental training and pedagogy. ***AI in Dental Diagnostics and Treatment (Radiographic Lesion Detection)*** and ***AI-Enhanced Dental Imaging and Analysis (Dental Image Detection)*** demonstrate a clear late-stage surge, especially post-2023, likely due to improvements in applied machine learning tools and clinical validation studies.

These trends suggest a growing emphasis on real-world integration of AI technologies, not only in technical domains but also in educational and operational contexts. Topic of ***AI Integration and Ethics in Dental Care (AI Integration Challenges)*** is also constantly growing since 2022.

In contrast, some previously prominent topics appear to be declining: ***Advanced 3D Dental Modeling and Reconstruction (Maxillofacial Reconstruction)*** and ***Advanced Dental Imaging Technologies (CBCT Image Enhancement)*** have steadily decreased in relative prevalence. This may reflect either topic saturation or consolidation into broader AI-enhanced imaging themes. Similarly, ***Advanced Image Processing in Dental Imaging (Metal Artefact Reduction)*** show decreasing emphasis, suggesting that these methods are increasingly treated as technical subcomponents of broader diagnostic or clinical workflows.

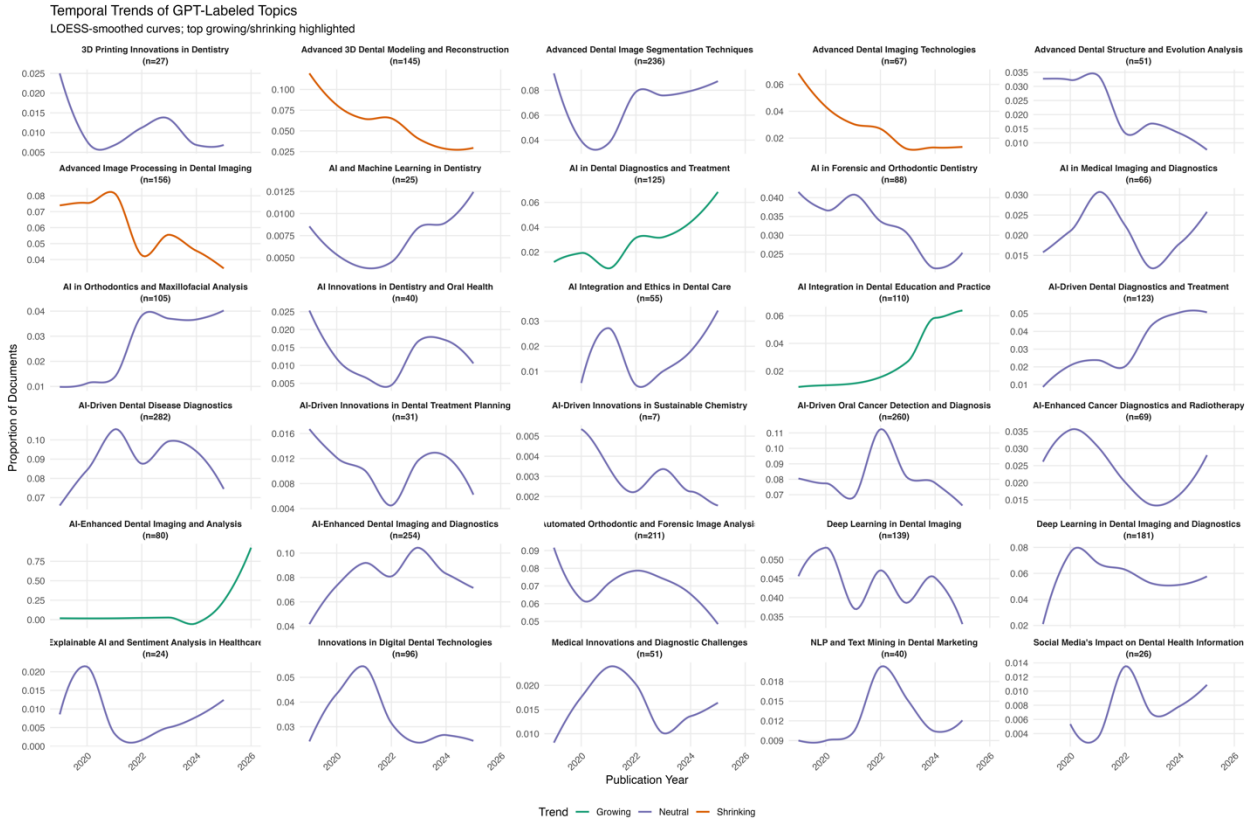
This should be noted that such topic as ***AI and Machine Learning in Dentistry (Dental Image Classification)*** shows stable growth after 2022.

Many topics display nonlinear patterns peaking in middle of period and then stabilizing or rebounding. ***AI-Driven Oral Cancer Detection and Diagnosis (Oral Cancer Detection)*** and ***Deep Learning in Dental Imaging (Deep Learning Model Performance)*** show early growth followed by a plateau, reflecting their maturation. ***NLP and Text Mining in Dental Marketing (GPT in Medical Exams)***, while niche in size, shows cyclical attention, possibly tied to regulatory or ethical discourse spikes.

Interestingly, some smaller topics show recent resurgence, including ***Explainable AI and Sentiment Analysis (AI Diagnostic Tools)***, hinting at emerging interest in communication-focused applications of AI.

This temporal mapping highlights the dynamic evolution of research priorities in AI-driven dentistry. While foundational techniques such as image processing and 3D modeling are receiving relatively less attention, application-focused topics – especially those related to clinical diagnostics, integration into practice, and patient communication – are rapidly gaining prominence. These insights provide both a retrospective understanding of the field's development and a forward-looking perspective on areas where innovation is currently accelerating.

Figure 7. Temporal Trends of STM→GPT Topics
Рисунок 7. Тренды тем с метками STM→GPT



5. DISCUSSION

This study offers a comprehensive comparative analysis of topic modeling approaches applied to the field of artificial intelligence in dentistry. We systematically examined three methodologies Structural Topic Modeling, embedding-based clustering, and zero-shot GPT-based topic extraction to uncover latent research themes, temporal trends, and conceptual alignments within the literature corpus spanning 2019 to 2025.

The STM approach, which utilizes word co-occurrence and covariate modeling, generated interpretable and distinct topics. Its probabilistic framework enabled soft topic assignments, providing nuanced insights into thematic overlaps and ambiguities. By analyzing topic prevalence trends derived from posterior probabilities and dominant topic frequencies, emerging areas such as ***AI Integration Challenges***, ***Dental Image Detection***, and ***Chatbot Response Evaluation*** were identified. The simultaneous increase in model-based topic probabilities and real-world document frequencies supports the conclusion that these topics are becoming key focal points in the field. Notably, STM outperformed other methods in terms of compactness and distinctiveness metrics, achieving the highest silhouette scores, tight document clustering, and the lowest redundancy in topic labeling.

The embedding-based approach, which utilized UMAP and Leiden clustering on OpenAI embeddings, provided an alternative perspective rooted in contextual semantic similarity rather than surface-level lexical patterns. The resulting clusters were generally coherent, and measuring cosine similarity to cluster centroids enabled quantification of topic-document relevance. This method highlighted emerging topics such as ***Dental LLM Evaluation***, ***Dental AI Chatbot Evaluation, CBCT Segmentation Accuracy,***

and AI-Enhanced Orthodontics, particularly after 2022. These findings align with observed technological advancements and the clinical adoption of AI-enhanced imaging tools in dental diagnostics, as well as a focus on NLP and communication within dentistry. However, the embedding model sometimes fragmented semantically related areas due to its sensitivity to local embedding structure and resolution settings.

The zero-shot GPT-based topic modeling offered a fresh perspective by generating topics and summaries without the need for training or predefined structures. While the GPT-derived topics were broader and less concise, they effectively captured thematic summaries consistent with trends observed in STM and embedding models. Temporal analysis of GPT-labeled topics highlighted the emergence of application-centered areas such as ***Advanced Dental Image Segmentation Techniques***, ***AI in Dental Diagnostics and Treatment***, and ***Deep Learning in Dental Imaging and Diagnostics.***

A significant contribution of this study is the multi-dimensional evaluation of topic model quality. While STM produced the most distinct and compact clusters, the embedding and GPT models provided complementary insights, especially in capturing semantic nuances and summarization capabilities. Our redundancy analysis emphasized STM's advantage in generating less overlapping topic profiles, a valuable feature for downstream applications such as systematic reviews or curriculum design.

The consensus mapping across models revealed both stable and divergent conceptual structures. Topics such as ***Advanced Image Processing in Dental Imaging, AI Integration in Dental Education and Practice, Automated Orthodontic and Forensic Image Analysis*** were consistently represented across all models, underscoring their centrality in AI-dental research. In contrast, GPT occasionally merged or split topics in ways that deviated from STM and Embed clusters, illustrating the influence of prompt-based generative modeling on topic formation.

Temporal analyses across all methods revealed a clear trajectory: a shift from foundational technical approaches (e.g., image processing, image segmentation) toward applied, interdisciplinary, and clinical implementations of AI. The steady increase in topics related to the use of large language models in dentistry, chatbot evaluation, and AI for education and treatment planning mirrors broader technological trends and policy changes in healthcare digitalization.

It is noteworthy that conclusions regarding the rise of NLP and hybrid models utilizing textual data, new modalities, and AI for dentistry education, treatment planning, image enhancement, and workflow optimization demonstrate considerable growth. These findings align with results obtained through manual coding of abstracts from WoS (Shirani, 2025; see also Büttner et al., 2025), thereby validating our automated approach.

Overall, our results indicate that no single modeling approach is sufficient on its own. STM excels in structural interpretability and compactness; embedding-based methods offer semantic grounding and clear cluster separation; and GPT-based models offer expressive labeling along with flexible, human-readable topic summaries. Together, these methods form a robust toolkit for analyzing and understanding domain-specific scientific literature.

This multi-method framework is adaptable across various disciplines and can support future research by facilitating the development of automated literature review tools, identifying research gaps, and monitoring the diffusion of technology in clinical fields. As AI advances, hybrid modeling approaches that integrate statistical inference, embedding spaces, and generative models will be essential for generating reliable, explainable, and comprehensive topic structures.

Like any study, ours has **limitations**. We used a single LLM with relatively simple

prompts, which may have limited model diversity and the range of topics identified. Our analyses were based on abstracts rather than full texts, potentially underrepresenting methodological details and affecting the accuracy of topic boundaries and trend estimates. Although topic labels were reviewed by the authors and showed high internal agreement, assessor bias may still be present. Additionally, the study primarily reports descriptive slopes and topic quality metrics without formal statistical testing. While these findings offer useful comparative insights, more rigorous methods such as ANOVA, bootstrapped confidence intervals, or permutation tests could provide stronger evidence of model differences and trend significance. We consider these extensions, along with broader model comparisons and external expert validation, to be important directions for future research.

6. CONCLUSIONS

This study introduces a cross-model GPT-labeled alignment framework that integrates probabilistic (STM), embedding-based (Leiden clustering), and generative (zero-shot GPT) approaches for topic modeling. To our knowledge, this is the first application of such a framework in dentistry. More broadly, it provides a replicable methodology for aligning and comparing heterogeneous topic modeling outputs. The key methodological innovation lies in combining topic-level and document-level similarity measures to construct a shared consensus topic space, enabling robust cross-model evaluation.

For method developers in NLP and bibliometrics, our findings demonstrate that no single approach dominates: STM produces compact and temporally interpretable topics, embeddings reveal fine-grained semantic clusters, and GPT generates highly readable thematic summaries. The blended alignment framework offer a generalizable tool for cross-model comparison that can be applied to other scientific domains beyond dentistry.

For domain experts in dentistry, this framework provides an automated, scalable method to map thematic landscapes and monitor research trends. When applied to AI in dentistry, it revealed a shift from foundational image-processing techniques toward applied and integrative themes, including LLM-driven applications, patient-facing AI tools, and educational initiatives. These insights are directly relevant to systematic reviews, guideline development, and research planning.

Overall, our study highlights that hybrid strategies, which combine probabilistic models with LLM-assisted labeling, produce the most comprehensive and interpretable topic analyses. While large language models enhance interpretability, they should not be used in isolation; careful integration with traditional NLP methods is essential to ensure reproducibility and explainability.

Future work will expand this approach by incorporating external human evaluations of topic quality, experimenting with diverse LLMs and prompting strategies, utilizing full-text corpora, and developing hybrid pipelines that more deeply integrate classic topic modeling with modern generative methods.

Declarations. We employed GPT-4o (OpenAI) to assist with topic extraction and topic labeling as a part of our methodology. The roles of these tools are described here and detailed in the Methods section; all analytical decisions and conclusions remain the authors' own. We used Wordservice.ai solely for English proofreading, including spelling, grammar, and stylistic edits. This service did not generate substantive content or perform any analysis. No generative tool made interpretive or methodological decisions without human oversight, and no confidential or personally identifiable data were shared to third-party services.

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Semantics in corpus linguistics: the basic colour term *red* in Modern Greek

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Abstract: This paper argues that electronic corpora provide a rich source of data and a useful tool for semantics. More specifically, collocations, semantic preference and semantic prosody of the basic colour term *kókkinos* ("red") in Modern Greek are examined, using text corpora, such as Greek electronic dictionaries, SEK (Corpus of Greek texts) and Educational Thesaurus of Greek Texts. The results of the research show that such a corpus-based analysis reveals the semantic and pragmatic aspects of language, the linguistic expression of emotion concepts, through conceptual metaphor and metonymy. Collocations with this term seem to reveal a high degree of semantic opacity in the framework of conceptual metaphor. In addition, *kókkinos* (red) is mainly related to negative semantic prosody, denoting for instance prohibition (*kókini zóni* = red zone, i.e. the area where entry is prohibited), danger/emergency (*kókinos sinaγermós* = red alert), prostitution/immorality *kókino fotáki* (= *red light in a tolerance house*) and negative emotions such as anger (*kókinos san astakós = as red as a lobster*), sorrow (*kókini traγοδία = red tragedy)* and shame (*égine kókinos san pantzári* (= *He turned as red as beetroot*). The originality of the research lies in the emergence of the power of context and contextual factors in linguistic analysis, using naturally occurring instances and precise corpus techniques. Regarding the study limitations, the analysis is based on a specific set of corpora (Greek electronic dictionaries, SEK, and Educational Thesaurus of Greek Texts), which, while valuable, may not represent the full diversity of language use in informal, spoken, or contemporary digital contexts (e.g., social media, forums).

Keywords: Corpus linguistics; Modern Greek; *kókkinos* "red"; Collocations; Semantic prosody

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1. Introduction

Corpus linguistics has emerged considerably over last decades as one of the most rapidly-developing and well-established fields of research (see Stubbs, 1996; Biber et al., 1998; Gries, 2009; Kennedy, 2014; Dunn, 2022). Large collections of machine-readable texts provide language researchers the possibility to get data easily and quickly at minimal cost, using authentic occurrences of language structure (including transcripts of spoken data) and real-life examples. Also, computerized corpora can be manipulated consistently and accurately, making the results more reliable (Sinclair, 1991, 2005; Lüdeling and Kytö, 2008; Conrad, 2010).

Through concordances and frequency lists, corpus linguists can exploit data about language, using the methods of computational linguistics for data quantitative analysis. Using methodological tools of corpora editing, researchers can derive information about collocations and semantic prosody (see Sinclair, 1991; Stubbs, 2001; McCarthy, 2006; Hunston, 2007; Bednarek, 2008; Barnbrook et al., 2013; Russnes, 2024). In the framework of cognitive linguistics, corpus linguistics has developed a large number of conceptual tools analyzing expressions of emotions (Oster, 2010, 2012; Theodoropoulou, 2012; Babanoğlu, 2015; Tsapakidou, 2015).

Basic colour terms, their collocations and semantic prosody have been studied through corpora, among others by Philip (2011), Steinvall (2006), Hemming (2012), Serakioti (2020, 2021), Hamilton (2016), Kalda and Uusküla (2019), Brosa-Rodríguez and Jiménez-López (2023), Dai and Zainal (2025), Wang and Yao (2025). Hamilton's research uses the data source of the Historical Thesaurus of English (HT), the British National Corpus (BNC) and the Corpus of Contemporary American (COCA) to examine the meaning of basic colour terms through collocations and semantic prosody. Kalda and Uusküla (2019) study English colour metaphors used in the translation tasks, conducting a cognitive empirical study. Serakioti (2021) studies the meaning of the terms *white* (aspros/lefkos) and *black* (mavros) in Modern Greek, based on Greek Corpora and Greek dictionaries. The research results showed that the term *mavros* has a negative connotation, as opposed to *lefkos* associated with a positive connotation. Also, Serakioti (2015) examines the collocations of the colour terms *galanó* (light *blue*) in relation to *galázio* (dark *blue*) through Corpus of Greek texts.

The lack of empirical work on *red* represents a significant gap in the literature, especially given its cultural and symbolic importance in Greek discourse (e.g., politics, religion, emotion, and everyday language). This study aims to fill that gap by conducting a comprehensive corpus-based semantic analysis of *κόκκινο* in Modern Greek, drawing data from large-scale corpora that span journalistic, educational, and general language usage. By using concordance tools and collocational analysis, the study investigates both the frequency and evaluative use of the term in various genres and registers. Specifically, this study seeks to investigate the term's collocational behavior, semantic preference, and prosody – both positive and negative – across various genres. By applying principles of lexical semantics, including conceptual metaphor and metonymy, the study highlights the emotional and evaluative meanings associated with *kókkinos*. Ultimately, the research demonstrates how electronic corpora can uncover subtle contextual and pragmatic dimensions of meaning in naturally occurring language.

Our basic hypotheses are that *κόκκινο* appears more frequently in evaluative rather than purely descriptive contexts, with a tendency toward negative semantic prosody – such as associations with danger, conflict, or strong emotion. Furthermore, it is expected that its collocational patterns will vary significantly depending on genre, reflecting different cultural and communicative functions of the term.

2. Literature Review and Theoretical Framework

The semantics of colour terms has attracted considerable scholarly attention across disciplines such as linguistics, cognitive science, and corpus-based semantics. The Berlin and Kay experiment (1969) is a landmark study in linguistics and cognitive science that investigated how different languages categorize basic colour terms (see Serakioti, 2015, 2020). Through cross-linguistic analysis, the researchers identified linguistic universals in the categorization of basic colour terms. Their findings led to the formulation of a universal hierarchy of basic colour term emergence,

suggesting that all languages develop colour vocabulary in a predictable sequence, starting with *white* and *black*, followed by *red*, and then *green* or *yellow*, *blue*, *brown*, *purple*, *pink*, *orange*, *grey*.

Later research has investigated how colour terms acquire metaphorical and evaluative meanings. For instance, Steinvall (2006) and Philip (2011) examined how colour terms function in context, revealing patterns of metaphor and collocational behavior, particularly in English. In addition, Hamilton (2016) provides a comprehensive analysis of how colour terms in English evolve from literal meanings to figurative uses through metonymy and metaphor. Her corpus-based study draws from large databases such as the Historical Thesaurus of English and explores how terms like *red*, *blue*, and *green* develop complex emotional and cultural connotations. She emphasizes that *red* commonly denotes emotional excess, danger, sin, or sexuality, often through expressions like "red alert", "red-light district", and "red-handed."

Lakoff and Johnson (1980) argue that colors are frequently used metaphorically to express emotions, qualities, or states. For example, *blue* denotes sadness and *green* expresses envy (jealousy). *Red* is used to denote anger, i.e. in expressions like "boiling with anger" or "seeing red." These expressions reflect how we use color concepts to frame and communicate emotional experiences. Kövecses (2002) builds on the work of Lakoff and Johnson (1980) and offers a comprehensive and systematic framework for understanding metaphor as a fundamental mechanism of human thought. Kövecses discusses how colors serve as powerful sources for metaphorical meaning. He highlights that some color metaphors are quite universal – for example, *black* often represents evil or death, *white* represents purity or innocence – while others vary widely by culture. He also analyzes color in the domain of emotions, a key area where colors are metaphorically used. For instance, *red* often symbolizes anger, passion or embarrassment due to embodied experiences, and *blue* typically stands for sadness or calmness.

From a structuralist perspective, Lévi-Strauss (1963) observes that *red* often functions as part of a symbolic binary (e.g., red/white, life/death) in mythology and ritual. In many cultures, this colour is associated with life force (blood, fertility), but also with violence and sacrifice. Also, Elliot et al. (2007) research in psychology show that *red* influences perception; *red* can increase attractiveness (in romantic contexts), signal dominance or aggression (especially in sports). This study investigates how exposure to the color red can impair performance in achievement contexts by evoking avoidance motivation.Furthermore, the study by Bellizzi and Hite (1992) investigates how the colors *red* and *blue* influence consumer emotions and purchasing behaviors within retail environments. The research found that red environments tend to evoke feelings of tension and negativity among consumers.

In the field of Modern Greek, Serakioti (2021) conducted a corpus-based analysis of the colour terms *mavros* ("black") and *lefkos* ("white"), examining their collocational patterns and semantic prosody across various textual genres. Her findings revealed that *mavros* consistently appeared in negative evaluative contexts, such as expressions of death, sorrow, and danger, while *lefkos* was frequently associated with positive connotations, including purity, innocence, and peace. By employing tools such as concordance lines and frequency analysis from Greek corpora, the study provided empirical evidence of how colour terms function not only descriptively but also evaluatively, reflecting deeper cultural and emotional associations. In Modern Greek, the semantic and evaluative uses of the term κόκκινο ("red") have not yet been studied through corpus-based methods. In Modern Greek linguistics there has been no systematic study of the color term *red* (κόκκινο) based on corpus analysis. Such research would fill a significant gap in the literature by providing

empirical data on the semantic and evaluative uses of *κόκκινο*, revealing its cultural, emotional, and contextual associations in this language. This would also enable comparisons with studies on other color terms and contribute to a deeper understanding of color semantics in Modern Greek.

3. Methodology

In this study, the electronic "Dictionary of Standard Modern Greek" (Manolis Triantafyllidis)[1], SEK (Corpus of Greek texts) (Goutsos, 2003), Educational Thesaurus of Greek Texts and text corpora from journalism and Secondary School (Corpus of New Greek Texts)[2] were used in order to reveal semantic relationships that are related to the term *kókkinos* ("red") in Modern Greek. The total corpus used in this study comprises approximately 35 million word tokens. The *Educational Thesaurus of Greek Texts* consists of: 1) a General corpus, 2) textbooks corpus and 3) the corpus of texts of teachers (the teacher can insert his/her own texts). The *corpus of New Greek Texts* contains about 5,000,000 word tokens published in the newspapers *Ta Nea* (2092594 words, 4,432 texts) and *Makedonia* (2,608,410 words, 8,012 texts). The material is grouped based on thematic units and genres (sports news, narrative texts, film reviews, political reporting, recipes etc.). The text corpora from the field of education contain, in electronic format, textbooks (for both students and teachers) from the Lower Secondary School (*gymnasion*) and the Upper Secondary School (*lykeion*). In this way, it enables the user to find authentic examples of the use of the Greek language by searching for specific words. For instance, by entering the word "*kókini",* all sentences containing this word are retrieved. In addition, corpora give the user the opportunity to search for the frequency of occurrence of words and lemmas, using statistical tools. The Corpus of Greek Texts (SEK) is a synchronic, monolingual corpus of Modern Greek that contains approximately 30 million word tokens, covering a wide range of text types and thematic categories. It includes both written and spoken texts, dating from 1,990 to 2,010 and all texts are pre-annotated with metadata specifying their mode (written or spoken) and genre, such as academic writing, news articles, opinion pieces, literary texts, interviews, and conversations. This diversity makes SEK a valuable tool for linguistic research, allowing for the analysis of word usage and phraseology across different contexts and genres.

Concordance analysis was performed using AntConc (version 4.1.0) to systematically retrieve all occurrences of the term *κόκκινο* and its inflected forms (e.g., *κόκκινη*), facilitating a comprehensive investigation of its distribution and contextual usage within the corpus. AntConc is a freeware concordance program developed by Professor Laurence Anthony. Frequency counts and collocational patterns were examined to identify semantic prosody and evaluative contexts – positive, negative, or neutral. Concordance lines allowed for close examination of the word's co-text to analyze emotional associations and connotations related to *κόκκινο* in different contexts. From the retrieved concordance lines, a stratified sample was selected to ensure representation across genres and text types. Large collections of spoken or written data (corpora) seem to be ideal for the investigation of collocations through concordances in user-friendly software. It is worth noting the fact that a concordance is one core corpus-handling technique for retrieving a word or a phrase analyzing the context before and after the example (i.e. co-text). In the case of connotations, concordances demonstrate the word emotional associations, the positive or negative feelings or emotions related to that word.

[1] https://www.greek-language.gr/greekLang/modern_greek/tools/lexica/triantafyllides/index.html
[2] https://www.greek-language.gr/greekLang/modern_greek/tools/corpora/index.html

This study follows a descriptive, corpus-based research design. First, instances of the color term *κόκκινο* and its inflected forms were extracted using keyword and lemma-based searches. Next, concordance lines were analyzed to identify co-text and collocational patterns. Finally, semantic prosody was assessed by categorizing each instance into evaluative types (positive, negative, neutral), providing insight into emotional and cultural associations. Frequency counts and collocational analyses were further processed using SPSS (version 28) to generate descriptive statistics and frequency tables of evaluative patterns.

4. Findings and Discussion

The results of the present research (see Figure 1) indicate that the term *kókkinos* ("red") in Modern Greek is related to the emotions of anger and rage, for example *kókino paní* (*red flag), égine kókinos apó ton θimó tu* (his *face turned red with anger*) / *kókinos san astakós* (*as red as a lobster*). In addition, kókinos denotes the feeling of shame (*égine kókinos san pantzári*/*san paparúna* (*He turned as red as beetroot/ as a poppy*). Also, the specific colour term is related *to prohibition* (*kókinos simatodótis = red traffic light*, kókini zóni = red zone, i.e. area where entry is prohibited), warning (*kókini kárta = red card* – for removing a player from the match) or t*hreatening*/danger/emergency (*kókini* γramí = *hotline – for direct or urgent communication between the governments of two countries, kókinos sinaγermós = red alert, kókinos katáloγos = red list of endangered animals*). In cases, such as *kókinos sinaγermós = red alert*, the overall semantic prosody is negative with metaphorical extension, associated with fear, urgency, danger, and disruption. Metaphorical extensions of *kókkinos* highlight cultural associations, linking the color not only with physical redness but also with emotional intensity and social conventions (e.g., shame, prohibition).

(1) N0244 P004 L010 … ης, γεγονός ότι η Εφορία αποτελεί **κόκκινο** πανί για το σύνολο των φορολογουμ (Corpus of New Greek Texts)

(2) N0473 P001 L001 … "**Κόκκινη**" γραμμή με τον εισαγγελέα Εκβιασθ… (Corpus of New Greek Texts)

(3) N0640 P015 L031 …ληνικού Κοινωνικού Φόρουμ.| Χωρίς **κόκκινη** ζώνη και συρματοπλέγματα| Οι διαδ … (Corpus of New Greek Texts)

(4) Διαμάχες φατριών Ο κ. Καρίμ θεωρεί αμελητέο το ενδεχόμενο ενός εμφύλιου πολέμου καθώς όπως λέει «είναι η **κόκκινη** γραμμή που όποιος την περάσει είναι καταδικασμένος να πέσει στην μαύρη τρύπα της παλλαϊκής κατακραυγής» (Educational Thesaurus of Greek Texts)

(5) M6978 P006 L010 … απλώς τοποθέτησε περιμετρικά μια **κόκκινη** κορδέλα, με την οποία απαγορεύετα … (Corpus of New Greek Texts)

Also, the term *kókinos* refers to defamation (for example kókini *láspi = red dust*) and prostitution/immorality (*kókino fotáki = red light in a tolerance house*) in the framework of conceptual metaphor. Another collocation with *kókinos* is related to importance/honorable welcome (*kókino xalí*[3] *= red carpet*).

(6) Η Αίγυπτος στρώνει **κόκκινο** χαλί» στους επενδυτές (Educational Thesaurus of Greek Texts)

It is worth noting the fact that the term *kókinos* can be used to denote a Greek football team (*i kókini* (plural) = *the team whose emblem is red*). In this case we observe the linguistic phenomenon of metonymy (see Stefanowitsch, 2006); a concept is referred to by the name of something associated with that concept. This usage often carries evaluative or emotive connotations, depending on the speaker's perspective, such as enthusiasm,

[3] Often the phrase is associated with an ironic connotation in Modern Greek.

rivalry, or criticism, illustrating how color terms in Modern Greek can acquire socio-cultural and affective meaning beyond their literal sense.

(7) N2303 P036 L079 … ης Λίβερπουλ και της Σέλτικ. Οι "**κόκκινοι**" πήραν την πρόκριση νικώντας με … (Corpus of New Greek Texts)
(8) N2710 P005 L018 … το Τσάμπιονς Λιγκ εκτός ήταν οι "**κόκκινοι**". Στο πρωτάθλημα, οι δύο βαθμοί … (Corpus of New Greek Texts)

More particularly, the term *kókini* refers to the players or fans of the Greek football team. Furthermore, the notion *kókinos* can express a political ideology (*kókinos dímarxos* = "red" mayor) and it has also been associated with blood (*kókini tragodía = red tragedy*) and revolution and to socialism and communism (*Kókinos Stratós = Red Army*):

(9) N3334 P010 L019 … 49, αρχίζοντας με την είσοδο του **Κόκκινου** Στρατού στην Οδησσό και τη φυγή … (Corpus of New Greek Texts)
(10) Η τραγική φιγούρα του Σοβιετικού Γιούρι Ολέσα (1899–1960) κυριαρχεί στο νέο τεύχος του περιοδικού «Πλανόδιον» (Δεκέμβριος 2004) – μια μορφή που, όπως εξηγεί η μεταφράστρια Ευγενία Κριτσέφτσκαγια, μεγάλωσε στην Οδησσό, υπηρέτησε στον **Κόκκινο** Στρατό, δημοσίευσε το μοναδικό του μυθιστόρημα «Φθόνος» στα 1927 κι έγραψε θέατρο που ανέβασε ο διάσημος Μέγιερχολντ. (Educational Thesaurus of Greek Texts)
(11) Και ... ξερίζωσαν από τις καρδιές τους την **κόκκινη** τραγωδία (Educational Thesaurus of Greek Texts)
(12) N0390 P005 L007 … μαζί με μερικούς ανεπιθύμητους "**Κόκκινους**" στη Ρωσία, όπου είχε την ευκαιρ … (Corpus of New Greek Texts)

Also, the term *kókinos* often denotes the upper limit:

(13) Στο **κόκκινο** χιλιάδες επιχειρήσεις και νοικοκυριά (Educational Thesaurus of Greek Texts)
(14) Στο **κόκκινο** η ρύπανση (Educational Thesaurus of Greek Texts)

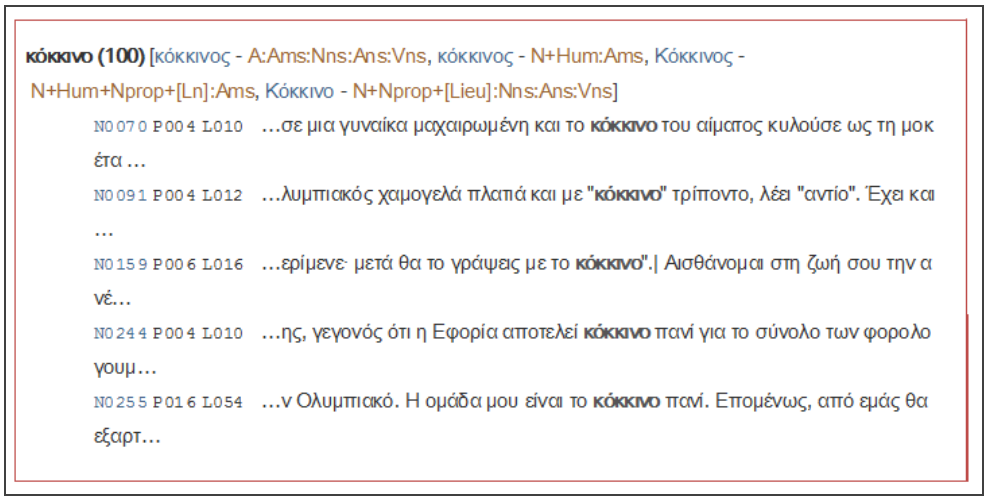
Figure 1. Concordance of red colour in SEK

5	Ευρώπη του διαστήματος θέλει να αποδείξει ότι ο**Κόκκινος**	Πλανήτης δεν είναι αποκλειστικό πεδίο ερευνών	sek_texts\WLCG15-5027	ΓραπτόΗλεκτρονικόΕΝΗΜΕΡΩΤΙΚΑ
6	ευχή των 6 δις. κατοίκων του πλανήτη είναι ο "**κόκκινος**	συναγερμός" του Λευκού Οίκου να μην ηχήσει ποτέ	sek_texts\WLCG15-0026	ΓραπτόΗλεκτρονικόΕΝΗΜΕΡΩΤΙΚΑ
7	μεγαλύτερη ανάσα μου. Περνούσαν οι καιροί κι εγώ, πιο**κόκκινος**	κι από το κόκκινο των ορίων, συνέχιζα την ίδια	sek_texts\WFCG11-5027	η/aΗλεκτρονικό ΛΟΓΟΤΕΧΝΙΑ
8	πληροφορίες σχετικά με τη σύσταση του 'ρη δείχνουν ότι ο**Κόκκινος**	Πλανήτης διαθέτει σιδερένιο πυρήνα σε ρευστή κατάσταση	sek_texts\WLCG15-5019	ΓραπτόΗλεκτρονικόΕΝΗΜΕΡΩΤΙΚΑ

In Figure 2, most of the collocations are conceptual metaphors and they are related to a high degree of semantic opacity. In addition, they denote negative prosody as long as they are associated to notions such as danger, prohibition, immorality and emotions, for instance anger or shame. For example, in the sentence «γεγονός ότι η Εφορία αποτελεί κόκκινο πανί για το σύνολο των φορολογουμένων» ("the fact that the Tax Office constitutes a red flag for all taxpayers"), the term is used figuratively to emphasize the public's emotional hostility toward the tax authority. The phrase κόκκινο πανί = red flag draws on conceptual metaphor theory, specifically the metaphor "ANGER IS PROVOKED AGGRESSION", where the red cloth symbolically incites a reaction, much like a red rag to a bull (see Lakoff and Johnson, 1980; Lakoff, 1993). This example reflects how kókkinos contributes to emotionally charged evaluative meaning in institutional and socio-political contexts, reinforcing the predominance of negative prosody in its figurative usage. Such expressions are grounded in embodied

experience and culturally mediated symbolism, reinforcing how metaphor and metonymy jointly shape lexical meaning and pragmatic interpretation. These examples illustrate the rich semantic versatility of *κόκκινος*, underscoring its pragmatic and symbolic functions in Modern Greek discourse.

Figure 2. Concordance of *red* in Corpus of New Greek Texts (Newspaper "Macedonia")



It is worth noting the fact that linguistic phenomenon of metonymy occurs in plural terms in which one entity is used to refer to another, related, entity. Our data could be compared with those of corresponding surveys which examine metaphorical extensions of *red* in corpora (see among others Bennett, 1988; Hamilton, 2016; Kalda A. and Uusküla, 2019). Hamilton (2016) denotes that *red* is related to negative associations due to its connection with blood and collocates with emotions including anger and shame. Also, MacLaury et al. (1997: 77), Kalda A. and Uusküla (2019: 692) and Vaňková (2007) support that *red* is related to negative emotions, such as anger. Benczes and Tóth-Czifra (2014) argue that *piros* in Hungarian is used more rather with positive concepts, while *vörös* has a negative connotation.

In Figure 3, the term *κόκκινος* ("red") in Modern Greek exhibits a wide range of metaphorical extensions and idiomatic uses across various semantic domains. These collocations often reflect strong emotional or conceptual associations. In the domain of anger, expressions such as *έγινε κόκκινος από τον θυμό του* ("he turned red with anger") are prototypical, while similes like *κόκκινος σαν αστακός* ("as red as a lobster") also serve to intensify emotional states. Shame is expressed metaphorically through phrases like *έγινε κόκκινος σαν παντζάρι/σαν παπαρούνα* ("he turned red as a beetroot/poppy"), highlighting the embodied reaction of blushing. In other domains, κόκκινος is associated with sorrow (*κόκκινη τραγωδία* – "red tragedy"), blood (*κόκκινος σαν το αίμα* – "as red as blood"), prohibition (*κόκκινος σηματοδότης* – "red traffic light", *κόκκινη ζώνη* – "red zone"), and warning (*κόκκινη κάρτα* – "red card"). It also occurs in expressions denoting danger or emergency, such as *κόκκινη γραμμή* ("hotline"), *κόκκινος συναγερμός* ("red alert"), and κόκκινος κατάλογος ("red list" of endangered species). *Κόκκινος κατάλογος* ("red list") refers to an official register of endangered or threatened species, highlighting those at risk of extinction. This collocation exemplifies the use of the color *red* to signal warning and urgency in environmental and conservation discourse. These metaphorical and idiomatic uses reflect culturally mediated symbolism, where kókkinos conveys social, political, and

emotional meanings beyond its literal color reference.

Other figurative uses include defamation (*κόκκινη λάσπη* – "red mud"/"smear"), immorality or prostitution (*κόκκινο φωτάκι* – "red light"), and political ideology (*κόκκινος δήμαρχος* – "red mayor", *Κόκκινος Στρατός* – "Red Army"). The phrase *κόκκινο φωτάκι* ("red light") is commonly used as a metonymic expression referring to prostitution or red-light districts and draws on the symbolic use of red light to indicate areas where sex work is tolerated or regulated, reflecting the color red's association with immorality and taboo in social contexts. Positive or neutral connotations also appear in collocations like *κόκκινο χαλί* ("red carpet") symbolizing an honorable welcome, and *στο κόκκινο* ("in red") used metaphorically to indicate intensity or reaching the upper limit, particularly in economic or performance contexts. The expression "red carpet", which conventionally denotes an honorable welcome or special treatment, can also acquire an ironic style, depending on the context. In such cases, the metaphor takes on a critical or sarcastic function, implying that someone is receiving exaggerated or undeserved attention. The irony emerges from the discrepancy between the literal meaning of the phrase and the actual tone or pragmatic implications of the utterance. These examples illustrate how *kókkinos* encodes affective responses and socially shared evaluations, signaling disapproval, prestige, or caution depending on the context.

Figure 3. Figurative meanings of *kókinos* ("red") in corpora

Metaphorical extensions	**Collocations**
Anger	- *kókino paní* (= *red flag)* - *égine kókinos apó ton θimó tu* (= his *face turned red with anger*) - *kókinos san astakós* (= *as red as a lobster*)
Shame	- *égine kókinos san pantzári*/*san paparúna* (= *He turned as red as beetroot/ as a poppy*)
Sorrow	- *kókini traγοδία (= red tragedy)*
Blood	- *kókinos san to éma (= as red as blood)*
Prohibition	- *kókinos simatoδótis* (= *red traffic light)* - *kókini zóni* (= *red zone, i.e. area where entry is prohibited*)
Warning	- *kókini kárta* (= *red card –for removing a player from the match*)
Threatening/Danger/Emergency	- *kókini* γramí (= *hotline - for direct or urgent communication between the governments of two countries)* - *kókinos sinaγermós* (= *red alert)* - *kókinos katáloγos* (= *red list of endangered animals*)
Defamation	- kókini *láspi* (= *red dust*)
Prostitution/Immorality	- *kókino fotáki* (= *red light in a tolerance house*)
Political ideology	- *kókinos dímarxos* (= "red" mayor) - *Kókinos Stratós* (= *Red Army*)
Honorable welcome	- *kókino xalí* (= *red carpet*)
Intensity/ The upper limit	- *sto kókino (= in red*) i *epixirísis*

In Figure 4, the term *κόκκινος* ("red") appears in the corpus in various inflected forms with a total frequency of 8,552 tokens, corresponding to 0.0885‰. The most frequently occurring form is the neuter singular κόκκινο (3,825 tokens, 0.0397‰), likely due to its use in set expressions and idioms. Other high-frequency forms include the neuter plural *κόκκινα* (1,636 tokens, 0.0169‰) and the feminine plural *κόκκινες* (860 tokens, 0.0089‰), reflecting agreement patterns in nominal phrases. The term *κόκκινοι* (nominative plural), *κόκκινων* (genitive plural) and *κόκκινους* (accusative plural) usually denotes the members of a political party/group (878 tokens). This distribution suggests that the color term is morphologically productive and appears in a wide range of syntactic environments. The prevalence of neuter forms may also reflect their frequent use in metaphorical and idiomatic expressions. Overall, the data underscores the semantic and functional versatility of *κόκκινος* in Modern Greek discourse.

Figure 4. Educational Thesaurus of Greek Texts: inflected forms of the Modern Greek adjective "κόκκινος" (“red”)

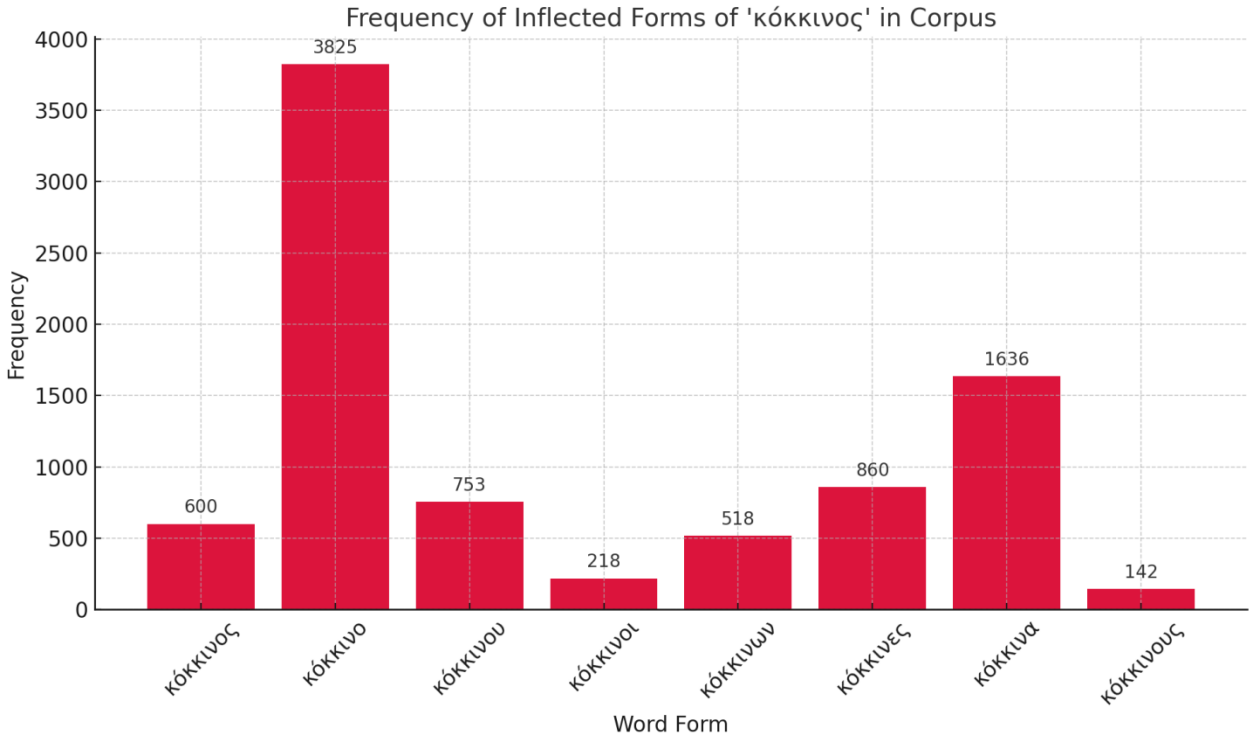
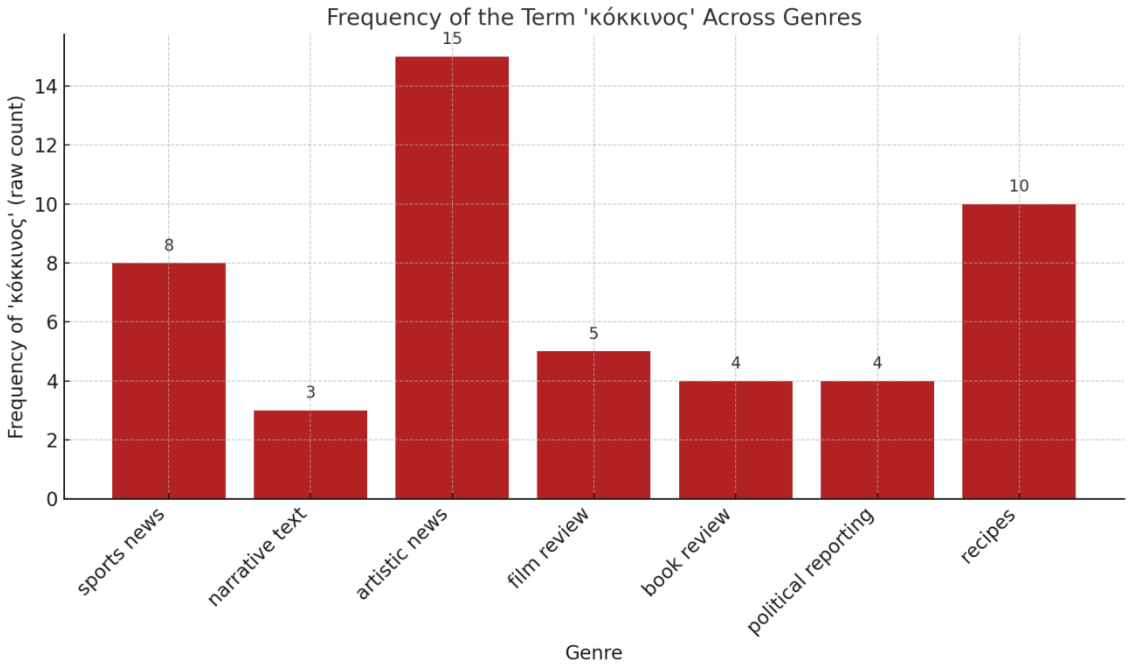


Figure 5. Frequency graph of *kókinos* ("red") in different genres (“Ta Nea” Journal)



According to Figure 5, research results show that the word *kókinos* (“red”) appears in a higher percentage in genres such as artistic news and recipes, mainly in the literal meaning of the term. In contrast, its occurrence in narrative texts, book reviews, and political reporting is relatively limited. These frequencies are presented as raw counts and reflect genre-based variation in the usage of color terminology. While artistic and culinary texts tend to use *κόκκινος* descriptively (e.g., red paint, red peppers), political and literary texts may employ the term more metaphorically or sparingly. Comparing across genres, it is evident that while culinary and artistic texts employ *kókkinos* primarily descriptively, narrative and political genres exploit its metaphorical and symbolic potential, reflecting both emotional and socio-political dimensions. This variation across genres demonstrates that kókkinos conveys context-dependent meanings, ranging from negative in political and sports settings to neutral or literal in artistic and culinary domains. In the case of appearing in sports news, it includes the players of a team whose characteristic color is red, for example *κόκκινοι* (*kókini*). Also, this term appears in phrases, such as “red cards”, and it is related to negative connotation (punishment, severe warning, rejection).

In political reporting the term *kókinos* appears to denote a political party or its supporters (i.e. communist or socialist parties) and typically functions metonymically. Its connotative charge varies with context, ranging from solidarity and leftist identity to radicalism or dissent. This reflects the broader phenomenon of color terms acquiring symbolic and evaluative meanings beyond their literal usage. Negative semantic prosody is associated with revolution, extremism, conflict, or even danger.

In narrative texts, the term *red* is frequently employed with predominantly metaphorical significance, particularly in relation to the emotional states of central characters. It commonly symbolizes intense affective experiences such as anger and fear. The color red often connotes heightened emotional arousal, encompassing not only rage and aggression but also danger and alarm. Additionally, red may evoke associations with violence and blood, further reinforcing its connection to physical and psychological intensity. Thus, within narrative

discourse, *red* functions as a powerful metaphorical device that conveys complex and visceral emotional dimensions of the protagonist. Comparing these genres, it is evident that *kókkinos* operates along a spectrum of meaning: in political reporting, it primarily conveys evaluative and symbolic associations tied to ideology and social positioning, whereas in narrative texts it functions as a vehicle for expressing intense emotional states and human experience. This demonstrates that the semantic prosody of *kókkinos* is highly context-dependent, shaped by both genre conventions and cultural knowledge.

5. Conclusions

Corpus analysis is proved to be a useful and accurate tool for linguistic research. The study results showed that the colour term *kókkinos* ("red") in Modern Greek is mainly associated with negative prosody, denoting anger, shame, prohibition, immorality and danger. In some examples it is related to politics (communism and socialism) and in other cases it metonymically denotes the members of a Greek team (*kókkini*) and it appears in the plural. Although there are expressions with a positive connotation, such as κόκκινο χαλί ("red carpet"), in a different context they may carry an ironic tone. Collocations with *red* seem to have a high degree of semantic opacity, due to the fact that the meaning of the phrase is not easily derived from the meaning of its members (i.e. *Kókinos Stratós*, *kókinos sinaγermós, égine kókinos san pantzári/san paparúna*). Statistically, as far as the genre is concerned, the term appears in artistic news and recipes that mainly express literal meaning, while when it appears in narrative texts it indicates a conceptual metaphor.

The corpus analysis of the colour term κόκκινος ("red") in Modern Greek demonstrates its high frequency and extensive morphological variation, with a total of 8,552 tokens identified across various inflected forms. The predominance of the neuter singular *κόκκινο* is indicative of its frequent appearance in noun phrases and fixed expressions. This distribution suggests that *κόκκινος* is a morphologically productive lexical item that participates in a wide range of syntactic constructions. The prevalence of neuter forms further points to their central role in metaphorical and idiomatic usage, underscoring the term's pragmatic flexibility. Also, concordances are a basic corpus-handling technique displaying the word's systematic co-occurrences in text, while co-text plays an indispensable role in the linguistic analysis providing important new insights about the word usage.

The study also showed that negative associations with *kókkinos* outnumber positive ones. However, it did not include quantitative analysis of the frequency of specific collocations, which is a limitation. Future research should include such quantitative data, expand corpora to include spoken and digital texts, and explore how the meaning of *kókkinos* may shift over time and across contexts. Ultimately, this study highlights the effectiveness of corpus-based methods in uncovering nuanced contextual and pragmatic aspects of lexical meaning, reinforcing the potential of such approaches in lexical semantic research.

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РАЗДЕЛ III. ЛИТЕРАТУРЫ НАРОДОВ МИРА
SECTION III. WORLD LITERATURES

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Interwoven blackness and whiteness: Langston Hughes' perspective on American pluralism

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Abstract. Hughes, like numerous African Americans, endured segregation, oppression, and marginalisation. In his poetry, Hughes interrogates the dire social conditions of the Black community. Hughes' poetry not only documents the widespread racism that fosters hostile environments for black people but also explores potential remedies to this issue. This study analyses the inequitable social dynamics and power relations between whites and blacks as depicted in Hughes' poetry and examines how the pluralistic politics expressed therein contribute to the improvement of social reality in America. This study attempts to investigate three specific questions: What creates America's unjust social reality? What are the pluralistic politics proposed in Hughes' poetry? And in what ways might pluralistic politics assist in enhancing the social reality in America? A dataset of 40 poems was analysed using thematic, Fairclough's, and van Dijk's critical discourse methodologies. The data analysis indicated that the inequitable reality depicted in Hughes' poetry stems directly from a white-centred ideology. Beliefs in whiteness contribute to the establishment of white supremacy and perpetuation of black inferiority. These beliefs manifest in racist actions and policies. The findings reveal that Hughes' pluralistic framework encompasses interest group pluralism, emphasising civil rights, equitable resource allocation, and equitable voting rights. This framework regards compromise as a form of negotiation. Hughes' pluralistic politics offer insights into the creation of safe spaces within a presumably pluralistic

society. This study provides a novel analysis of the power dynamics between whites and blacks as portrayed in Hughes' poetry, offering an in-depth investigation of the pluralistic ideologies expressed within it.

Keywords: Langston Hughes; Hughes' representation of whiteness; Critical race analysis in Hughes' poetry; Pluralistic ideology; Critical realism

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1. Introduction

Existing scholarly explorations of Hughes' poetry have primarily focused on the racism, racial discrimination, and oppression that blacks have suffered in the United States (e.g., Poongodi, 2012; Reddy, 2013; Nichols, 2014; Muslih, 2016; Stephane, 2017a, 2017b; Prathap and Kumaresan, 2022). The construction of whiteness and blackness, the formation of a black national identity, and Hughes' liberating sense of resistance to oppression have been the subject of several studies (Minato, 1998; Hatem, 2011; Mehta, 2011; Sharma, 2017; Mahmood and Majeed, 2019, Al-Ramahi et al., 2021; Fernández-Alonso and Barros-del Río, 2021; Prathap and Kumaresan, 2022; Almahasneh, 2024). Our study delves into Hughes' pluralistic framework, which helps address the black-white conflict in the US and the contrasting interactions between whiteness and blackness, as depicted in his poetry. Hughes' significance lies in his groundbreaking commitment to portraying the whole spectrum of African American life. By concentrating on these everyday realities, Hughes validated a crucial facet of Black reality that had been largely ignored in serious art, thus democratising the themes of the Harlem Renaissance. His discourse recurrently refers to the narrowness of safe spaces that are assumed to be black. Thus, depicting black people's lives in white supremacist culture has been central to Hughes' work (Boostrom, 1998). In his poems, Hughes questions the terrible social reality of the black community. Hughes' poetry not only chronicles the pervasive racism that creates hostile environments for black people but also delves deeply into potential solutions to this problem, offering black people hope for a better future (Holley and Steiner, 2005). The following questions were the focus of this study:

RQ1. What creates America's unjust social reality?

RQ2. What are the pluralistic politics proposed in Hughes' poetry?

RQ3. In what ways might pluralistic politics assist in enhancing the social reality in America?

This study presents a novel examination of the power dynamics between individuals from white and black racial backgrounds, as depicted in Hughes' poetry. Additionally, it offers a thorough analysis of the diverse political ideologies advocated by this body of research. This work goes beyond traditional examinations of the language surrounding racial oppression and prejudice, as it addresses the three research questions listed previously. The findings of this study may have an impact on academic discourse aimed at addressing the concepts of whiteness and blackness. This study emphasises Hughes' pluralistic framework, which addresses the unequal relationship between white and black individuals in the United States.

2. Conceptual Framework

2.1 Whiteness

Achieving whiteness is considered a form of self-actualisation that occurs in the absence of the Other (Nakayama and Krizek, 1995; Dwyer and Jones, 2000; Scott and Rodriguez Leach, 2024). Whiteness confers an advantage to individuals who are socially identified as white, which is linked to white privilege (Harris, 1993; Frankenberg, 1993; Fanon, 2008; Owen, 2007; Jungkunz, 2011).

Whites and blacks live in a racially controlled reality in which whites are taught to regard their lives as morally neutral, normative, average, and ideal (Giddens, 1984; McIntosh, 1988; Roediger, 1992). DiAngelo's (2011) concept of white fragility has helped explain whites' lack of racial stamina when confronted with whiteness on a regular basis. Furthermore, Frankenberg (1993) contends that whites not only build the world of colour and exclude coloured people but also establish whiteness as an imperceptible and unmarked norm. According to Mahoney (1997), whiteness is a dominant, transparent criterion that determines which racial features should be measured. The language of whiteness assumes Whites' claim to agency while denying others' agency (Samaj, 1981). Whiteness, with its deep relationship to race and racism (Bhabha, 1998; Ogbonnaya, 1994; Allen, 2001; Khan, 2024), aids in the maintenance of the racist system. Thus, whites' incapacity to see their whiteness contributes to the perpetuation of race and racism (Allen, 2001; Leonardo, 2009; Cole, 2009).

Despite extensive analysis of whiteness by several scholars (e.g., Fanon, 1986; Nakayama and Krizek, 1995; Efird et al., 2024), the flexibility of whiteness as a classification is more than commonly perceived (Satzewich and Liodakis, 2010). Whiteness, as defined within the paradigm of white privilege (McIntosh, 1988), refers to a collection of decisions that provide advantages to white individuals. While whiteness has traditionally been associated with the lifestyle, beliefs, and ideals of White individuals, the notion itself is widely regarded as problematic due to its inherent racism, as it perpetuates the racist system (Satzewich and Liodakis, 2010). Post-racial societies have consistently criticised and questioned the concept of whiteness and white privilege, as these concepts highlight the institutionalisation and validation of racism (Lund and Carr, 2015).

2.2 Blackness

The association of blackness with black skin has marginalised black people's identity, leading to a sense of inferiority (Fanon, 1986). According to Johnson (2003), blackness is characterised as elusive because of its ability to undergo transformation and move in a different direction. Blackness is not solely determined by skin colour but is also a social construct that is consistently defined in contrast to whiteness (Johnson, 2003; Mapedzahama and Kwansah-Aidoo, 2017; Jablonski, 2021). Since Black people have historically been mostly classified according to their biological traits, blackness is occasionally boiled down to a simple physical attribute (Gabriel, 2006; Yancy, 2008). Whiteness ideologies stereotype blackness as negative, which makes whites detest and fear blackness, justifying its exclusion (Fanon, 1986; Biko, 1996; Marriot, 2007). For some Black people, escaping the constraints of blackness has been more beneficial than remaining in the black space. However, many people feel forced to accept white values and practices. Logan (2014) contends that black people who wish to appear white should be personable, lively, helpful, pleasant, and well-spoken without appearing excessively black.

2.3 Pluralism

Pluralism denotes the presence of multiple cultures coexisting within a single civilisation. The distinctiveness of each culture is preserved. According to McLennan (1995), pluralism is a concept of being both equal and distinct. McLennan (1995) defines pluralism as the utilisation of diverse concepts and attitudes, allowing for an impartial evaluation of different options. On the other hand, Giménez (2003) sees pluralism as a fundamental characteristic of a democratic society, where there is a presence of social, political, and legal diversity. Swann (1985) highlighted the facets of pluralism. One such aspect is social harmony. Furthermore, pluralism ensures that all citizens shape society's democratic framework. The pluralist

position is that different groups should have equal access to political power so that they can pursue their own interests (Miller, 1983). Another strength of pluralism is the equitable allocation of the political power it promotes, which contributes to the idealisation of democracy (Miller, 1983).

According to Hughes, the plural society can contribute to making life safe for Black people in America. Thus, Hughes has expressed pluralistic politics in his poetry, which could help Black people feel stronger and prouder of who they are. Hughes has continued to express his pride in being Black, despite the prejudice that Black people are weak and inferior. According to Nash (2012), Hughes draws strength and inspiration from his blackness, which is evident in his deep dedication to black culture. By highlighting the importance of blackness and establishing blacks as an interest group capable of competing, Hughes' insistence on polarisation between whiteness and blackness reinforces blackness.

3. Theoretical Framework

An analytical lens grounded in Critical Discourse Analysis (CDA) was used in this study. Critical Discourse Analysis examines how social power, domination, and inequality are performed, reproduced, and resisted in texts and speeches in social and political situations (van Dijk, 2001; Fairclough, 2010). According to Young and Harrison (2004), the CDA uncovers language-encoded ideologies that justify power inequality. CDA makes naturalised ideas unnatural, allowing them to be challenged or rejected (Lazar, 2005). CDA discusses language, ideology, power, discourse, social identity, social change, and the discourse's role in creating and preserving inequality (McGregor, 2011). CDA emphasises that the persistent use of unequal representations encourages unequal social processes where authority misrepresents marginalised and vulnerable people (O'Halloran, 2001). Thus, CDA's critical analysis brings attention to discourse tactics that create, maintain, and perpetuate symmetrical power dynamics (van Dijk, 1997a).

The data from the present study were examined using Fairclough's Critical Discourse Analysis (CDA), which helped us assess the social context of Hughes' poems and illustrate the interdependence between language and ideology. Fairclough (1996) investigated the correlation between power and language in discourse, with a specific emphasis on the textual and social knowledge necessary for its creation and understanding. Discourse is involved in the creation and understanding of language since language is inherently social (Fairclough, 2001). Fairclough's Critical Discourse Analysis approach consists of three essential elements: discourse-as-text, discourse-as-discursive-practice, and discourse-as-social-practice (Blommaert and Blucaen, 2000; Simpson and Mayr, 2010). These components helped this study analyse discursive social practices related to whiteness, blackness, and pluralism. According to Fairclough (1992, 1995), the analysis of texts as a social practice exposes the existence of hegemony and ideology within them.

Hughes' poetic discourse was analysed using systematic functional grammar (SFG) of texts (Fairclough, 1995). Literary text style elements associated with ideologies of whiteness and plurality in Hughes' poetry were identified by the SFG's social context language analysis (Cunanan, 2011). Moreover, our study's critical analysis depended on the ideational functions of language patterns to help us better grasp the human experience as a means of experiencing 'reality' (Halliday, 2002). Transitivity is necessary to study how language alters people's perspectives on the world, (Halliday, 1985, 1994). Our mental representation of the universe and reality is reflected in language (Simpson, 1993; Young and Harrison, 2004). In our research, we used transitivity system analysis to compare the social experiences of Blacks and Whites. Transitivity applies to all verbally articulated phenomena, such as acts, events, consciousness processes, and relationships. Transitivity patterns reveal the author's 'mind style' (Fowler, 1986) which is

defined as any distinct language representation of one's mental self (Fowler, 1977).

Although Fairclough's CDA approach played a significant role, van Dijk's Critical Discourse Analysis was crucial for analysing the data of this study. This approach establishes a connection between cognition, text, and society, with cognition having an impact on society (Hart, 2010). According to van Dijk (1990), language plays a key role in the formation, acquisition, and alteration of social cognition, including ideological beliefs, opinions, and attitudes toward others. Van Dijk (1995) argued that discourse analysis is essentially an analysis of ideologies. He suggests that any aspect of discourse that conveys, establishes, affirms, or highlights a biassed group opinion, viewpoint, or stance, particularly within the sociopolitical context of societal conflict, should be considered. Applying van Dijk's methodology to evaluate Hughes' poetry facilitated the examination of ethnic discrimination and resistance of dominant groups (van Dijk, 2005).

4. Materials and Methods of Research

Purposive sampling was used to collect the data. This selection strategy allowed us to select examples that contained a considerable amount of information, thus enhancing our ability to answer the study questions. Data from 40 poems were meticulously studied and evaluated twice to acquire complete comprehension of their underlying meanings. We used Braun and Clarke's (2006) thematic analysis. Using this iterative method, we created and identified initial codes associated with whiteness ideas such as 'discrimination' and 'oppression.' Other codes were grouped according to their relevance to pluralistic politics, such as 'equal voting rights,' 'freedom of thought,' and 'civil rights.' Following the first coding, the resulting codes were examined to derive their comprehensive meanings.

Subsequently, we categorised the recently surfaced codes into potential themes, considering their resemblances in meaning and purpose, such as 'white supremacy,' 'black inferiority,' and 'interest group pluralism.' Subsequently, we revisited the evolving themes and subthemes to ensure that the collected poems for each theme were appropriately cohesive. The data underwent thematic mapping, allowing for identification of the portions where each theme was most prominently depicted. The current study determined that the material was encoded and organised in a natural and sequential manner. Prior to the report's production, the final themes were generated.

In addition, the critical discourse methodologies of van Dijk and Fairclough were subsequently utilised to critically analyse the codes and themes produced by the thematic analysis. This facilitated the identification of the linguistic features of Hughes' poetic discourse that encapsulate ideologies linked to identified codes and themes. The following section elucidates how Critical Discourse Analysis facilitated the interpretation of the data in this study.

We employed GPT-4o (OpenAI) to assist topic extraction and topic labeling as a part of our methodology. All analytical decisions and conclusions were the authors' own. We used wordservice.ai for English proofreading only (spelling, grammar, and stylistic edits). The service did not generate substantive content or perform analysis. No generative tool made interpretive or methodological decisions without human oversight.

5. Findings and Discussion

The research findings indicate that Hughes' poetry encompasses various themes that illustrate the concepts of whiteness, blackness, and pluralistic viewpoints. The data provide additional evidence that these themes highlight racial policies and pluralistic politics. This study employs the frameworks of van Dijk and Fairclough to analyse the discourse in Hughes' poetry, elucidating its portrayal of the intricate relationship between whiteness and blackness, along with Hughes' inclusive perspective. The analysis examines the inequitable social conditions experienced by African Americans, emphasising the theme

of racial segregation, oppression, and discrimination. The analysis also highlights Hughes' pluralistic politics, encompassing interest groups that advocate for equal voting rights, civil rights, and the distribution of resources, along with Hughes' perspective of negotiation-based compromise, which emphasises the recognition and appreciation of differences while valuing shared commonalities. Therefore, it analyses Hughes' efforts to foster a more inclusive society.

5.1 Whiteness Ideologies and the Unjust Social Reality in the United States of America

Whiteness has been emphasised in Hughes' poetry, notably its function in creating safe spaces for whites. Simultaneously, this poetry extensively depicts the threat to blackness posed by whiteness ideologies. As a result of the incompatible ideologies of both blackness and whiteness, Hughes' poetry has generated dichotomies of whiteness and blackness inside unjust social reality. It is important to note that whiteness portrays whites as a privileged ethnic group by emphasizing their superiority over blacks. Whiteness ideologies that reinforce white superiority have been shown through racist acts and policies. The 40 selected poems had a total of 72 instances where racist acts and policies were repeated. The data obtained from the 40 selected poems in Table 1 illustrate the emerging themes in whites' racist acts and policies, along with their corresponding frequencies.

Table 1. Evolving thematic points in relation to racist acts and policies portrayed in Hughes' poetry

Themes related to racist acts and policies	n	Percentage
1) Racial segregation (social-geographical)	13	18.05
2) Oppression by force (e.g., lynching)	19	26.38
3) Oppression by deprivation (e.g., dignity)	8	11.11
4) Cultural oppression (superior-sub cultures)	7	9.72
5) Racial discrimination (e.g., education)	25	34.73

The findings reveal a discrepancy in the occurrence of racist acts and policies depicted in Hughes' poetry. The predominant racist conduct and policy observed in the selected sample of Hughes' poetry was racial discrimination (Table 1). Data analysis revealed a recurring theme of racial discrimination, accounting for approximately 34.73% of the dataset. The prevalence of racial discrimination in the 40 poems indicates that Hughes aims to illustrate the dominance of white individuals, while also highlighting the detrimental impact of racial discrimination on black individuals. Hughes' poetry exhibits racial discrimination more frequently than oppression by force, which is a racist act and policy. This constituted nearly 26.38% of the sample, as shown in Table 1.

Racial segregation was less prevalent in the sample selected than in instances of racial discrimination and oppression through coercion. This constituted approximately 18.05% of the sample (Table 1). This finding suggests that Hughes' main concerns revolved around racial discrimination and the use of force to oppress the people. This highlights the contradictory link between whiteness and blackness, as both racist acts and policies involve a significant level of violence (van Dijk, 2001). The selected poems exhibited a limited recurrence of themes related to the oppression caused by deprivation and cultural subjugation. The prevalence of oppression by deprivation was 11.11% in all instances, while cultural oppression accounted for 9.72% (see Table 1). We argue that these two themes are

only sporadically reiterated, since Hughes primarily concentrates on the perpetration of violence against black individuals, which serves to perpetuate the dominance of whites and engenders an unfair world. The following sub sections address themes related to racist acts and policies against Black people. As part of the theme presentation, five extracts from the current study's sample were covered, which were examined using Critical Discourse Analysis by Fairclough and van Dijk.

5.1.1 Racial Segregation

Hughes' poetry mostly focuses on depicting the hardships faced by black individuals and has extensively addressed the problem of racial segregation. Hughes portrays bleak images of black individuals residing in segregated neighborhoods in his poems. The selected instances were thoroughly analysed to enhance the conversation regarding this problem. Extract 5.1 from Hughes' poem *Air Raid over Harlem* highlights racial divisions. Segregation is achieved by isolating-coloured individuals in Harlem.

Extract 5.1

1 Harlem, that's where I live!
2 Look at my streets
3 Full of black and brown and
4 Yellow and high-yellow
5 Jokers like me.
(Hughes, 1994, p.185)

The analysis of polarisation in Extract 5.1 contributes to highlighting the segregation of coloured people. According to van Dijk's (1998) ideological square, the polarisation of inter-group discourse occurs through Us against the Them dichotomy. Hughes' reference to all coloured people in Harlem, including himself (lines 1-4), polarises the inter-group relationship. Inter-group polarisation is also accompanied by the presentation of the group's positive aspects. To clarify, Hughes' allusion to colourful individuals living in a crowded location (lines 3-4) implies that those people can coexist. Hughes' exclusion of white is ideologically motivated, as demonstrated in Extract 5.1. This exclusion reflects the sociological reality that groups coloured people together in this small area and separated them from whites. According to Willhelm (1970), these ghettoised communities have marginalised coloured people. More crucially, the final phrase of this extract emphasises the terrible other by referring to the other's unfavourable attitudes that have caused those coloured folks to become Jokers (line 5). It is possible to argue that whites' racial policies, which isolate coloured people, are the root cause of their misery. In this sense, Hughes' depiction of coloured people as clowns (line 5) implies that Whites regard them as inferiors, and hence racial regulations prevent whites from socialising with such inferiors.

5.1.2 Racial Discrimination

Extract 5.2 from Hughes' poem *The Backlash Blues* highlights how white ideologies restrict life prospects for black individuals, emphasising the issue of racial discrimination. Hughes highlights how several aspects of black life have been significantly impacted by the ideologies of whiteness in this extract. These ideologies have contributed significantly to racist policies that benefit whites. Racist policies have had a significant impact on the economy, housing, and education of black individuals.

Extract 5.2

1 You raise my taxes, freeze my wages,
2 Send my son to Vietnam.
3 You give me second-class houses,
4 Give me second-class schools,
(Hughes, 1994: 552)

Studying the pattern of transitivity in this extract reveals unequal power dynamics resulting from institutional racist practices strongly backed by white supremacist ideologies. Stylistically, the dominance of Whites is mainly achieved through the frequent use of material process verbs like 'freeze' (line 1), 'send' (line 2), and 'give' (lines 3-4) in this extract. The verbs in question are commonly linked with the out-group pronoun 'you' in lines 1 and 3, which specifically pertain to Whites. The verbs (e.g., raise-line 1 and send-line 2) demonstrate the

significant level of agency of Whites. Whiteness has enabled white individuals to develop agency, thereby enhancing their power. The examination of 'lexicalisation' (Fairclough, 1989) in this extract shows the negative impact of Whites' actions on blacks. The derogatory words associated with black people indicate their socioeconomic status, such as 'second-class residences' (line 3) and 'second-class schools' (line 4). These words also demonstrate the devaluation of blackness, which has significantly affected the perceptions of black individuals in American society. This sample highlights how whites institutionalise the inferiority of black individuals by impacting their quality of life. This has significantly contributed to the creation of unsafe environments for black individuals. Pinderhughes (1989) agrees that institutional racism impacts the opportunities, lifestyles, and quality of life for both white individuals and people of colour.

5.1.3 Oppression by Force

Hughes' poetry describes numerous forms of forceful oppression, including lynching, gunshots, biased laws, police brutality against blacks, hard labour, and humiliation. Hughes' poetry accurately illustrates the tyranny by force that Blacks have suffered in America, since he is deeply concerned with communicating the suffering they have endured in an unjust reality.

Extract 5.3 from Hughes' poem *Always the Same* depicts the horrific realities that Blacks have had because of a social reality controlled by whiteness beliefs. As a result, this extract provides significant evidence of Whites' contribution to the creation of hazardous settings in which blacks are endangered because of their blackness.

Extract 5.3

1 Black:

2 Exploited, beaten and robbed,

3 Shot and killed.

(Hughes, 1994: 165)

Analysis of the 'pattern of transitivity' (Fairclough, 1989) can assist in exposing the extract's gloomy impression of blackness. In this extract, the passivized verbs of the material process used in the phrases reflect Black and White roles in the social order. Because the passivized structure may be related to ideological text (Fairclough, 1992), agency could be a significant attribute stated in this extract. In these phrases, Black is portrayed as agentless and is impacted by acts (lines 2-3). According to Karp (1986), an agent utilises power to achieve a specific result. The extract constructs power relations using passivized structures, confirming blacks' lack of power. It is possible that the construction of blacks as agentless stems from both their blackness and whiteness ideologies. Those Blacks, who were seen as being agentless, were threatened. Furthermore, the technical chains (Fairclough, 2006) of passivized EN participle verbs exploited, beaten, robbed (line 2), shot, and slain (line 3) highlight Blacks' weaknesses and the many methods used by Whites to subdue those Blacks. The finding that blacks are perceived as agentless in comparison to agent whites supports Logan (2014), who argues that there is no meaning of blackness in the United States without an implicit connection to whiteness. In Extract 5.3, the continuous use of passivized language structures to convey blacks' experiences demonstrates how whiteness beliefs have had a significant impact on the formation of agent and agentless ethnic groupings. Consequently, passive constructs in Hughes' language play a stylistic role in representing power relations in social reality.

5.1.4 Cultural Oppression

Hughes' poetry centres on culture due to the impact of cultural oppression on Black identity. Cultural oppression refers to the unequal recognition of ethnic groups' traditions within a common geographical area (Hanna et al., 2000). Dominant groups establish and formalise their superior culture among various ethnic groups to retain power. Hughes may be alert because this type of persecution has become ingrained and inherent in black life. Extract 5.4 from Hughes' poem *Poem [1]* shows his apprehension of the ultimate European

American civilisation, which is said to be the wellspring of universal principles.

Extract 5.4

1 All the tom-toms of the jungles beat in my blood,
2 And all the wild hot moons of the jungles shine in my
3 soul.
4 I am afraid of this civilization —
5 So hard,
6 So strong,
7 So cold.
(Hughes, 1994: 32)

Van Dijk's (1998) ideological square can show Hughes' 'positive self-presentation' and 'negative other presentation' in Extract 5.4's discursive ideas about cultural oppression. Hughes depicted Black self-identity using traditional African scenery (e.g., jungle tom-toms-line 1 and wild hot moons-line 2). Hughes compares the African cultural heritages that beat in my blood (line 1) and shine in my soul (line 2) to the American cultural scene that is so hard, strong, and cold (lines 5-7) to show his pride in his cultural legacy and his concerns about dominant American culture (lines 4-7). Hughes uses severely negative terms (e.g., hard-line 5 and cold-line 7) to highlight Whites' civilisation's negativity, reinforcing his deep connection to his African culture, which runs in his blood (line 1) and soul (line 3). We argue that Hughes' comparative impression of African culture's warmth and American civilization's coldness is an immediate consequence of his anxiety over Blacks' involvement in such a hard and strong (lines 5-6) society. Hughes believed that Blacks would be quickly civilised and cold by the dominating American culture since they had lost their African culture.

5.1.5 Oppression by Deprivation

Hughes' poetry depicts the oppression that black people face daily because of deprivation, including a lack of respect, dignity, and necessities. The rejection of Black people's fundamental rights is a key theme in Hughes' poetry, which shows how White racial policies perpetuate the Black people's inferiority complex and white supremacy. Extract 5.5 from Hughes' poem *Porter* demonstrates his reverence for the Black people's inherent worth.

Extract 5.5

1 I must say
2 Yes, sir,
3 To you all the time.
4 Yes, sir!
5 Yes, sir!
6 All my days
7 Climbing up a great big mountain
8 Of yes, sirs!
(Hughes, 1994: 116)

Examining the power dynamics in Extract 5.5 demonstrates the impact of Whites' power on Black self-esteem. The authority of whites can be exposed using Fairclough's (1989) transitivity pattern in the power relations analysis of the extract. The deontic modal auxiliary 'must' (line 1) is used only once, yet it creates the impression of the Blacks' duty throughout the clause (lines 1-3). Simpson (1993) defined deontic modality as a speaker's attitude toward the level of obligation associated with performing specific actions. Consequently, blacks must address whites as sirs (line 8) because they are in positions of authority. Blacks' devotion to this language behaviour displays their lack of agency while demonstrating Whites' authority. As the discourse reflects the social structure, the recurrence of 'Yes, sir!' (lines 2, 4, 5, and 8) reveals the high level of devotion that blacks are expected to demonstrate toward authoritative whites.

5.2 A More Equitable Social Reality in the United States—the Pluralistic Politics Advocated in Hughes' Poetry

Hughes' poetry helps address Black people's conflicting relations with the Whites by creating a pluralistic worldview. Redistributing power among all ethnic groups within one society is the basis of the pluralistic framework proposed in his poems to improve the prejudiced reality. Doing so would keep these groups on equal grounds, which would pave the way for a world in which everyone has a voice and can pursue

their passions. Hughes' pluralistic perspectives are supported by two pillars. One is the pluralism of interest groups, which advocates equal voting rights, civil rights, and resource distribution. Regarding Hughes' pluralistic perspective, the second pillar is negotiation-based compromise, which emphasises recognising and appreciating differences while valuing commonalities. Among the 40 poems chosen, there were 34 instances of pluralistic politics. The data derived from the 40 poems in Table 2 show the rising themes and frequency of Hughes' pluralistic politics.

Table 2. Evolving thematic points in relation to pluralistic politics portrayed in Hughes' poetry

Themes related to pluralistic politics	n	Percentage
1) Civil rights	8	23.53
2) Equal resource distribution	11	32.35
3) Equal voting rights	6	17.65
4) Valuing commonalities and respecting differences	9	26.47

According to the data presented in Table 2, the most common form of pluralistic politics is equal resource distribution, accounting for 32.35% of the total number of instances. The likely explanation for this relatively high percentage is that Hughes appears to be cognizant of the situation that blacks face, which is a lack of resources that causes vulnerability. The following are the valuing commonalities and respecting differences, which together accounted for 26.47% of the total. Hughes' belief that African culture is equivalent to white culture may explain the high prevalence of this pluralistic perspective. The data presented in Table 2 demonstrates that the occurrence of civil rights was also significant, accounting for 23.53% of the total occurrences. Equal voting rights are pluralistic politics that occur the least frequently, accounting for 17.65% of all instances. Voting is extremely important; nevertheless, other pluralistic politics are prioritised in terms of frequency since they meet basic needs. The following subsections discuss topics related to pluralistic politics. Four extracts from the study's sample were analysed using Critical Discourse Analysis by Fairclough and van Dijk as part of the theme presentation.

5.2.1 Equal Resource Distribution

Hughes' deep concern about the distribution of power in American society manifested itself in his poetry. Extract 5.6, from Hughes' poem *To Captain Mulzac*, highlights the unequal allocation of resources between Blacks and Whites, which is a direct result of unfair power distribution.

Extract 5.6

1 Formerly the beaten and the poor

2 Who did not own

3 The things they made, nor their own lives—

4 But stood, individual and alone,

5 Without power—

(Hughes, 1994: 293)

Hughes, as indicated in this extract, has pointed to the conflict of interest that has occurred between Blacks and Whites, resulting in Whites, the powerful group, controlling resources while other powerless groups are unable to protect their interests. This pluralistic discourse, which incorporates the argument over conflicts of interest among diverse groups within one society, is consistent with van Dijk (1987), who states that groups live safely when they have access to resources; however, when access is threatened, they engage in disputes. Similarly, the extract highlights blacks' lack of agency,

which has allowed the dominant group, Whites, to monopolise resources.

Agency was evaluated by studying the chains of negative lexicalisation (Fairclough, 2006) associated with blacks in this extract. These negative lexical chains contain nouns (e.g., the beaten and the poor-line 1). The chains also comprised adjectives (e.g., individual and alone-line 4). They also include negated structures with not (e.g., did not own-line 2, nor their own lives-line 3, or without power- line 5). Ideologically, the extensive usage of chains of negated lexicalisation to describe Black people demonstrates their lack of agency because of American society's unequal power distribution. As a result, their lack of autonomy jeopardises their personal security and assets (line 3). We suggest that Hughes' recommendation to reconsider power allocation among competing parties stems from his reference to the consequences of such unequal power distribution (lines 2-4). Notably, resource allocation is significantly affected by an unequal power distribution.

5.2.2 Civil Rights

Hughes' pluralistic perspective includes liberal democracy, which protects the civil rights of all groups regardless of their ethnic backgrounds. This ensures the involvement of all ethnic groups in every element of life. Sniderman et al. (1996) stressed the need to grant all individuals equal rights, such as freedom of thought, personal security, and property protection. Extract 5.7 from Hughes' poem *Beaumont to Detroit: 1943* highlights the exclusion of Black individuals from the democratic realm. Simply put, black individuals are denied equality, resulting in their inability to compete with other groups and acquire civil rights.

Extract 5.7

1 Yet you say we're fighting
2 For democracy.
3 Then why don't democracy
4 Include me?
(Hughes, 1994: 281)

Applying the discursive approach of polarisation (van Dijk, 1997b) to analyse Extract 5.7 demonstrates how Blacks are portrayed as victims since they are unable to protect their political interests. Thus, they have been denied the opportunity to acquire civil rights that would have enabled them to become a powerful group (lines 3-4). Whites are shown negatively for bringing blacks to fight to further their own interests, as indicated in the passage (line 1). Upon returning to America after the war, black individuals encountered a stark truth of inequity. Whites' assurances to black soldiers that they would achieve freedom and have common goals after the war were not fulfilled. The Black persona, portrayed as a victim, criticises the democracy of Whites that excludes them. Extract 5.7 highlights Hughes' pluralistic perspective as the most effective way to safeguard Black civil rights.

5.2.3 Equal Voting Rights

Hughes' poetry offers perspectives on how to confront white supremacist beliefs. Hughes, a pluralist, sees pluralism as an action in his poetry, emphasising the political rights that black people have been denied because of white ideas and racial practices. Extract 5.8 from Hughes' poem *Ballad of Sam Solomon* emphasises the Black community's desire to obtain their democratic right to vote.

Extract 5.8

1 Negroes never voted but
2 Sam said, It's time to go
3 To the polls election day
4 And make your choice known
5 Cause the vote is not restricted
6 To white folks alone.
(Hughes, 1994: 295)

Hughes expresses the concept of liberal democracy in this extract, which grants all diverse groups equal rights to participate in the entire political process, including voting. Pluralism is a democratic approach which ensures that various groups freely express their viewpoints (Longley and Kiberd, 2001). Extract 5.8 illustrates the black community's fight for voting rights and the white community's efforts to prevent them from participating in the political process by denying them the right to vote. Whiteness

glorifies and excludes others, allowing White people to wield political power and achieve dominance.

Applying van Dijk's actor description (van Dijk, 1997b) to this extract, the demonstration of shared authority among agents (Dahl, 1956) can be realised. The portrayal of social actors in the extract highlights the favorability of in-group and the unfavourability of out-group identifications. Blacks are depicted in this extract as actively working to safeguard their interests (lines 2-4), while whites are portrayed unfavourably for imposing limits on other groups, such as limiting voting rights to white individuals only (lines 5-6). The method of actor description in ideological stylistics reveals the ideological battle between Blacks and Whites in both poetic discourse and social reality. The power construction process is controlled by opposing interests, leading whites to continuously strive to influence resources, such as the voting rights of other groups. Whiteness is attained by excluding black individuals and depriving them of civil rights. Hughes challenges the social reality governed by white beliefs to transform it (lines 5-6). Hughes' poetry helps establish safe environments for black individuals by examining the elements of a societal structure that favours white people.

5.2.4 Valuing Commonalities and Respecting Differences

Hughes emphasised the importance of highlighting shared values among different ethnic groups in American society to encourage mutual acceptance. Extract 5.9 from Hughes' poem *America* exemplifies Hughes' idea of creating a diversified society in which power is equally shared among different ethnic groups. The plural sense in this extract implies harmonious connections among all ethnic groups in a plural society. Building diversity in America helps maintain shared characteristics and distinctions among many ethnic groups, leading to the development of a thriving American society.

Extract 5.9

1 You and I,
2 You of the blue eyes
3 And the blond hair,
4 I of the dark eyes
5 And the crinkly hair.
6 You and I
7 Offering hands
8 Being brothers,
9 Being one,
10 Being America.
(Hughes, 1994: 52)

Hughes' depiction of diversity in America is evident in this extract. Hughes portrays a pluralistic America in which black and white individuals have close ties, live as equals, and work together for the country's success. Blackness and whiteness are equally important in plural societies. Utilising van Dijk's (1998) ideological square, the examination of the polarised structure, in lines 1 and 6 of You and I, shows that both Black and White are portrayed favourably. The positive nature of this polarised structure (lines 1 and 6) reflects Hughes' ideological position in diverse America in terms of style. The main theme of this extract is the increasing rationality expected to develop because of the equal possibilities provided to both Black and White individuals in the suggested democratic plural American society (lines 6-10). In this society, power is evenly dispersed among all ethnic groups, ensuring that blacks are no longer under risk. This extract illustrates a utopian society that creates secure environments for all ethnic groups, eliminating any potential for opposing interests.

7. Conclusion

This study examined 40 Langston Hughes' poems from the perspectives of van Dijk and Fairclough to find a challenging relationship between whites and blacks in the United States, as well as Hughes' pluralistic perspectives as suggested in his poetry. The findings of this study imply that the unjust reality in American culture is a direct effect of white-centered ideology. Whiteness notions contribute to the establishment of white supremacy and perpetuation of black inferiority. Our findings suggest that the

inequitable reality portrayed in Hughes' poetry stems from whites' racist actions against blacks, encompassing racial segregation, coercive oppression, deprivation, cultural subjugation, and racial discrimination. The data indicate that Hughes' pluralistic paradigm encompasses interest group pluralism, emphasising civil rights, equitable resource distribution, and equal voting rights. This framework perceives compromise as a type of negotiation. Hughes' pluralistic politics offer explanations for the establishment of safe zones within a seemingly pluralistic society. This study contributes novel insights into the existing body of research on Hughes' depictions of social reality and pluralistic viewpoints. We aim to demonstrate how Hughes' poetry encapsulates the social dynamics of competing whiteness and blackness, along with his pluralistic suggestions for enhancing reality, thereby contributing to an expanding corpus of knowledge.

However, this study had a few limitations. The study included a limited sample of 40 poems. Given the qualitative nature of this study, we prioritised selecting examples with significant information for comprehensive analysis rather than emphasising data quantity. Another limitation was the narrow scope of issues, encompassing racist actions and pluralistic politics. This study prompts a reevaluation of Hughes' political ideologies and the contentious dynamics between whiteness and blackness in America. Future research may enhance the existing knowledge on this issue by exploring intrinsic political ideologies within poetry. Potential avenues for additional research involve analysing this context and considering emerging ideologies concerning whiteness.

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Appendix. 40 purposively selected Hughes' poems

Air Raid over Harlem	Imagine	Ballad of Walter White	America
Little Song on Housing	Porter	Song of the Refugee Road	Dream of Freedom
Go Slow	Freedom Train	The Bitter River	The Mitchell Case
Silhouette	The Backlash Blues	Seven Moments of Love	The Kids in School with Me
Always the Same	Vagabonds	Circles	We're All in the Telephone Book
One-Way Ticket	Bible Belt	Beggar Boy	Ballad of Sam Solomon
Who but the Lord?	Argument [2]	Beaumont to Detroit: 1943	Dear Mr. President,
Blue Bayou	Flight	Listen Here Blues	Beaumont to Detroit
Poem [1]	Memo to Non-White Peoples	To Captain Mulzac	Abe Lincoln
A Ballad of Negro History	Migration	Black Workers	Sailor

STATEMENT. *We employed GPT-4o (OpenAI) to assist topic extraction and topic labeling as a part of our methodology. The roles of these tools are reported here and reflected in the Methods; all analytical decisions and conclusions are the* authors' *own. We used wordservice.ai for English proofreading only (spelling, grammar, and stylistic edits). The service did not generate substantive content or perform analysis. No generative tool made interpretive or methodological decisions without human oversight, and no confidential or personally identifiable data were provided to third-party services. The authors take full responsibility for the content of the publication.*

The authors have read and approved the final manuscript.

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