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Is Transitivity Register-specific? A Corpus Exploration of Online Science News

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Abstract

This paper deals with parsing and exploring transitivity in ten online science news articles in one of the leading national broadsheets in the Philippines. The corpus analysis used two software applications: AntConc and UAM Corpus. Specifically, this study compared the transitivity features of ten online science news with the transitivity features of non-science-based registers. The transitivity analysis of the science-based and the non-science-based registers has resulted in identifying and classifying the underlying semantic roles of Participants, Process types, and Circumstances. Identifying the semantic features across the registers has resulted in identifying the prominent and foregrounded features of transitivity in the corpus. This study reiterates that foregrounding is crucial in stylistic analysis of texts. The analysis has established that while the non-science-based registers use the six Process types, the science-based registers primarily use the Material and the Relational Process types. This disproportionate occurrence of the Process types, especially the non-use of the Behavioral process types, strongly corroborates the notion that transitivity is register-specific. The present study supports a systemic and functional stance that considers language a network of choices applicable across varied genres and registers. Also, this study recommends the use of software applications in language pedagogy. Finally, the findings may also facilitate teaching L2 academic writing and producing science-based materials.

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Introduction

Engaging second language (L2) students with the intricacies of academic and scientific writing is challenging for teachers and students. Moreover, L2 learners encounter many challenges in mastering the nuanced intricacies of academic discourse within their secondary language, particularly when navigating the complexity of a science-based register. Llamas, Mullany, and Stockwell (2007, p. 227) define register as the "combination of lexico-grammatical choices appropriate to the social setting and context,"

which in Systemic Functional Grammar (SFG) "can be described by field, tenor, and mode." Register pertains to "the language associated with particular contexts" (Holmes, 2018, p. 257). Considering the various features of language within a social spectrum, a framework for language analysis and language pedagogy is crucial, and in validating both the embedded and foregrounded features in the science-based register, the need for a framework that takes language as a network of options is paramount.

Halliday's SFG (1985, 1994a, 1994b, 2004, 2014, 2017) offers a comprehensive model for exploring how language is a resource for different functions across text types and contexts as a network of choices for negotiating meaning in a communicative situation and various fields like critical discourse analysis, education, language teaching, and linguistics; a grammatical model that highlights metafunctions, genre, and register. These concepts are needed to understand how language works "to construe reality and transform experience into meaning" (Halliday, 2004, p. vii). Exploring the transitivity system requires Process type, Participant, and Circumstance. Halliday and Martin (1993, p. 74) refer to transitivity as the "explicit textual and logical interconnections" in a text.

In SFG, the clause assumes a pivotal role as the fundamental unit of analysis, encompassing three distinct levels of realization: Mood, Tenor, and Field. Mood pertains to the clause as a message, representing the textual metafunction, while Tenor embodies the clause as an exchange, encompassing the interpersonal metafunction. Last among the three, Field encapsulates the clause as a representation or ideational metafunction.

In SFG, these metafunctions are simultaneous representations of the modes of meaning. Using this sentence as an illustration, *the rate of glass crack growth depends on the magnitude of the applied stress* (Halliday, 2004, p. vii), the simultaneous operation of the three metafunctions, as shown in Table 1.

Table 1. A trinocular perspective in using the three metafunctions

Metafunction	The rate of glass crack growth	depends		on the magnitude of the applied stress.
Textual	Topical Theme	Rheme		
Interpersonal	Subject	(present) Finite	Depend Predicator	Adjunct
	Mood		Residue	
Ideational	Participant	Attributive Relational Process		Contingency Circumstantial

Also, SFG illustrates how clause structures express the ideational, interpersonal, and textual strands of meaning. Specifically, the ideational meanings encompass experiential and logical components, with the transitivity system's experiential meaning (Eggins, 2004; Halliday, 1994).

The transitivity system comprising Process Type, Participant, and Circumstance offers insights into the representation of experiences in language that Table 1 illustrates.

The interface of linguistics and computer science has engendered a notable surge in research initiatives characterized by their remarkable vibrancy and groundbreaking nature. Integral in the dynamism of research in applied linguistics and the language of science is corpus analysis. As a tool, corpus analysis enables language researchers to examine large-scale empirical linguistic data by unpacking varied language features, patterns, and statistical regularities to understand scientific discourses for interdisciplinary collaboration.

Table 2. The Synthesis of Process Types and Participants within the Transitivity System Network (Downing & Locke, 1992)

Process Type	Meaning	Roles of Participants
Relational (Rel)	Relationships	Carrier, Possessor, Circumstantial, Identified, and Identifier
Verbal (Ver)	Verbal Communication	Sayer, Verbiage, and Target
Mental (Men)	Cognition and Perception	Senser and Phenomenon
Behavioral (Beh)	Behaviors	Behaver
Material Mat)	Actions and Events	Actor, Patient, and Goal
Existential (Exi)	Existence	Existent

In SFG (Halliday, 1994a), transitivity in its literary sense refers to how language enacts actions, processes, and events that allow the analysis of how Participants enact within a text and how their actions shape the narrative. Subsequent publications attest to the wide-range applicability of transitivity as a tool for analyzing varied texts, genres, and registers: advertisement (Ayoola, 2015), editorial (Vinchristo, 2022), gender sensitivity (Yang & Han, 2022), media literacy (Smith et al., 2020), novel (Alaei & Ahangari, 2016; Sloan, 2004), poem (Isti'anah et al., 2020), short story (Ammara & Anjum, 2019; Cunanan, 2011 & 2019; Wang, 2019), science article (Johnson et al., 2022), and speech (Mushtaq et al., 2020). Further, SFG enables the analysis of various text types, such as academic, literary, medical, scientific, and technical.

Frameworks like the SFG are relevant in a country gaining momentum in research and publication. The Philippine academic community exhibits animated research interests, particularly in applied linguistics. In this regard, analyzing scientific discourses emphasizing transitivity is a point of departure for scholarly investigation. Given this view, the present study explores transitivity in ten online science news articles published in the Manila Bulletin from June 14, 2022, to February 3, 2023.

This study aims to answer how transitivity analysis compares the salient features of language in science-based and non-science-based registers. Specifically, it answers the following questions: (1) What prevailing patterns emerge within the corpus of the study concerning the three metafunctions? (2) What distinct transitivity features characterize the Participant type, Process, and Circumstance? (3) What distinctive transitivity features differentiate science-based registers from non-science-based registers?

Methodology

In exploring the transitivity features of the corpus of ten science news and non-science registers, this study used the Universidad Autonoma de Madrid Corpus Tool (UAMCT, version 6.2) and the AntConc software (version 4.2).

Wang and Liu (2022, p. 218) believe that aside from being "attractive," AUMCT is known for "its authority, accessibility, operability, and versatile functions." Developed in 2008 by computational linguist Mick O'Donnell, AUMCT "allows manual and automatic annotation of collections of text at several linguistic layers" (Wang & Yu, 2022, p. 352).

AntConc is helpful for annotating, searching, retrieving, statistical analysis, and visualization. Munalim and Gonong (2019) used AntConc to analyze the use of active and passive voices in the written compositions of Filipino students. Wang and Yu (2022, p. 355) have found that UAMCT has been "widely used in Systemic Functional Linguistics and its new development". On the one hand, UAMCT (O'Donnell, 2008, p. 1434) "allows the user to define any number of layers, and to provide hierarchically organized tagging scheme for each layer, using a graphical tool." On the other hand, AntConc is also a widely used software program for corpus analysis that facilitates linguists and researchers working with textual data, concordance, keyword analysis, collocation study, and frequency analysis.

The present study used a corpus of ten science news articles as the primary source for transitivity. Table 3 shows that the corpus constitutes online materials from one of the most widely read Philippine national dailies. For a century, the Manila Bulletin has provided information through responsible journalism to a wide readership both in print and online platforms. This national broadsheet caters to the needs of its subscribers in different fields like business, commerce, culture, education, entertainment, livelihood, public service and information, science and technology, and world events. Using ten randomly selected online science news from 2022 to 2023 as a corpus of this study illustrates the importance of exploring authentic materials in science pedagogy, especially in teaching L2 writing. The random selection of genres in corpus linguistics is consistent with the stance of McEnery and Hardie (2012). Also, using authentic texts provides the students with real-world concepts in science and technology that may encourage them to see the connection between the classroom environment and the world where they live. Further, using authentic science-based materials exposes the students to the register in developing literacy and language skills. Using a science-based register for the corpus illustrates how the functional notion of language can contribute to developing higher-order-thinking skills crucial to understanding the natural world.

Table 3. The Corpus of the Study

Text No.	Title of the science news	Online source
Text 1.	Everything, everywhere, all in 2023	Vivas, 2023, January 9
Text 2.	Webb Telescope: What will scientists learn?	Agence France-Presse, 2022, Aug 3
Text 3	Scientists find 2-million-year-old DNA in Greenland	Agence France-Presse, 2022, Dec 8
Text 4	Early human ancestors were one million years older than thought	Agence France-Presse, 2022, June 29
Text 5	Webb telescope captures colourful Cartwheel Galaxy	Agence France-Presse, 2022, Aug 3
Text 6	Milky Way's Secrets Revealed by Massive Space Probe Map	Agence France-Presse, 2022 June 14
Text 7	Scientists develop direct hydrogen-from-air tech	Xinhua, 2022 September 10
Text 8	World's largest bacteria discovered in Guadeloupe	Agence France-Presse, 2022 June 24
Text 9	How sustainable is research and science in the Philippines?	Salvana, 2023 February 3
Text 10	Chinese scientists discover new lunar mineral	Xinhua, 2022 September 10

Results and Discussion

Using the UAMCT 6.2 software, transitivity analysis was completed as the first layer in annotating the six Process types. Software applications facilitate analyzing the network of choices in SFG.

Critical analysis of various registers using software applications is crucial in exploring syntactic and semantic features of a language with greater efficacy, accuracy, and consistency. Also, the process facilitates and expedites visual presentation and quantitative analysis that provides a cross-disciplinary approach in areas where meaning-making potential is crucial. One feature of language analysis and information technology is the capacity to unearth rhetorical patterns objectively. This feature of corpus analysis lends itself to the scientific investigation of different registers and genres. Also, it can isolate bias, trends, and anomalies in texts.

The use of UAMCT 6.2 completed the first layer of annotating transitivity. Using software applications facilitates the analysis of the network of choices in SFG. In critical analysis of various registers, software applications are vital in exploring syntactic and semantic features of a language with greater efficacy, accuracy, and consistency. Also, the process facilitates and expedites visual presentation and quantitative analysis that provides a cross-disciplinary approach in areas in which the meaning-making potential of language is essential.

One interface of language analysis and information technology is the capacity to unearth rhetorical patterns objectively. This feature of corpus analysis lends itself to the scientific investigation of different registers and genres. Also, bias, trends, and anomalies in texts are isolated easily when presenting the features of the text to create space for exploring connections between the features of language in various socio-cultural and cognitive contexts.

The ideational metafunction and its three components of realization: Participant, Process type, and Circumstance. It presents the coding schemes of transitivity of the corpus using UAMCT 6.2 (O'Donnell, 2008). The ideational metafunction captures the transitivity system in which the semantic roles of nominal Participants relate to their corresponding six Process Types: Material, Mental, Verbal, Relational, Behavioral, and Existential. The six processes are comprised of primary and secondary types. For the primary types, the Material Process deals with 'actions happening at the physical realm' where the Participants are the actor and goal/object, respectively.

Also, the Mental Process concerns 'feeling,' 'seeing,' 'sensing,' 'thinking,' and 'wanting,' in which the participants are senser and phenomenon, respectively. In addition, the Relational Process deals with 'being,' 'attributing,' and 'identifying' in which the Participants are attribute, carrier, identified, identifier, token, or value.

For the secondary types, the Verbal Process deals with *saying* in which the Participants are sayer, target, and verbiage. Also, the Behavioral Process concerns 'behaving', in which the sole Participant is a behaver. The last type, the Existential process, concerns the occurrence or presence of an entity that identifies with *be, come, go,* and *stay* with a participant known as existent. AntConc 4.2 and UAMCT 6.2 software applications facilitated the processing of the corpus, especially the Process types and roles of the Participants.

1. The Prevailing Patterns of the Three Metafunctions in the Corpus

Table 3 shows the efficacy of UAMCT 6.2 in parsing the language features of the corpora with the three components: 817 Participants (42.5%), 573 Process types (29.8%), and 532 Circumstances (27.7%). Table 3 shows the six Process types, with the two first most frequent being 336 Material Processes (58.8%) and 100 Relational Processes (17.5%). Material Process types are 223 Monotransitives (66.4%), 78 Intransitives (23.2%), 26 Ergatives (7.7%), and 9 Ditransitives (2.7%). Further, the Mental Processes there are 42 Mental-active (64.6%) and 23 Mental-passive (35.4%). For Verbal Processes, 58 are Verbal-active (98.3%) and one Verbal-passive (1.7%).

With the Relational Processes, 82 are Attributive (84.5%), 15 are Possessive (15.5%). The software does not code three processes.

These findings demonstrate the vigor of UAMCT 6.2 by elaborating the embedded elements of transitivity in the science-based corpora, facilitating the analysis and interpretation of the nuances in enhancing science pedagogy. Halliday and Martin (1993) have underscored that the features of the language of science enable theoretical concepts comprehensibly to facilitate learning and make it more interesting, engaging, and rewarding. Moreover, if the medium of instruction is clear and accessible to the learners, scientific concepts last for a deeper understanding.

Table 3. Summary Distribution of the Lexical Patterns of the Ideational Features of the Corpus using UAMCT 6.2

GRAMMATICAL-RANK	N	%
Participant	817	42.5
Process	573	29.8
Circumstance	532	27.7
TOTAL	1922	100
PROCESS TYPE	**N**	**%**
Material	336	58.6
Mental	65	11.3
Verbal	59	10.3
Relational	100	17.5
Behavioral	0	0.0
Existential	13	2.3
TOTAL	573	100.0
MATERIAL-TYPE	**N**	**%**
Intransitive	78	23.2
Monotransitives	223	66.4
Ditransitive	9	2.7
Ergative	26	7.7
TOTAL	336	100

MENTAL-TYPE1 & 2	N	%
Mental active	42	64.6
Mental passive	23	35.4
TOTAL	65	100
VERBAL-TYPE 1 and VERBAL-TYPE 2	**N**	**%**
Verbal-active	58	98.3
Verbal-passive	1	1.7
TOTAL	59	100
RELATIONAL-TYPE	**N**	**%**
Identifying	0	0
Attributive	82	84.5
Circumstantial	0	0
Possessive	15	15.5
Uncoded	3	-
TOTAL	97	100

2. The Features of Transitivity as Shown by the Participants, Process Types, and Circumstances

Table 4 presents the specifics of the six Process types in the corpus of ten science news. A closer look at the distribution of the Process types delineates the objectivity of science and the subjectivity of creativity. From the breakdown of the Process types, two appear more prevalent: Material Process (*n* = 336, 58.64%) and Relational Process (*n* = 100, 17.45%), and the absence or non-use of the Behavioral Process (*n* = 0, 0.00%) in the corpus.

The first two Process types codify events and phenomena occurring in the physical realm. In this regard, this lexico-semantic tendency in the corpora of science news to validate the objective, tangible, and empirical relationship of the Participants, Process types, and Circumstances. Also, the absence of the Behavioral process types implies the non-use of nonvolitional and subjective conditions in an imaginative and creative fiction language.

Table 5 illustrates the occurrences of the six processes across various genres or text types. Furthermore, the subtleties within the transitivity system across these registers appear in Figure 1. It shows that while Behavioral Processes exhibit a complete absence (0.00%) in the science-based registers, their occurrence varies across other genres. For instance, they manifest at a rate of 3.50% in advertisements, 2.94% in editorials, and 1.17% in film analysis. In novels, they range from 3.10% to 5.70%; in short stories, from 2.86% to 10.68%; and speeches, they are at 0.23%.

Table 4. Summary of Frequency Distribution of Lexical Patterns of the Six Process Types using UAMCT 6.2

Length	Material		Mental		Verbal		Relational		Behavioral		Existential		Total
Particulars	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*N*
Number of Segments	336	58.64	65	11.34	59	10.30	100	17.45	0	0.00	13	2.27	573
Token in Segments	4519	49.49	1096	12.00	1563	17.12	1728	18.92	0	0.00	226	2.47	9132
Words in Segments	4132	50.24	1002	12.18	1319	16.04	1569	19.08	0	0.00	202	2.46	8224

Table 5. Mean Distribution of Process Types in Selected Non-science-based Registers*

Genre	Source	Number	Material	Mental	Verbal	Relational	Behavioral	Existential
Advertisement	Ayoola, 2015	139	80.50	5.00	2.80	4.20	3.50	3.50
Editorial	Qasim, Sibtain, & Nawaz, 2020	34	52.94	5.88	5.88	29.41	2.94	2.94
Gender sensitivity	Yang & Han, 2022	378	62.96	3.70	1.32	30.69	0.00	1.32
Film Analysis	Pratiwi & Rahmah	685	44. 67	18. 83	4. 53	28. 03	1.17	2. 77
Novel	Alaei & Ahangari, 2016; Sloan, 2004	416	40.40	20.40	6.20	27.20	3.10	2.60
	Ammara, Anjum, & Javed	9240	14.50	17.10	8.60	49.60	5.70	4.10
Political Opinion	Isti'anah, 2014	40	57.50	5.00	7.50	30.00	0.00	0.00
Short story	Ammara & Anjum, 2019	223	13.39	2.93	0.84	2.93	0.00	0.00
	Cunanan, 2011	93	19.36	15.05	15.05	15.05	0.00	35.49
	Cunanan, 2019	140	20.00	11.4	10.00	34.29	2.86	21.43
	Sari & Yulianto	543	37.02	10.87	14.36	23.97	10.68	3.13
	Wang, 2019	76	32.90	5.26	52.63	7.89	1.32	0.00
Speech	Mushtaq, Saleem, Afzal, & Saleem, 2020	1297	16.35	2.54	2.00	4.55	0.23	0.85
	Distribution Range		14.50-80.50	2.54-20.40	0.84-52.63	2.93-49.60	0.00-10.68	0.00-35.49

*Including meteorological Process types

Figure 1. Percentage Distribution of the Process Types Across the Non-Science-Based Registers

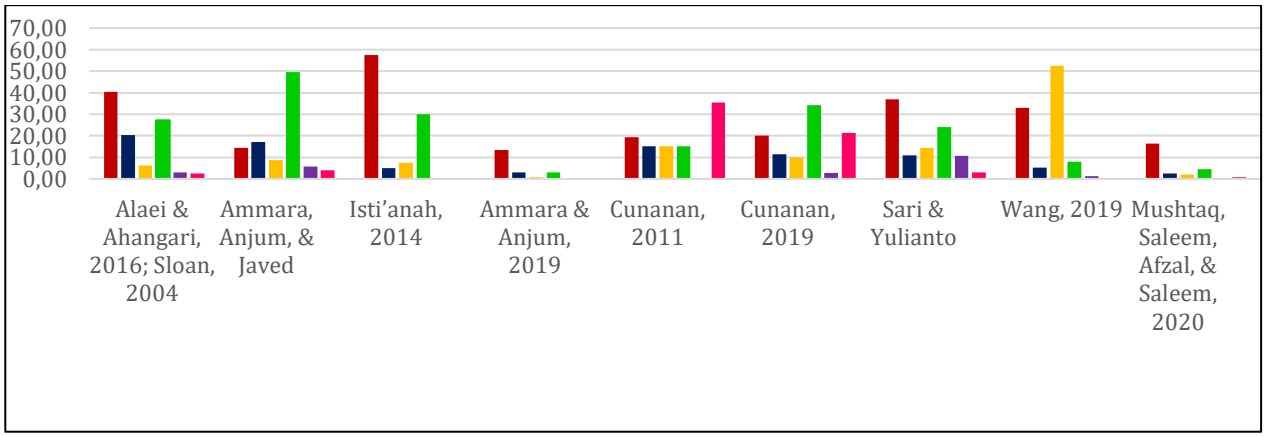


Figure 1 presents the percentage distribution of Processes across the spectrum of registers like advertisements, drama, editorial pieces, gender sensitivity texts, film analyses, novels, political opinions, short stories, and speeches. In terms of the range of percentage distribution observed in selected text types, the six Processes exhibited the following ranges: Material (14.50% - 80.50%), Mental (2.54% - 20.40%), Verbal (0.84% - 52.63%), Relational (2.93% - 49.60%), Behavioral (0.00% - 10.68%), and Existential (0.00% - 35.49%).

Figure 2. Frequency Distribution of the Process Types in the Corpus

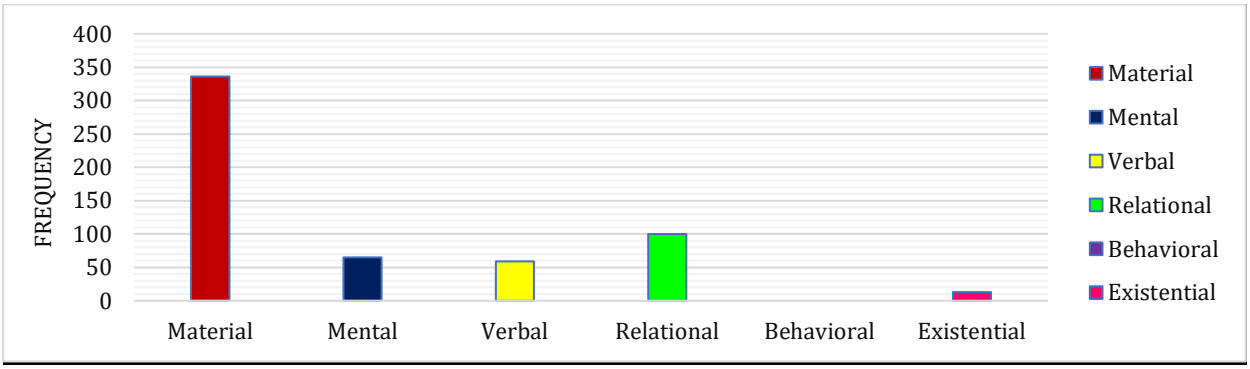


Figure 2 shows the frequency distribution of the six Process types in the corpus of ten science news. The three most frequent types are Material (*n* = 336, 58.64%), Relational (*n* = 100, 17.45%), and Mental (*n* = 65, 11.34%). The least frequent types are Verbal (*n* = 59, 10.30%), Existential (*n* =13, 2.27%), and Behavioral (*n* = 0,0.00%). Figures 1 and 2 suggest delineating the process types between the non-science-based and science-based registers, most notably the Behavioral process type.

Table 6. Frequency Distribution of Complexity, Lexical Density, Subjectivity, Academicness, and Reference Density across Process Types Utilizing UAMCT 6.2

Text Complexity	Material	Mental	Verbal	Relational	Behavioral	Existential
Average Word Length (word in a clause)	4.96	4.88	4.90	4.84	0.00	4.84
Average Segment Lenth (average number of segments in a clause)	12.30	15.42	22.36	15.69	0.00	15.54
Minimum Segment Length	1.00	2.00	2.00	3.00	0.00	8.00
Maximum Segment Length	46.00	48.00	64.00	40.00	0.00	25.00

Lexical Density						
Lexemes per segment	6.85	8.37	12.56	8.13	0.00	7.46
Lexeme % of text	55.74	54.29	56.18	51.82	0.00	48.02
Subjectivity						
Subjective Positivity	0.27	0.23	0.20	0.27	0.00	0.29
Subjective Negativity	0.26	0.35	0.38	0.37	0.00	0.29
Academicness						
Academic Word Use	9.00	6.91	6.29	6.29	0.00	4.96
Academic Rareness	3.61	3.46	3.95	3.66	0.00	2.67
Reference Density						
1p Reference	1.55	1.69	2.20	1.34	0.00	0.50
2p Reference	0.05	0.30	0.23	0.13	0.00	0.00
3p Reference	2.44	2.20	2.50	2.29	0.00	4.95

Table 6 characterizes the language of science-based discourse. It reflects that the average word length or words in a clause in the six Process types, except for the Behavioral Process type, ranged from 4.84 to 4.96. In stories corpus. Table 6 further presents the lexemes or linguistic units that constitute both individual words and the core meaning they suggest. In this regard, the Verbal Process types get the highest lexical density of 12.56 compared with the Material Process types of 6.85.

A similar observation applies to the average segment length of 22.36 for Verbal Process types and 12.30 for Material Process types. addition, the average for the Participants, Process types, and Circumstances in the corpus ranged from 12.30 to 15.69. This also shows the compactness and non-embellished nature of the sentences in the ten-science news

On the one hand, Table 6 indicates the low subjective positivity (0.23 to 0.27) and negative subjectivity of the discourse of the science corpus (0.26 to 0.38). This low level of subjectivity indicates that the language of the science corpus is very likely to be impartial and unbiased. On the other hand, Table 6 reflects a relatively higher level of academicness (4.96 to 9.00) and academic rareness (2.67 to 3.95).

Table 7. Summary of Frequency Distribution and Percentages of the Initial 20 Lemmatized Nouns, Verbs, Adjectives, and Adverbs in the Corpus Employing UAMCT 6.2.

Rank	Noun			Verb			Adjective			Adverb		
	Word	Freq	%	Word	Freq	%	Word	Freq	%	Word	Freq	%
1	year	38	0.007	say	45	0.008	new	20	0.004	ago	7	0.001
2	scientist	33	0.006	have	18	0.003	other	13	0.002	well	7	0.001
3	galaxy	26	0.005	find	18	0.003	first	8	0.001	previously	6	0.001
4	star	22	0.004	be	16	0.003	different	7	0.001	first	5	0.001
5	Webb	16	0.003	make	13	0.002	old	7	0.001	together	4	0.001
6	time	15	0.003	add	11	0.002	human	5	0.001	ever	4	0.001
7	research	15	0.003	see	11	0.002	smaller	5	0.001	home	4	0.001
8	study	14	0.003	reveal	9	0.002	huge	5	0.001	far	3	0.001
9	Gaia	14	0.003	show	9	0.002	important	5	0.001	anywhere	3	0.001
10	way	14	0.003	think	8	0.001	black	5	0.001	at	2	0.000
11	image	11	0.002	use	8	0.001	high	5	0.001	jointly	2	0.000
12	science	11	0.002	come	8	0.001	such	4	0.001	long	2	0.000
13	DNA	11	0.002	produce	7	0.001	financial	4	0.001	better	2	0.000
14	energy	11	0.002	provide	7	0.001	single	4	0.001	actually	2	0.000
15	data	10	0.002	discover	7	0.001	possible	4	0.001	already	2	0.000
16	species	10	0.002	become	6	0.001	scientific	4	0.001	eventually	2	0.000
17	world	10	0.002	accord	6	0.001	Filipino	4	0.001	directly	2	0.000
18	University	9	0.002	include	6	0.001	older	4	0.001	clearly	2	0.000
19	milky	9	0.002	work	6	0.001	same	4	0.001	indeed	2	0.000
20	fossil	9	0.002	tell	6	0.001	long	4	0.001	normally	2	0.000

Table 7 reflects the more frequent use of the third-person reference in all the accounted Process types (2.20 to 4.95) compared to the first-person reference (0.50 to 2.20) and second-person reference (0.05 to 0.30). It appears that the objective, unbiased, generalized, and impersonal quality of language in writing science news prefers using the third person.

3. The Transitivity Features in Science-based and Non-science-based Registers

Tables 7 to 10 present the transitivity features peculiar to the science news. Aside from the non-use of the Behavioral Process type, the top 20 lemmatized words, such as nouns, verbs, adjectives, and adverbs, are also shown.

Additional features of the UAMCT 6.2 software application's functions have explored the capacity to retrieve, annotate, categorize, and organize large amounts of information. These functions facilitate and expedite the storage and retrieval of authentic texts from various contexts and registers. UAMCT 6.2 accounts for frequency distribution and collocation of lexemes to determine the foregrounded and dominant features. To this end, Table 8 presents the 100 most frequently used words in the online science news.

The data show that article *the* appears as the most often used word in the corpus since this definite article is a collocate of the Relational Process type as the second most frequently used process type (Figure 6). The definite article *the* and other grammatical words like *be, of, a*, and *to* are very salient in achieving cohesion in science-based registers. Halliday and Hassan (1975, p. 70) consider that as a unique feature of English, *the* belongs to "the class which includes the demonstratives and the possessives." In their definitive work on cohesion, Halliday and Hassan (1976, p. 70) have acknowledged that *the* "is a specifying agent" that identifies "a particular individual or subclass within the class designated by the noun," and its presence has "no specifying element on its own." Table 8 implies that *the* may be semantically associated with specificity and definiteness. These two are the Material and Relational Process types that typify the objective and factual nature of the science-based registers.

Table 8. Synopsis of the Frequency Distribution of the Foremost 100 Words in the Corpus, Encompassing Lemmatized Lexis while Excluding Proper Names

Word	Freq	%	Word	Freq	%	Word	Freq	%	Word	Freq	%
the	370	0.069	but	24	0.004	one	12	0.002	some	8	0.001
be	195	0.036	million	24	0.004	image	12	0.002	environment	8	0.001
of	181	0.034	which	24	0.004	two	12	0.002	out	8	0.001
a	133	0.025	by	23	0.004	DNA	11	0.002	no	8	0.001
to	125	0.023	star	21	0.004	energy	11	0.002	dust	8	0.001
and	125	0.023	can	20	0.004	through	11	0.002	since	8	0.001
in	115	0.021	new	20	0.004	add	11	0.002	country	8	0.001
it	67	0.012	like	19	0.004	see	11	0.002	come	8	0.001
that	63	0.012	not	19	0.004	species	10	0.002	gas	8	0.001
we	61	0.011	also	18	0.003	so	10	0.002	even	8	0.001
have	57	0.011	I	18	0.003	reveal	10	0.002	plant	7	0.001
say	45	0.008	than	18	0.003	there	10	0.002	work	7	0.001
for	40	0.007	find	18	0.003	world	10	0.002	provide	7	0.001
year	38	0.007	study	16	0.003	about	10	0.002	well	7	0.001
with	36	0.007	he	15	0.003	think	10	0.002	you	7	0.001
they	35	0.006	time	15	0.003	show	9	0.002	give	7	0.001
as	33	0.006	research	15	0.003	where	9	0.002	mineral	7	0.001
from	31	0.006	its	15	0.003	use	9	0.002	universe	7	0.001
scientist	30	0.006	will	14	0.003	fossil	9	0.002	only	7	0.001
at	29	0.005	around	14	0.003	could	9	0.002	how	7	0.001
's	27	0.005	first	13	0.002	data	9	0.002	discover	7	0.001
galaxy	26	0.005	make	13	0.002	up	9	0.002	capture	7	0.001
more	26	0.005	what	13	0.002	most	9	0.002	ago	7	0.001
on	25	0.005	into	13	0.002	do	9	0.002	or	7	0.001
this	25	0.005	other	13	0.002	science	8	0.001	sediment	7	0.001

Table 9. The Initial Ten Keywords in Context (KWICs) Extracted from a Total of 370 Instances of the Definite Article *the*, Analyzed using AntConc 4.2

Text-3.txt	the northernmost part of Greenland known as Kap Copenhagen, said	*the*	University of Copenhagen lecturer. The fragments "come from an
Text-3.txt	DNA", said Karina Sand, who heads the geobiology team at	*the*	University of Copenhagen and who took part in the
Text-7.txt	the Ganjiang Innovation Academy under the Chinese Academy of Sciences,	*the*	The University of Manchester and the University of Melbourne jointly
Text-7.txt	the Chinese Academy of Sciences, the University of Manchester, and	*the*	The University of Melbourne jointly developed an electrolytic cell prototype.
Text-8.txt	of knowledge" in microbiology, Olivier Gros, professor of biology at	*the*	University of the Antilles and co-author of the
Text-8.txt	the bacterium with the Lawrence Berkeley National Laboratory, run by	*the*	University of California. With financial backing and access to
Text-9.txt	to be successful. After graduating from PSHS, I went to	*the*	The University of the Philippines where I was an Oblation
Text-9.txt	Oblation Scholar and proceeded to train in medicine also at	*the*	University of the Philippines. I left the country for
Text-2.txt	into Sagittarius A*, the black hole at the center of	*the*	Milky Way, which is shrouded in dust. Stellar nursery
Text-6.txt	with incomparable precision," Mignard said. But Gaia also sees beyond	*the*	Milky Way, spotting 2.9 million other galaxies as well as 1.9

Table 10 showcases ten Keywords in Context (KWICs) derived from 370 occurrences utilizing the definite article *the*. This linguistic element signifies using shared information between writers and intended readers, a communicative phenomenon predominantly observed within Material and Relational Process types, as illustrated in Figure 2. The Material Process type pertains to communicative phenomena within the physical realm, whereas the Relational Process type is associated with attribution, identification, possession, and qualification.

Also, Table 10 presents excerpts from a corpus of ten science news articles, showcasing Key Words in Context (KWICs) derived from 370 instances that use the Relational process *is*. In SFG, this Relational Process type encompasses various semantic roles, including attribution, classification, characteristic, identification, location, possession, property, state of being, or circumstantial condition. Furthermore, the definite article *the* signifies certainty and objectivity, which are characteristics of science-based texts or registers.

Table 10. The Initial Ten Keywords in Context (KWICs) from 370 Total Hits of the Relational Process is Explored in AntConc 4.2

Text-6.txt	reveals the huge array of differences between stars. "Our galaxy	*is*	a beautiful melting pot of stars" said a Gaia member
Text-10.txt	Friday. The new mineral, which has been named Changesite-(Y),	*is*	a kind of colorless transparent columnar crystal. It was
Text-9.txt	a long way to reaching this goal. A happy scientist	*is*	a productive scientist. Productive scientists will make our nation
Text-9.txt	diseases, molecular epidemiology, and disease outbreaks. One major issue that	*is*	a recurring problem is compensation that is at par
Text-3.txt	a part of North Greenland", he explained. Today, Kap Copenhagen	*is*	an Arctic desert, where different types of deposits, including
Text-1.txt	restrictions of lockdowns. With the industry thriving the most, it	*is*	an exciting period to be involved in the tech
Text-1.txt	writers stirring the pot, but no. Quality trumps all. It	*is*	for all seasons. Even the most vapid of readers
Text-1.txt	in the virtual concept from last year. The direction, hence,	*is*	for businesses to adopt AI and create “intelligent enterprises,”
Text-6.txt	said. "It is the Swiss Army knife of astrophysics -- there	*is*	not a single astronomer who does not use its

Text-8.txt	to two centimetres (three-quarters of an inch), "Thiomargarita magnifica."	*is*	not only is around 5,000 times bigger than most bacteria -- it

Conclusion

Based on the findings, the use of computer software to extract and compare the features of science-based and non-science-based corpora facilitates various layers of functionality, in which exploration provides opportunities for unbiased and generalizable procedures in linguistic analysis, enhancing comprehension, and L2 science writing.

Software applications like AntConc and UAM Corpus Tool v. 6.2 can analyze transitivity across science-based and non-science-based registers. These software applications can efficiently categorize the embedded nuances and semantic features in delineating the foregrounded linguistic elements in science news and various non-science-based texts.

The empirical information from the corpus-based analysis of various genres and registers can scaffold and facilitate science pedagogy. Also, software analysis can assist in identifying, analyzing, and comparing elements of transitivity: Participants, Process types, and Circumstances. The procedure can help researchers, teachers, and students uncover the underlying cognitive mechanisms of consuming and producing authentic and L2 science-based materials.

Lastly, the interface between functional linguistics and information technology is open for achieving a rigorous, robust, organized, and systemic analysis, comparison, and interpretation of registers across genres and communicative phenomena.

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