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Binarity of Language: An Alternative to Chomskyan Analysis of Syntactic Structure

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Abstract: This paper proposes and defines the new construct of Pedagogical English Grammar based on a scrutiny of English grammar from the perspective of prescriptivism. Thenceforth, cognitive binarity manifests itself in Pedagogical English Grammar, involving noun-verb binarity and other binary characteristics, which are identified as Binarity of Language that can form an intersection with machine language by way of Boolean calculation. Furthermore, Binarity of Language gives rise to an alternative to Chomskyan analysis of syntactic structure and can dissolve the Chomskyan UG conundrum. This paper formally endorses the term of Chomskyan Linguistics, as it designates human-oriented theoretical linguistics as an interdisciplinary field of study concerning such disciplines as biology, physics, and mathematics.

Keywords: The subject-predicate logic; Pedagogical Grammar; Pedagogical English Grammar; Binarity of Language; Chomskyan linguistics

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1. Introduction

The distinction between subject and predicate is a cornerstone in logic; however, the nature of subject and predicate in language is by no means made clear, the subject-predicate logic in English syntactic structure is doubted and dislodged de facto by Jespersen, who calls attention to the obligatory presence of "verb" in the predicate in his detailed analysis of Modern English grammar, and the subject-predicate bipartition is useful in syntax only when the predicate is affected by clause negation, omitted through ellipsis or replaced by a pro-form [1–3]. The binary division of subject and predicate is adopted in Chomskyan analysis of syntactic structure, where either subject (marked as an NP (noun phrase)) or predicate (VP (verb phrase)) can be further divided into binary elements [4–6]. This very subject-predicate binarity presented in Chomskyan syntactic trees has veiled the very Chomskyan minimalist perspective of language, though it does display one structural fact of language. Binarity can be a linguistic universal, but presents itself in ways different from that of subject-predicate.

Therefore, an alternative to Chomskyan analysis of syntactic structure is proposed in this paper, and it is derived from a critical review of the features in English grammar, respectively by Jespersen (1933), Quirk et al. (1985), Zhang (2023), and Chomsky (1957, 1995) [2–4, 6–7].

Chomsky's Universal Grammar (UG), a 1957 theory in search of the mechanism of linguistic generation, reveals the nature of human language, while the language system can be called by non-linguists "a bubble of an abstract construct", like the time people think they experience [8]. The recent issue looming large is whether artificial intelligence (AI), such as the Large Language Model, is better than theoretical linguistics [9]. Such debate is put in the foreground by the negative criticism of Chomskyan linguistics from the 2024 winner of the Nobel Prize in Physics and Ulysses Medal and the 2018 winner of the Turing Award, Geoffrey E. Hinton [10]. Hinton's groundbreaking contribution to AI is acknowledged, but his provocative view on Chomsky's theoretical linguistics is refuted by linguists differentiating human intelligence from digital intelligence, such as Zhiwei Feng et al. (2024), Ding and Feng (2025), and Jianming Lu (2025) [11–13]. Accordingly, synergy between UG and LLM (Large Language Model) is called for. Or rather, linguistic research entails integration of paradigms for scientific inquiry, which is driven by empirical evidence, scientific theory, computational science, big data[14], and artificial intelligence. Hence, it is of imperative necessity and urgency to identify the intersection of human language and machine language: binarity.

The alternative analysis herein is based on the limited prescriptive rules of present-day English (PDE) and boiled down to a new construct, binarity of language (BOL), which can be verified as a property of human language as well as a joining node between the rule-driven human approach and the data-driven artificial approach to language. PDE is demonstrated through another new construct, pedagogical English grammar (PEG), which is expected to facilitate language pedagogy in the practice of teaching and learning English (especially ELF, English as a lingua franca), to afford an inclusive and accessible way of language comprehension, and to elicit enquiry into other properties of human language.

2. English Grammar

2.1. The language of English

A general consensus among linguists is that linguistic universalism is of invaluable significance and should be justifiable by both philosophical consistency and empirical analysis of particular languages [15]. The language of English goes through grammatical change over time and space, which makes linguistic data (or parole, the observable production or behavior of language users) intricate. Phonetic and phonological rules of English are excluded in this paper as they can be ancillary to written English.

Chronologically, English grammar changes continually. For example, the word-order SVO (subject verb object) becomes progressively and increasingly fixed over time in a thousand years as a result of the regularizing trend of written English from synthetic constructions to analytic ones or from an essentially verb-final to a clearly verb non-final language [2, 16]. Spatially, there are many Englishes, as the language of English is a major foreign language in the extending circle countries such as China, a second language in the outer circle countries such as India, a native language in the inner circle countries such as UK and USA, according to the world Englishes paradigm by Braj Kachru in 1992, and a lingua franca around the world [17].

ELF (English as a lingua franca) has been a contemporary reality with the advocacy of linguistic diversity and human rights. This routine may be prevalent in language education around the world. However, there are two kinds of disapprovals concerning ELF, which are "oddly contradictory" [17]; the first identifies English

as an alien invasive force threatening linguistic and cultural diversity because of the hegemonic influence of English, and the second perceives the various deviations from the established standard English as undermining the very integrity and intelligibility of the language itself [17]. These two disapprovals, ELF either deemed as a threat to non-native users of English or a threat to the English language itself, can be dissolved if the teaching and learning of English (or any language) could be made easier by identifying the "stability" of English (or the language learned) [18]. In addition, Birkeland et al. argue that "all linguists can and must deessentialize and decenter NATIVENESS" [19]. Hence, a fresh reconceptualization in the linguistics of English, like the one in this paper, is needed. Moreover, despite technological innovations such as generative AI, teachers must remain at the core of all educational endeavors, including language education [20], and teachers are expected to relieve the cognitive load of learning a language.

Language, or *langue*, is described by Saussure in 1916 as an ideal system, a self-contained whole or "un tout en soi" that should be subordinated to the natural instinct of the faculty of speech [21–22]. The limited rules of language are the prescriptive rules that are created to assist, but not to dominate, human beings who have a limited capacity of memory and often make mistakes in applying these rules. This is why a descriptive approach rather than a prescriptive approach to language education is adopted and advocated in human society. Linguistic prescriptivism vis-à-vis descriptivism reveals the relationship between language and human beings that "language is mankind's last homestead" while "language betrays human beings" [23].

Nevertheless, the perennial tension between descriptivism and prescriptivism [24] melts away in this context of extracting the prescriptive rules of present-day English from the literature of English grammar.

2.2. Present-day English grammar

Grammar can be dichotomously classified into prescriptive grammar and descriptive grammar according to whether the goal of the grammar is to describe the rules people know or to prescribe what rules people should follow [25]. Grammar can also be divided into pedagogical grammar and theoretical grammar, according to whether it is specially formulated for language teaching and learning [7]. English grammar, despite the descriptivism practice in English education, has a set of prescriptive rules, especially in terms of syntactic or clause structures. Such limited and prescriptive rules of a language may be named as Pedagogical Grammar (PG, initial letters capitalized), and PG components embrace word-class, type of clause, and clause constituent, in addition to syntactic pattern. PG for English can be termed as Pedagogical English Grammar (PEG).

One of the most popular analyses of English grammar in China is by Zhang (2023), where an English sentence or clause consists of a subject and a predicate, with a set of syntactic patterns listed (**Table 2**), which are quoted from Quirk et al. (**Table 1**) except for the specific examples [3, 7].

Table 1. English sentence structures in Quirk, Greenbaum, Leech, and Svartvik (1985: 754)

Type	Clause structures	Examples
1	**SVC**	1.1a She is happy.
		1.2a He turned traitor.
		1.3a The show was interesting.
2	**SV**	2.1a He was working.
		2.2a The curtains disappeared.
		2.3a The wind is blowing.

Table 1 (Continued)

Type	Clause structures	Examples
3	**SVA**	3.1a He was at school.
		3.2a She got into the car.
		3.3a He is lying on the floor.
4	**SVO**	4.1a He threw the ball.
		4.2a She has a car.
		4.3a They fought a clean fight.
5	**SVOA**	5.1a He placed it on the shelf.
		5.2a The storm drove the ship ashore.
		5.3a A car knocked it down.
6	**SVoO**	6.1a I bought her a gift.
		6.2a She gave the door a kick.
		6.3a She knitted me a sweater.
7	**SVOC**	7.1a He declared her the winner.
		7.2a The sun turned it yellow.
		7.3a I found it strange.

[1] SVC (subject + predicate verb + complement)
[2] SV (subject + predicate verb)
[3] SVA (subject + predicate verb + obligatory adverbial)
[4] SVO (subject + predicate verb + object)
[5] SVOA (subject + predicate verb + object + obligatory adverbial)
[6] SVoO (subject + predicate verb + object)
[7] SVOC (subject + predicate verb + complement)

Table 2. English sentence patterns in Zhang (2023: 39–50)

Type	Clause structures	Examples
1	**SVC**	1.1b The car is very expensive.
		1.2b The girl looks fine.
		1.3b The box weighs almost a ton.
2	**SV**	2.1b My head aches.
		2.2b His plan has changed.
		2.3b The children may have been sleeping.
3	**SVA**	3.1b They have been singing for half an hour.
		3.2b The hunters live in London.
		3.3b The war lasted (for) eight years.
4	**SVO**	4.1b He opened the door.
		4.2b He can drive a truck.
		4.3b You must have heard the news.
5	**SVOA**	5.1b The stranger laid his hand on my shoulder.
		5.2b They have put men on the moon.
		5.3b The kind man treated me kindly.

Table 2 (Continued)

Type	Clause structures	Examples
6	**SVoO**	6.1b He told me the news about Paul.
		6.2b You have done me a favor.
		6.3b Susan taught us English.
7	**SVOC**	7.1b They appointed him (to be) manager.
		7.2b All of us believed him mistaken.
		7.3b People called him a coward.

There are three categories of inadequacy in the analysis of (some examples of) English syntactic patterns by Quirk et al. and Zhang, giving rise to cognitive overload. The flaw of category (a) brings about that of category (b), which in turn results in that of category (c).

a. The general and vague term of predicate verb does NOT demarcate the distinctive conceptual border between action verb and linking verb. Despite the fact that verbs are known to "indicate action, activity, and temporary or changing conditions", the term of action verb (in opposition to linking verb) is missing in Jespersen (1924, 1933, 1937), Quirk et al. (1985) and Zhang (2023) and can be added in the categorization of verb (**Table 3**) [2–3, 7, 26–27]. Action verb and linking verb are a pair of interdependent concepts affirming that everything in the world is either moving or unmoving, either dynamic or static, which is cognitively simple, easy, and clear while describing the reality of the physical world in human eyes.

Table 3. Categorization of verb (adapted from Zhang (2023: 99–115))

Verb	Main verb	**Action verb**	Transitive verb	Mono-transitive verb
				Ditransitive verb
				Complex transitive verb
			Intransitive verb	
		Linking verb		
	Auxiliary verb	*Primary auxiliary verb*		
		Modal auxiliary verb		
		Semi-auxiliary		

b. The original clause constituents of complement and adverbial seem NOT convincing anymore in the light of the conception of action verb vs. linking verb. A modified version of syntactic structures (**Table 4**) may help to reveal and reinforce the simple human cognitive habits displayed by action verbs and linking verbs. First, complement (abbreviated as C) may be distinguished from predicative (abbreviated as P) (see section 3). Second, adverbial (abbreviated as A), pertaining to the nature of an adverb, could be reinterpreted as not obligatory in syntactic structures (see section 3.2 and section 3.4) despite its important function of adding semantic information to a clause.

Table 4. Reinterpretation of the complement and adverbial

Original	Examples	Revised	
SVC	1.1a She is happy.	**SVP**	**SVP/SVC**
	1.2a He turned traitor.		
	1.3a The show was interesting.		
SVA	3.1a He was at school.	SVP	
	3.2a She got into the car.	SVP	
	3.3a He is lying on the floor.	SVC	
SVOA	5.1a He placed it on the shelf.	SVOC	**SVOC/SVO**
	5.2a The storm drove the ship ashore.	SVOC	
	5.3a A car knocked it down.	SVO	
(Quirk et al. 1985) (see **Table 1**)			
SVC	1.1b The car is very expensive.	**SVP**	**SV/SVC**
	1.2b The girl looks fine.		
	1.3b The box weighs almost a ton.		
SVA	3.1b They have been singing for half an hour.	SV	
	3.2b The hunters live in London.	SVC	
	3.3b The war lasted (for) eight years.	SVC	
SVOA	5.1b The stranger laid his hand on my shoulder.	SVOC	**SVOC/SVO**
	5.2b They have put men on the moon.	SVOC	
	5.3b The kind man treated me kindly.	SVO	
(Zhang 2023) (see **Table 2**)			

c. The types of syntactic structures, which do NOT follow the simplest logic, can be modified.

The proposed version of categorization of verbs in English corresponds to the English syntactic structures or patterns revised herein (**Table 5**).

Table 5. English verbs and English syntactic patterns

Verb	Main verb	**Action verb**	Transitive verb	Mono-transitive verb	⇒ SVO (/SV in passive voice)
				Ditransitive verb	⇒ SVOO (/SVO in passive voice)
				Complex transitive verb	⇒ SVOC (/SVC in passive voice)
			Intransitive verb	⇒ SV / SVC	
		Linking verb	⇒ SVP		
	Auxiliary verb	*primary auxiliary verb*			
		modal auxiliary verb			
		semi-auxiliary			

Here is the revised version, named as English Syntactic Patterns (or ESPs, from ESP1 to ESP6), where V

stands for main verb (since auxiliary verb, as product of "grammaticalization", can be considered as pragmatic, discursive and not necessarily present, while grammaticalization is the evolutionary process of human language, termed as such by Antoine Meillet in 1912 and originating from the speculation of Wilhelm von Humboldt in 1822 that "only concrete ideas could be expressed" before the evolution of grammar or grammatical forms) [28–30] and the syntactic/clause constituent that co-occurs with the linking verb is labelled as P or predicative. This label of P, absent in Quirk et al. (1985) and Zhang (2023), is initially defined and presented by Jespersen (1933, 1937) and frequently mentioned in FLE (foreign language education) practice in China or in many academic materials such as exercise books for TEM (test for English majors) [2–3, 7, 27].

ESP1: SV

ESP2: SVO

ESP3: SVO_iO_d

ESP4: SVOC

ESP5: SVC

ESP6: $SV_{linking}P$

ESPs present themselves as fixed in present-day English (PDE) and lend themselves to an inclusive, exhaustive, and illustrative description of PDE grammar. To be precise, each declarative simple sentence in PDE boils down to one of the six ESPs, which involves a manageable cognitive load, may be pedagogy-friendly, and can generate an infinite number of always grammatically correct sentences and express whatever needs to be put into words with the aid of two extra devices that are not obligatory in a sentence: coordination and subordination. Coordination is realized through a coordinate clause, and subordination is achieved by means of a subordinate clause, attributive, adverbial, and appositive, while attributive, adverbial, and appositive, in addition to S, O, P, and C, can be in the form of word, phrase, and clause.

2.3. Pedagogical grammar

What is called pedagogical grammar (initial letters NOT capitalized) is the grammar taught in traditional language classes where descriptivism rather than prescriptivism is implemented. Nevertheless, Pedagogical Grammar (initial letters capitalized, PG) can be a universal construct that contains the core rules of a language, serving as the guideline in language learning and teaching or the requisite knowledge held in long-term memory that may help learners to achieve language proficiency and accuracy. In addition, PEG (Pedagogical English Grammar) may be a paradigm for PG, as the following sections may turn out.

3. Pedagogical English grammar

Descriptivism features the scrutiny of English grammar by Jespersen (1924, 1933, 1937), Quirk et al. (1985), and Zhang (2023), where the subject-predicate logic is expediently used and the value of the bipartition of subject and predicate on the theory of grammar is doubted [2–3, 7, 26–27]. This is where the problem lies in the linguistics of English, as far as language pedagogy is concerned. Hence, the above-mentioned prescriptive ESPs.

The six ESPs can be the kernel of Pedagogical English Grammar, being generative and being able to accommodate, but not requiring the subject-predicate logic. These syntactic patterns can be made easily accessible or cognition-friendly with a coherent, systematic, and prescriptive account of the other three PEG components, i.e., word-class, type of clause, and clause constituent.

3.1. Cognitive load

Cognitive load is one of the concerns in language learning and teaching, as the capacity of human memory is limited: the long-term knowledge of memory is of great flexibility, while the number of information units or categories in working or short-term memory is limited (viz. 7±2). It is a "common…view that short- and long-term memory systems are intimately related" [31]; Miller (1956) points out that capacity limits in short-term memory are seven plus or minus two units in serial recall and in perceptual tasks, proposes the notion that the capacity of short-term memory can be increased through the binding of information into larger chunks, and indicates how long-term knowledge can greatly increase short-term memory [32].

Working and long-term memories remain central to the Cognitive Load Theory (CLT), initially established by Sweller in 1988 and being under constant development ever since [33]. CLT, based on the model of cognitive architecture (which includes sensory, working, and long-term memories and which was introduced by Atkinson and Shiffrin in the 1960s and well established by the 1980s), is "an instructional theory" where the goal of all cognitive load theory effects is "optimizing working memory load to facilitate the accumulation of knowledge held in long-term memory" [33–35].

According to CLT, biologically primary knowledge consists of information easily, automatically, and unconsciously acquired without instruction as long as one is a member of a functioning society, while biologically secondary knowledge consists of information that requires conscious effort and needs to be explicitly taught [35]. As for language instruction, biologically primary knowledge may be the signification process in Ferdinand de Saussure's linguistics, or how a signifier (or signifiant) is used to refer to a signified (or signifié), or linguistic "semiology", the notion of which was invented by Saussure and "the object of which would be the laws of the creation and transformation of signs and their meaning" [36]; hence, word (as one ingredient of PEG) may be viewed as biologically primary knowledge while prescriptive grammatical knowledge like word-class, ESP, type of clause, and clause constituent (as the other ingredients of PEG) may be deemed as biologically second knowledge that is processed by working memory (of limited capacity and duration) and thus must be well-designed and made explicit by teachers. Therefore, it is necessary to further clarify PEG so as to optimize intrinsic cognitive load (caused by the natural complexity of linguistic information) in language learning and acquisition. In addition, pragmatic and discursive concerns in language learning are related to extraneous cognitive load, which refers to "complexity imposed by how information is presented to learners and the cognitive activities required of them" [34].

To minimize intrinsic cognitive load, word classes, types of clauses, clause constituents, and syntactic patterns are to be simplified, logicized, and systematized from a linguistic perspective.

3.2. Word-classes

In traditional grammar, there are 10 main word-classes in English (namely, noun, adjective, numeral, pronoun, verb, adverb, (definite or indefinite) article, preposition, conjunction and interjection), where the articles, numerals and other items may be used as "determiners" and Jespersen prefers the term of "substantive" to "noun" as it denotes a substance or existence [2–3, 7]; nonetheless, a determiner is not a word-class but an item equivalent to a pre-modifier of a noun.

First of all, pragmatic and discursive meanings in a language make language learning a lifelong and creative journey. The semantic meaning of a word is the original meaning in etymology or biologically primary knowledge, which cannot be changed; the pragmatic or discursive meaning of a word, emerging as a creative

usage at a particular point of time in a certain context, is often recorded as a new entry in the dictionary and thus biologically secondary knowledge, which may be always renewed by human innovation. Although some pragmatic meaning might be undeniably acquired earlier than the etymological meaning left in oblivion somewhere along the continuum of history, the dictionary keeps a record of all the meanings and is ready to keep new entries. In language acquisition, pragmatic and discursive meanings do not fall into the province of intrinsic cognitive load as they might do in language instruction, since, from the bio-linguistic perspective, "language is a recent and emergent system" and "the lexicon … should not be generative, but rather should consist of a static list of morphemes accessible to syntactic computation" and many features such as the inventory of the inflected forms of the lexical verb "should be purged from the lexicon", just as Cheng (2018) argues against the flawed conceptions of the lexicon in mainstream theories including the Chomskyan Minimalist Program [37]. In other words, syntactic computation is devoid of all pragmatic and discursive elements.

Second, interjections and conjunctions are pragmatic and discursive in terms of their basic function. An interjection is to express an emotion. Either a coordinate conjunction is to juxtapose a linguistic element (such as a word, phrase, or clause) or a subordinate conjunction is to make an expression (often a clause) dependent on the main clause. Their semantic meanings may vary from word to word.

Third, in a similar vein, numerals, articles, and prepositions are also pragmatic and discursive in terms of their essential role of adding new information about a noun. They are modifiers of a noun. Their semantic meanings may vary from word to word. Besides, a pronoun generally functions like a noun and identifies without naming what the noun refers to. Pronouns and auxiliary verbs are pragmatic and discursive as well. Additionally, since preposition is totally dependent on noun (/nominal expression) or has to be followed by a noun (/nominal expression), the focus or base of a prepositional phrase (PP) could be conceived as the noun (/nominal expression) instead of the preposition itself; this is implied in the functions of PP in a clause (**Table 6**).

Table 6. Words and phrases as clause constituents (adapted from Quirk et al. (1985))

Word	**Phrase**	**Clause constituent**
Noun	Noun Phrase	S, O, P, C, *Attributive*, **Adverbial**, Appositive
Verb	Verb Phrase	V
Adjective	Adjective Phrase	P, C, *Attributive*, Appositive
Adverb	Adverb Phrase	S, P, C, **Adverbial,** Appositive
	Prepositional Phrase	S, P, C, *Attributive*, **Adverbial**, Appositive
Numeral	/	S, O, P, *Attributive*
Pronoun	/	S, O, P
Article	/	*Attributive*
conjunction	/	syntactic and pragmatic *marker* of coordination or subordination
interjection	/	pragmatic and discursive *marker* of emotion

Note: **Complement** and **Predicative** are not differentiated in Quirk et al. (1985), whose grammar reveals "the blurring of nominal and adverbial functions" [3] and prepositional functions, pointing out that "… adverb phrases and prepositional phrases can exceptionally function as subjects" [3] with the following examples:
[A] When are we going to have the next meeting? *On Tuesday* will be fine.
[B] Will *after the show* be soon enough?
[C] *Slowly* is exactly how he speaks.
[D] *Because Sally wants to leave* doesn't mean that we have to.

Fourth, nouns and verbs enjoy top importance in human language or human cognition, which can be testified by the ESPs or the subject-predicate logic, where S and V are of mandatory presence, and the Subject is either a noun or a nominal expression and co-occurs with its corresponding (main) verb in English. Of secondary prominence are the adjective (used to modify or describe a noun) and adverb (used to modify a verb, an adjective, or another adverb to add more information about place, time, circumstance, causality, manner, or degree), as they mainly serve nouns and verbs as dependent elements. It is worth noting that an adjective serves to single out one of the several qualities that cannot all be expressly indicated in the name of the noun itself [2]. It is also notable that new information introduced by an adverb can be designated as a separate notion (such as place, time, and degree) and associated with the subject; and it is not obligatory, since it is additional and thus pragmatic and discursive. The basic function of an adverb is adverbial, which is as pragmatic and discursive as an attributive or appositive. Such a conclusion of the ancillary status of adverb among the word-classes can even be microscopically justified by the three-event-model proposed by Fuyin Li in cognitive semantics, where "the first event represents the initial state, and the second event indicating the manner or cause links the first with the third event, which represents the final state" [38], as this semantic analysis also implies that something is either moving or not moving (i.e. of some state) in a simple clause (see section 4.4).

There are set, rigid, and normal rules governing the relationships and collocations of the first eight word-classes, as far as semantic meanings are concerned. However, in real-life and practical language education, pragmatic meanings are prevalent, if not dominant; for instance, "deafening silence" is often considered as a good collocation as it employs the rhetoric of oxymoron, while it is as semantically incorrect as "colorless green" and "green ideas." Accepted or established expression deviating from normal usage is pragmatic or discursive, which involves not intrinsic cognitive load but extraneous cognitive load.

To summarize, only nouns and verbs are at the top of the hierarchy of importance, respecting linguistic role or human cognition (**Table 7**).

Table 7. Degree of syntactic importance regarding word classes in English

Class	Word		Syntactic importance
1	Noun	Verb	primary
2	Pronoun Adjective Preposition Numeral Article	Adverb	secondary
3	conjunction interjection		lesser

3.3. Types of clauses (TOCs)

Consequently, it is not surprising that all the dependent clauses function as nouns, adjectives, and adverbial do, which can be named as nominal clauses, adjective clauses, and adverbial clauses (**Table 8**). Nominal clauses can be present in the places of S, O, P, C (Subject, Object, Complement, Predicative), follow a preposition (in a prepositional phrase), or be an appositive, just as a noun does. An adjective clause is to modify a noun (or noun phrase), while an adverbial clause is often conspicuously juxtaposed with the main clause. Besides, the device of apposition is often used, putting one expression immediately after another of the same function, whether it be nominal, adjective, adverbial, verbal, or prepositional, though the nominal appositive might enjoy more frequency [7].

Table 8. Types of clauses in English

Categories	TOCs		Names		Forms	Examples
Coordinate Clause	<1> Coordinate Clause		Coordinate Clause		coordinated by punctuation marks such as comma (,), semi-colon (;) and colon (:)	[1] Mary is a nurse, her brother is a doctor, and her parents are writers. [2] Mary is a nurse; her brother is a doctor; her parents are writers. [3] Sports at any age are beneficial: they keep your pulse hopping. (Zhang 2023: 591–621)
					coordinated by Coordinating Conjunctions such as "and", "but" and "or"	[1] Think it over again ***and*** you will find a way out. [2] He didn't see me, ***but*** I saw him. [3] Give the book to John, ***or*** you may just keep it. (ibid.)
Subordinate Clause	**<2> Nominal Clause (NC)**	in clausal form	[1]Subject-clause [2]Object-clause [3]Predicative-clause [4]Appositive-Clause [according to its position in the sentence]		that-clause	[1] That he is still alive is sheer luck. [2] They claimed that their team had won. I'll see to it that you get your reward. [3] The odds are that he will not do it. [4] Stories that the house was haunted angered the owner. [5] She is convinced (that) he is honest. (Zhang 2023: 627–640)
					wh-word clause	[1] Why she did this is not known. Whoever told you to quit smoking is quite right. [2] We don't know when she'll come. Hob was not certain of what he wanted to do. I'll do whatever you ask me to. [3] The mystery is whether he ever went there at all. Home is where your friends and family are. [4] Have you any idea how soon they are coming? [5] I wasn't certain whose house I was in. (ibid.)
		in special form	[1]Subject [2]Object [3]Predicative [4]Appositive [5] Object Complement	gerund (phrase)	doing sth. sb.('s) doing sth.	[1] *Not being punctual* makes him unreliable. [2] He doesn't deny *his breaking the agreement*. [3] I don't mind *Jane buying another one*. [4] His hobby was *collecting stamps*. [5] I saw him *crossing the road*. [6] She worked all day without *ever complaining*. (Zhang 2023: 707–719, 722–724)
				infinitive	(to) do sth.	[1] *To see* is *to believe*. [2] I expect *to be back on Sunday*. [3] The child did nothing except *weep*. [4] I heard her *sing*. [5] We consider him to be very capable. (Zhang 2023: 682–688)
					for sb. to do sth.	[5] It took six weeks *for the travellers to reach the coast*. (ibid.)

Table 8 (Continued)

Categories	TOCs	Names	Forms	Examples
	<3> Adjective Clause	Relative Clause **(RC)** [/Attributive Clause]	RC introduced by **relative pronoun** (such as that, which, who, whom, whose)	[1] All the books **that** had pictures in them were sent to the little girl. I know someone else **whose father** works here. [2] The two books **(which)** he has just published are intended for Western readers. [3.1] My typewriter is not the machine **(that)** it was. [3.2] He asks for the latest book **(that)** there is on the subject. [4.1] Can you mention anyone **that** we know who is so talented as he? [4.2] She has an adopted child **who** she says was an orphan. [4.3] The air then passes to a compressor, **where** it is compressed, and **from which** it is delivered to the combustion chambers. [5] The have four children, **all of whom** are now at school. [6.1] He tried to stand on his hands for five minutes, ***which*** — as you know — is rather a difficult thing to do. [6.2] He admires Mrs. Brown, ***which fact*** surprises me. (Zhang 2023: 821–844)
			RC introduced by **relative adverb** (viz. when, where, why)	[1] That is the day **when (= on which)** he did the experiments. [2] That is the house **where (= in which)** he lived ten years ago. [3] The reason **why** I was alone in the mountain is that I had a difficulty with my guide. [4] Stratford-on-Avon, **where** Shakespeare was born, is visited by thousands of tourists. (ibid.)
		Participle Clause **(PC)**	-ing PC (without conj.)	[1] I have a friend *living in London.* [2] There are clear signs of great changes *impending*. [3] The apple tree, *swaying gently in the breeze*, had a good crop of fruit. (Zhang 2023: 701–744)
			-ed PC (without conj.)	[1] Things *seen* are mightier than things *heard*. [2] The quantity of oxygen *liberated to atmosphere by growing vegetation* is obviously very large. (ibid.)
		Infinitive	to do sth.	[1] This should be a good opportunity *to speak to him*. [2] He gave orders *for the visitors to be shown in*. (Zhang 2023: 689–690)
			for sb. to do sth.	[3] John was very pleased *to be given the job*. [4] That question is difficult *to answer*. [5] The rivers are narrow *for big ships to sail up*. [6] These books are easy *to sell*. (Zhang 2023: 694–699)
	<4> Adverbial Clause (all-inclusive concept)	**adverbial clause** (traditional concept)	often introduced by Subordinating Conjunction and indicating **time, place, manner, cause, result, purpose, condition, concession** (such as when, whenever, where, wherever, as if, because, so that, in order that, if, if only, although, even if)	[1] *When/Whenever they go to town*, they visit their grandfather. [2] *Wherever he happens to be*, John can make himself at home. [3] He behaves *as though he were the duke himself*. [4] He didn't buy it, *because it was expensive.* [5] He spoke *so eloquently that we were all moved to tears*. [6] You must be quiet *in case the fish are frightened*. [7.1] *If he is not in the office*, he must be out for lunch. [7.2] *If the dam broke in the coming rainstorms*, there would be great loss of life and property. [8] It is true, *no matter what you may say*. (Zhang 2023:641-699)

Table 8 (Continued)

Categories	TOCs	Names	Forms	Examples
		Participle Clause **(PC)**	-ing PC (with/without conj.)	[1.1] *Opening the door*, I saw nobody in. [1.2] They continued to talk *while walking down the aisle*. [2] *Not being used to the strong sun*, I got a sunburn. [3.1] *Happening in war time*, this would amount to disaster. [3.2] *Even if receiving visitors*, patients must observe normal hospital rules. [4.1] *Working or playing*, Sarah is always intense. [4.2] *Though understanding no Greek*, Charles was able to communicate with them. [5.1] They walked by the lake, *holding hands*. [5.2] Alice stopped speaking *as if waiting for him to speak*. [6] Their car was caught in a traffic jam, *thus causing the delay*. (Zhang 2023:701-744)
			-ed PC (with/without conj.)	[1] *Written in haste*, her thesis has quite a few mistakes. [2] *Heated*, water changes into steam. [3] *Judged by the ordinary standards*, this young man is trustworthy. [4] *Although told to stop*, he kept on working [5] He threw himself from his horse and lay still *as if shot*. [6] He came back, *utterly exhausted*. (ibid.)
		absolute construction	-ing/-ed participle with its own logical subject, which is different from the subject of the main clause	[1] *The job finished*, we went home straight away. [2] *So many members being absent*, the meeting had to be put off. [3] *There having been no rain*, the ground was dry. (ibid.).
		verbless clause	without any (main) verb	[1] He went off, gun in hand. [2] The rescue party brought the victims down to the camp, half dead with the cold. [3] *Speechless*, Victor Henry nodded and sat on a folding seat. [4] She talked about her friends, *all of them television stars*. [5] *Though alone*, he was not lost. [6] *Once out of the can*, canned goods will lose its bacterial immunity. [7] *Ripe*, these apples are sweet. (ibid.)
		Infinitive	to do sth. for sb. to do sth.	[1] I stopped *for him to speak to me*. [2] He arrived late *to find the others had gone home*. [3] He laughed *to see such fun*. (Zhang 2023:690-693)

3.4. Clause constituents

Accordingly, clause constituents conform to word-classes and TOCs, since the major function of a clause constituent is to occupy a niche in the sentence, which extends the possibility of expression from a single word, to a long and complicated phrase, to even a clause whose length and complexity can be infinite.

In addition to S, O, P, and C (which are present in ESPs), the other four constituents of an independent clause in traditional grammar are predicate (referring to all that is left by the subject in a clause), appositive, attributive, and adverbial. The predicate can be ignored to minimize intrinsic cognitive load. Appositive is often a noun (phrase) or nominal clause (or any parallel clause constituent), attributive is to modify a noun and may be any kind of modifier, such as noun, adjective, determiner, and adjective-clause, and adverbial is to add more information and may be noun (phrase), adverb, prepositional phrase, and adverbial clause [7].

3.5. English syntactic patterns

English Syntactic Patterns, as the name "pattern" rather than "structure" indicates, are regular and prescriptive, involving only one word-class (i.e., verb) and four clause constituents (S, O, P, C). This is cognition-friendly and should be accredited to the Danish linguist Otto Jespersen (1860–1943), whose initiation of SVO (subject verb object), SVP (subject verb predicative) and other syntactic structures, in effect, gives prominence to the primary status of V (verb) and, accordingly, N (noun) since any verb necessitates its agent — the subject, which must be present in written form in English and is expressed as either a noun (phrase) or nominal-clause [2]. The primary importance of the verb is explicitly pointed out by Jespersen as a consensus of grammarians [26]. The top importance of nouns and verbs is later highlighted and made well-known by the syntactic analysis of Chomsky [4][39] that a sentence is made up of a noun phrase and a verb phrase: "Sentence → NP + VP."

Three differentiations can be observed in the six ESPs proposed in section 2.2. One differentiation is between action verbs and linking verbs, which are verbs depicting dynamic and static phenomena correspondingly; the second is between subject and object, which are both nominal expressions denoting the agent and the patient of action verbs, respectively, in ESP1 to ESP5, and the third is between predicative and complement. Predicative co-occurs with the linking verb (and the subject) in ESP6; complement is concurrent with the preceding subject or object (in ESP4 and ESP5) while the linking verb between complement and its preceding subject or object is semiotically invisible but semantically discernible, semiotically denied but semantically identified; to sum up, linking verb in ESP6 is marked and explicit while linking verb in ESP4 and ESP5 is unmarked and implicit in terms of linguistic form. This makes an alternative analysis of syntactic structures possible, which is to be stated in the next section.

4. An alternative to Chomskyan analysis of syntactic structures

The Chomskyan analysis of syntactic structures resounds with a bias of subject-predicate logic, which was initially and partially, if not fully, dislodged de facto by Jespersen with such analyses as SVO and SVP. Diachronic progress of syntactic analysis is interwoven with descriptivism and the subject-predicate logic, both of which can be dissociated from an alternative analysis (**Table 9**).

Table 9. Comparison of syntactic analyses

By	Grammar	Major features/contributions	Salient feature
Jespersen (1933,1937)	English (descriptivism)	(A) dislodgement of the subject-predicate bipartition/logic (B) concurrence of the word-class (Verb) and clause constituents (C) distinction of "predicative"	absence of (D)
Quirk et al. (1985) & Zhang (2023)	English (descriptivism)	(D) highlight of simple declarative sentence structures (E) exhaustive types of clauses and their syntactic functions	absence of (C)
Chomsky (1957, 1995)	English to UG (descriptivism)	(F) prominence given to NP and VP (G) UG as an abstract construct involving generative mechanism that is claimed to be minimal but not demonstrated in a minimalist way	absence of (A)
An Alternative Analysis	English to UG (prescriptivism)	(H) inclusion of (A), (B), (C), (D), (E) & modification of (F), (G) (I) exclusion of pragmatic and discursive concerns (J) concrete and simple generative mechanism: binarity of language (BOL)	absence of descriptivism

4.1. Jespersen's analysis

The value of the subject-predicate logic is doubted by Jespersen, who initiates an analysis of sentence structures that gives prominence to "verb" and "predicative" (not predicate) and de facto dislodges the subject-predicate logic [27]. Jespersen (1924, 1933, 1937) describes in detail all the elements in a sentence and all the forms of an English sentence, "syntactic research" engaging "much of his efforts for fifty years" [2, 26–27, 40].

Jespersen (1924: 86) finds that "the verb is a life-giving element, which makes it particularly valuable in building up sentences", and the definition of "predicative" with example sentences in his analysis implies the distinction of linking verb from action verb [2, 26–27].

In view of the fact that language and grammar change with time, Jespersen advocates a historical approach to grammar and thus considers a purely descriptive grammar to be of greater value than a prescriptive grammar in the context of linguistic research [2]; nevertheless, Jespersen favors an "appreciative" grammar that examines whether grammatical rules are "in every way clear (unambiguous, logical), expressive and easy" and whether some rules are preferable to other alternatives in any one of these respects [2]. This indicates that prescriptive grammar can be distilled from descriptive grammar.

4.2. Analyses by Quirk et al. and Zhang

The successful attempt to demonstrate the structure of a declarative simple clause instead of other forms of sentences (such as questions) is an important step forward by Quirk et al. (1985), whose exhaustive list of the types of clauses and their syntactic functions is another step forward to benefit English learners [3]. These two contributions are quoted and translated into Chinese by Zhang (2023) [7]. Descriptivism is applied in both works, while the notion of "predicative" (initiated by Jespersen) is missing. Nonetheless, the structure of a declarative simple clause by Quirk et al., in fact, initiates a prescriptive account of present-day English.

4.3. Chomskyan analysis

The subject-predicate logic is adopted in Chomskyan syntactic trees, which highlight NP and VP and attempt to expound the generative rules of how to locate all elements in a sentence (including auxiliary verb, etc.) and how to produce all forms of sentences (including question etc.) in a way of descriptivism [4–6]. This does not conform to Chomsky's long-held construct of Universal Grammar or the Minimalist Program (MP) in 1995,

which attempts to supply the "simplest grammar" for each language that is alleged as a computational system and understood as "biological endowment" and that is not specified until 2016 [41].

Afterwards, Chomsky (2016) explicitly points out the linguistic "linear order" being the "ancillary property of language" when he gives an account of the two post-MP (Minimalist Program) concepts: the "principle of Minimal Computation" called "Merge" and the "atoms of computation", which necessitates an alternative to Chomskyan syntactic analysis [42].

4.4. An alternative analysis

The alternative analysis herein features Binarity of Language (BOL), or, to be precise, NV Binarity (**Table 10**) in the context of prescriptive grammar. Dealing solely with linguistic intelligence among all the multiple intelligences of the human mind, BOL can be one of the "language-independent principles of computational efficiency" and thus can be a solution to the UG "conundrum" and form a mortise and tenon joint with the above-mentioned two post-MP concepts that are equally enlightening and awakening [43–45].

Table 10. Details of the Binarity of Language and the UG conundrum

Details of BOL	**movement**			
	(i) noun vs. verb (NV entity in the form of NV binarity)		regarding concrete physical objects (and extended to abstract concepts)	
	(ii) action verb vs. linking verb			
	(iii) present time vs. past time			
	(iv) perfect vs. continuous aspect			
	(v) active voice vs. passive voice			
	iteration vs. recursion		both physical and linguistic phenomenon	
	(vi) coordination vs. subordination		concerning abstract linguistic concepts	
	(vii) nominalization vs. modification			
UG conundrum	"(i) UG must be rich enough to overcome the problem of POS (poverty of stimulus)". (ii) UG must be simple enough to have evolved under the conditions of human evolution. (iii) UG must be the same for all possible languages." [23]			
Binary Entities	Type **A**= NV_{action} Type **B**=$NV_{linking}$			Number
ESP1	SV	The stones rolled.	A	1
		The stones were thrown (by the boys).	AA	2
ESP2	SVO	The boys threw stones.	AA	2
		Mary gave the ticket (to Tom).	AA(A)	2 (or 3)
		Tom was given the ticket (by Mary).	AA(A)	2 (or 3)
ESP3	SVOO	Mary gave Tom the ticket.	AAA	3
ESP4	SVOC	The news made Tom happy.	AB	2
		The book helps people to learn English.	AB	2
		Tom put sugar in the coffee.	AB	2
ESP5	SVC	The driver ended up in prison.	AB	2
		Tom was made happy (by the news).	A(A)B	2 (or 3)
ESP6	SVP	The boys are students	B	1
		Tom is worth his salt.	BB	2

First, UG differs from traditional studies (which focus on the language itself) in that it is concerned with the human brain that generates language, which is called a revolution in the history of linguistics. "UG is a theory of the initial state S_0 of the relevant component of the language faculty", while the language faculty is "one of the components of the mind/brain …. dedicated to language and its use" [6, 41, 46]. Chomsky argues that UG is "autonomous and independent of meaning", and it is maintained that language is best viewed as "an autonomous cognitive mechanism" [39, 47].

Second, UG obviates "the utopian idea of a perfect language" or a language common to all humanity — the dream "that has run now for almost two thousand years" [48]. Expected to describe the physical world that is constantly moving or changing in some way, UG can be visualized in the following details of BOL.

(1) Noun vs. verb: NV binarity is the way in which the abstract language describes everything in the ever-changing physical world as an NV binary entity (NV BE).

It is noteworthy that the writing rules of languages can be arbitrary and vary from one language to another, with only prescriptive Present-day English pinning it down that the subject must be put at the very beginning of the sentence and at least one main verb must be present, as illustrated in the above-mentioned ESPs of PEG. It should be emphasized that the writing rule is not a syntactic rule. Syntactic rule (traditionally called "grammar") is essentially binary and cognitively subject-based or noun-based in prescriptive Present-day English, since the absence of a subject indicates the abortion of a sentence; therefore, there is at least one NV binary entity in an English sentence. Additionally, an NV binary entity can be either N-based (marked as NV) or V-based (marked as VN when the presence of a verb implies the existence of its corresponding noun that may be absent in written form). Furthermore, the linking verb or the copula could be "understood but not overtly expressed" in some languages such as Old Hittite, Old Persian, Greek, Latin, and Tocharian [49].

(2) Action verb vs. linking verb: Binarity created by action verb and linking verb is attributable to Jespersen's analysis of English structure and can be credited to the human cognitive binarity or the human capacity of philosophical thinking of relativity. This is another way in which the physical world is virtualized by language, which portrays everything as either moving (action verb) or not moving (linking verb).

(3) Present time vs. past time: Likewise, binarity is constructed artificially and roughly by "past" and "present" time in language, while in the real physical world, "any phenomenon that repeats itself is a possible time" and movements of celestial bodies (such as Earth's rotation determining the length of the day) are used as time in the human world where "to meet the need for a better time standard, atomic clocks have been developed" [50]. In other words, "time" in human daily life cannot be "accurate" in the absolute sense; "present" and "past" are, in essence, relative terms for movements of celestial bodies, and "future" is also a relative concept that is periphrastically expressed and not accepted as a tense by many grammarians [16].

In addition to "time", an appellation for relative movement in the physical world and a label of "tense" in language, "aspect" and "voice" are devoted to two other binary attributes of physical movement: whether the movement is completed or not, where the movement originates and arrives at, viz. (4) perfect vs. continuous aspect, and (5) active vs. passive voice.

(6) Coordination vs. subordination: Logically, both iteration and recursion are found in language as well as in the physical or natural world. In language, they are replicated by way of coordination and subordination, respectively. Meanwhile, subordination is achieved through nominalization and modification.

(7) Nominalization vs. modification: Nominalization (**Table 8** and **Table 10**) exists in English, and it can be universal in human language. For instance, in Chinese, all verbs can be nominalized without changing

their morphological forms; "in other words, all verbs in Chinese are verbal nouns in nature", as Shen (2012) highlights [51]. In English, there are four ways of nominalization or five types of nominal expressions: (1) noun (phrase), (2) gerund (the -ing form of a single verb), (3) the nominalization of verb phrase (3A— the infinite -ing form of verb phrase, i.e. doing or doing something, 3B — the infinitive form of verb phrase, i.e. (to) do or (to) do something), (4) the nominalization of a sentence (4A— the infinite -ing form of a sentence, i.e. somebody's doing something, 4B — the infinitive form of a sentence, i.e. (for somebody) to do something), and (5) nominal clauses (the infinite form of a sentence that must follow specific rules of nominalization). Modification, realized through such devices as adjective clauses (**Table 8**) in addition to other modifiers, is another way of producing complex expressions.

5. Binarity of language

By courtesy of Pedagogical English Grammar expounded herein, Binarity of Language (BOL) manifests itself, which is in marked contrast to the binarity demonstrated by Chomsky or artificial deep neural network algorithms (**Table 11**).

Table 11. An alternative analysis of syntactic structure

Syntactic analysis	Paradigms for intelligence	Binarity	Methods	Traits	Weights	Intelligence	Risk	Computing
Chomskyan Analysis (Natural Language Generation: **NLG**)	The logic-inspired approach	subject-predicate binarity	using symbolic rules to manipulate symbolic expressions	**embodied creativity** and **high efficiency** in computing due to biological autonomy	**determinate**, relying on human cognition	**human**	from human	Minimalism
Artificial Deep Neural Network (Natural Language Processing: **NLP**)	the biologically-inspired approach	binarity of machine language effecting powerful algorithm(s) of the DNN	learning the strengths of the connections in an artificial deep neural network (DNN)	**data-driven creativity** and **high efficiency** owing to the great power of algorithms	**random**, to be picked and changed through training LLMs	**inhuman** (hallucination and confabulation)	from the complexity of big data and algorithms	Boolean Calculation
An Alternative Analysis (NLG)	the language-inspired approach	noun-verb binarity and other binarities	transforming human linguistic expressions into binary codes (/ machine language)	**embodied creativity** and **high efficiency** due to the generative nature of language rules	**determinate,** with noun/ nominal expression and verb enjoying highest weight	**human**	from human	Boolean Calculation
(adapted from Geoffrey Hinton's speech in 2024)								
(1) The "principle of Minimal Computation" called "Merge" "The simplest computational operation, embedded in some manner in every relevant computational procedure, takes objects X and Y already constructed and forms a new object Z. Call it Merge. The principle of Minimal Computation dictates that neither X nor Y is modified by Merge, and that they appear in Z unordered. Hence Merge (X, Y) = {X, Y}. That does not of course mean that the brain contains sets, as some current misinterpretations claim, …" [22] **(2) The "atoms of computation"** "The atoms of computation — call them "atomic concepts" — are word-like objects but not words. Words are constructed by the ancillary process of externalization, which does not feed the systems of thought, …… The atoms are sometimes called "lexical items", but that is not quite right either. The atoms of the syntactic computations that reach the conceptual-intentional interface do not have phonological properties, as lexical items do. These are assigned as an early step of externalization and are arbitrary, in the familiar Saussurean sense. Furthermore, as is now known, sound is only one possible modality for externalization." [22]								two post-MP ideas of Chomsky

5.1. Binarity of language

Chomskyan analysis of syntactic structure, explaining how knowledge is represented with the subject-predicate binarity, does not match two post-MP ideas of Chomsky mentioned in section 4.3, as the post-MP Chomskyan thinking virtually divests MP of the assumption of Phonetic Form (PF) and Logical Form (LF) in the minimal computation of language, which is the essence boiled down from Chomsky (2016) and Cheng and Shen (2022) [42, 52].

Nonetheless, NV binarity in the alternative analysis herein, ruling out the subject-predicate logic, can match the two post-MP ideas. (1) NV binary entities (BEs) are, echoing Chomsky's thoughts in 2016, "word-like but not words", especially when N is an abstract thought expressed in the form of a nominal clause, a thought that does "not have phonological properties, as lexical items do" [42]. Moreover, if "words are constructed by the ancillary process of externalization, which does not feed the systems of thought", NV binary entities are "assigned as an early step of externalization and are arbitrary", to borrow the exact words of Chomsky [42]. Hence, NV binary entities just sound like what Chomsky calls "the atoms of computation" [42]. (2) When the clause contains more than one NV binary entity, only one of them (the primary BE) is the most important or the cognitive focus; it appears at the beginning of the clause in PDE, but it may be placed at the ending place or other places of the clause in other languages. NV binary entities are rigidly ordered in PDE but may enjoy much freedom in other languages. In conclusion, NV binary entities, which can correspond to the "X and Y" that form a new Z in Chomsky's account, are "dictated" by the simple cognitive operation of merging or Chomskyan "Merge" [42]. It is noticeable that Z (herein understood as the aggregation or order of NV binary entities that finally form, for instance, the prescriptive ESPs) is strictly ordered in PDE, while Z (like the syntactic patterns in other languages) may be likely to be "unordered" or flexible in other languages. (3) Cognitive binarity presents itself in the details of BOL (**Table 10**), which can be expressed in Cartesian coordinates (**Table 12** and **Table 13**) in addition to "Merge" [42].

Table 12. English Syntactic Patterns in Cartesian coordinates

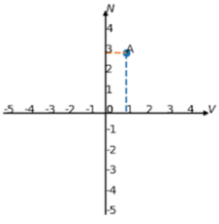
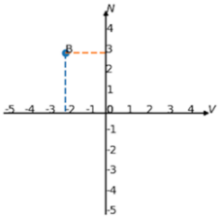
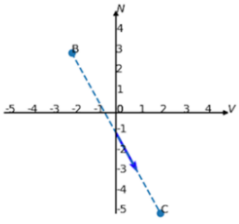
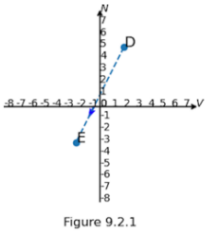
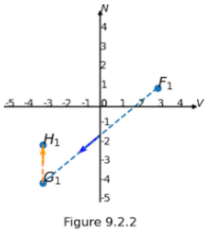
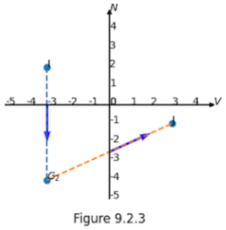
ESPs		Examples and figures		
ESP1	**SV**	**SV_1:** The stones rolled. (Figure 9.1.1)	**SV_2:** The stones were thrown. (Figure 9.1.2)	**SV_3:** The stones were thrown [by the boys]. (Figure 9.1.3)
		 Figure 9.1.1	 Figure 9.1.2	 Figure 9.1.3
ESP2	**SVO**	**SVO_1:** The boys threw stones. (Figure 9.2.1)	**SVO_2:** Mary gave the ticket [to Tom]. (Figure 9.2.2)	**SVO_3:** Tom was given the ticket [by Mary]. (Figure 9.2.3)
		 Figure 9.2.1	 Figure 9.2.2	 Figure 9.2.3

Table 12 (Continued)

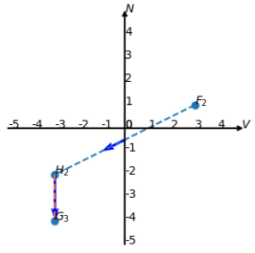
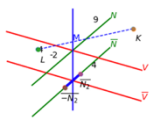
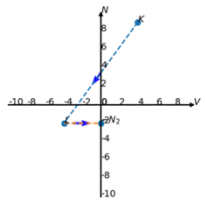
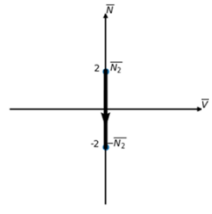
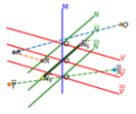
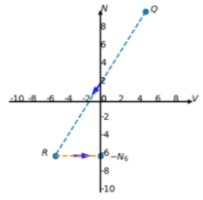
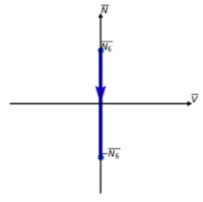
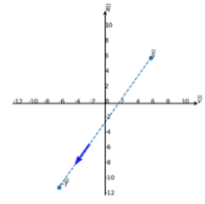
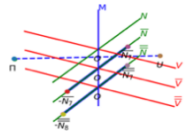
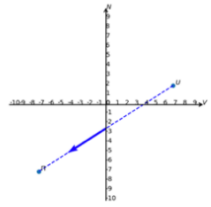
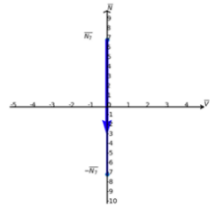
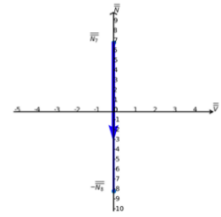
ESPs		Examples and figures		
ESP3	**SVOO**	**SVOO:** Mary gave Tom the ticket. (Figure 9.3)		
		 Figure 9.3		
ESP4	**SVOC**	**$SVOC_1$:** The news made Tom happy. (Figure 9.4.1)	**$SVOC_2$:** The book helps people to learn English. (Figure 9.4.2)	**$SVOC_3$:** Tom put sugar in the coffee. (Figure 9.4.3)
		 Figure 9.4.1  Figure 9.4.1 a  Figure 9.4.1 b		
		 Figure 9.4.2  Figure 9.4.2 a  Figure 9.4.2 b  Figure 9.4.2 c		
		 Figure 9.4.3  Figure 9.4.3 a  Figure 9.4.3 b  Figure 9.4.3 c		
ESP5	**SVC**	**SVC_1:** The driver ended up dead. (Figure 9.5.1)	**SVC_2:** The driver ended up in prison. (Figure 9.5.2)	**SVC_3:** The driver ended up honking the horn all the way. (Figure 9.5.3)
		SVC_4: Tom was made happy [by the news]. (Figure 9.5.4)	**SVC_5:** Sugar was put in the coffee [by Tom]. (Figure 9.5.5)	**SVC_6:** People are helped to learn English [by the book]. (Figure 9.5.6)

Table 12 (Continued)

ESPs	Examples and figures

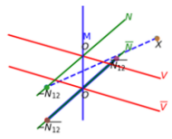


Figure 9.5.1

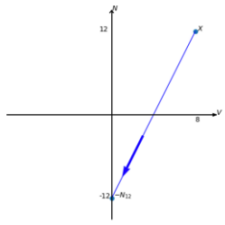
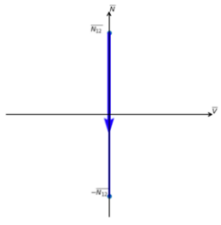


Figure 9.5.1 a



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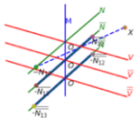
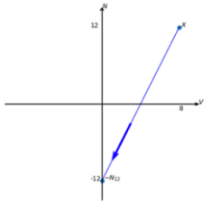


Figure 9.5.2



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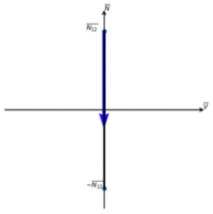


Figure 9.5.2 b

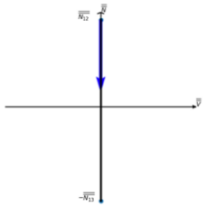


Figure 9.5.2 c

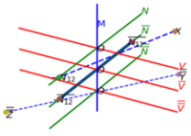


Figure 9.5.3

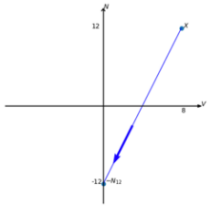


Figure 9.5.3 a

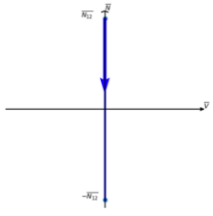


Figure 9.5.3 b

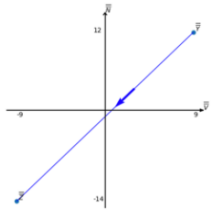
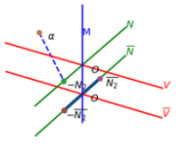


Figure 9.5.3 c



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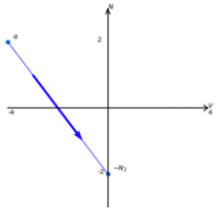

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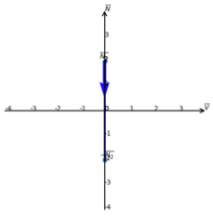

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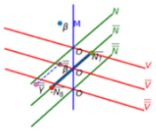

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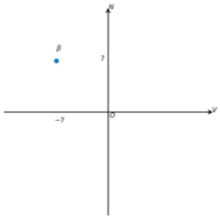

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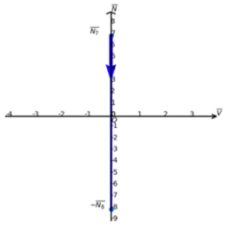

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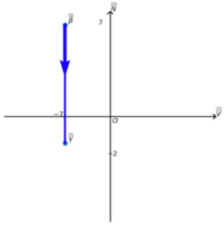


Figure 9.5.5 c

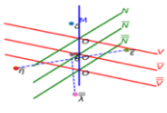


Figure 9.5.6

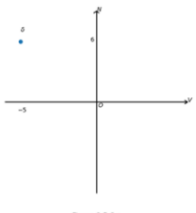


Figure 9.5.6 a

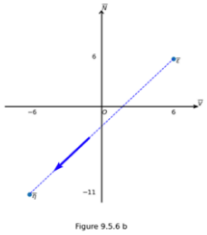


Figure 9.5.6 b

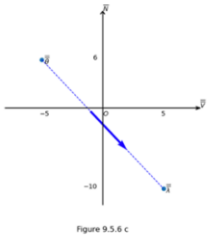


Figure 9.5.6 c

Table 12 (Continued)

ESPs		Examples and figures		
ESP6	**SVP**	**SVP1:** The boys are happy/students. (Figure 9.6.1)	**SVP2:** The boys are in the gymnasium. (Figure 9.6.2)	**SVP3:** Tom is worth his salt. (Figure 9.6.3)

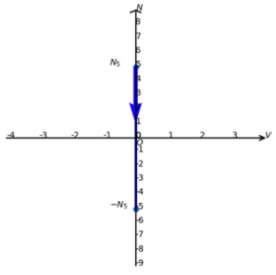


Figure 9.6.1

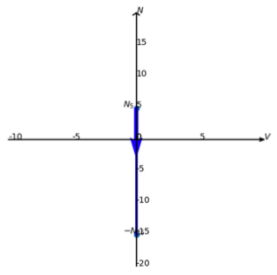
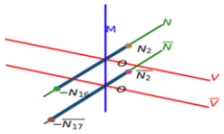


Figure 9.6.2



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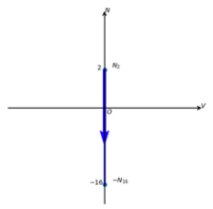


Figure 9.6.3 a

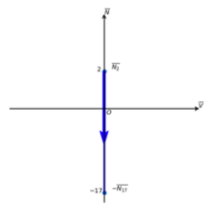


Figure 9.6.3 b

Table 13. English complex sentences in Cartesian coordinates

Types of clauses		Examples and Cartesian coordinates
Coordinate Clause (Figure 10.1)		Sports are beneficial: they keep your pulse hopping. (Figure 10.1.1) Tom didn't see Mary, but Mary saw Tom. (Figure 10.1.2)
Subordinate Clause (Figure 10.2)	**Nominal Clause**	Tom didn't know whether Mary had gone. (Figure 10.2.1a) Wherever Tom once lived was well preserved. (Figure 10.2.1b) The truth is that Mary's grumbling annoyed Tom. (Figure 10.2.1c) The fact has to be faced that the bus station is far away. (Figure 10.2.1d) Mary's grumbling annoyed Tom. (Figure 10.2.1e) It is important for people to learn languages. (Figure 10.2.1f)
	(Figure 10.2.1)	

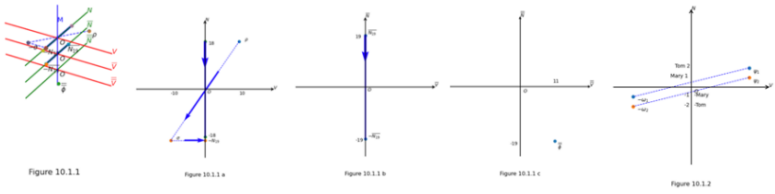


Figure 10.1.1 Figure 10.1.1 a Figure 10.1.1 b Figure 10.1.1 c Figure 10.1.2

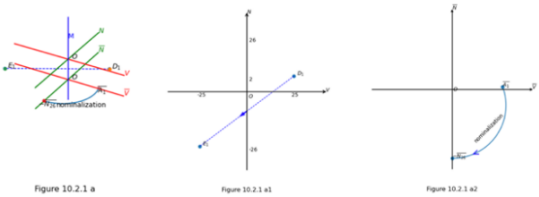


Figure 10.2.1 a Figure 10.2.1 a1 Figure 10.2.1 a2

Table 13 (Continued)

Types of clauses	Examples and Cartesian coordinates

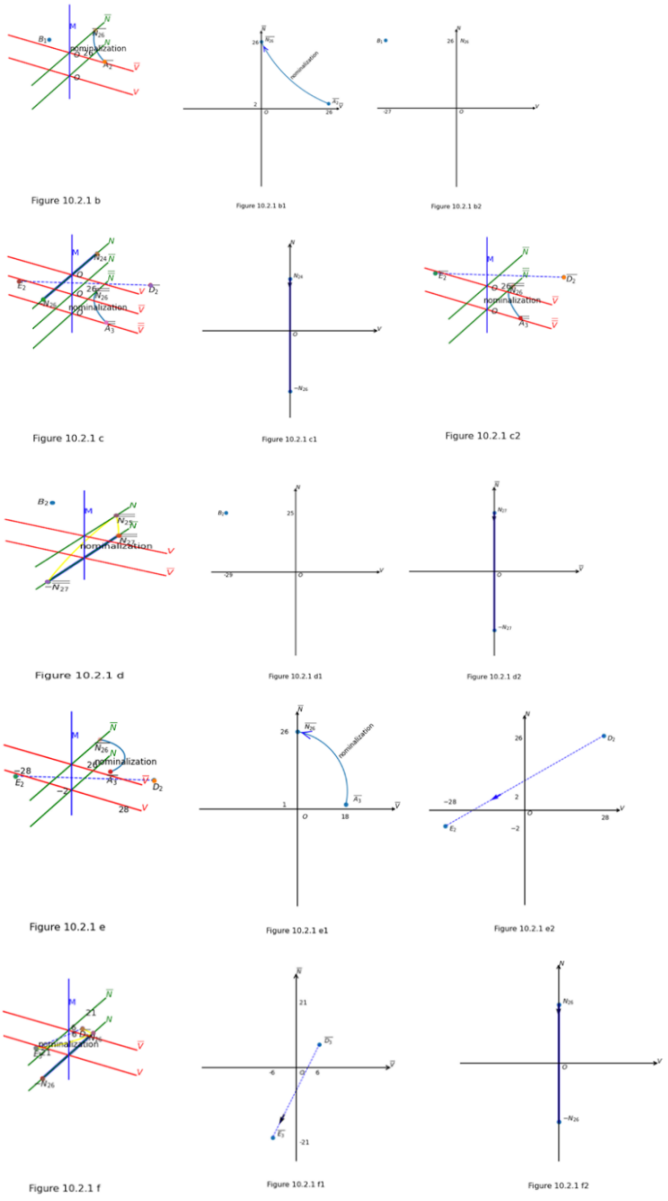


Figure 10.2.1 b

Figure 10.2.1 b1

Figure 10.2.1 b2

Figure 10.2.1 c

Figure 10.2.1 c1

Figure 10.2.1 c2

Figure 10.2.1 d

Figure 10.2.1 d1

Figure 10.2.1 d2

Figure 10.2.1 e

Figure 10.2.1 e1

Figure 10.2.1 e2

Figure 10.2.1 f

Figure 10.2.1 f1

Figure 10.2.1 f2

Adjective Clause Mary saw Tom, who didn't see her. (Figure 10.2.2a)
The driver honking the horn ended up in prison. (Figure 10.2.2b)
The stones thrown by the boys rolled. (Figure 10.2.2c)
Tom bought a book for Mary to learn English. (Figure 10.2.2d)

(Figure 10.2.2)

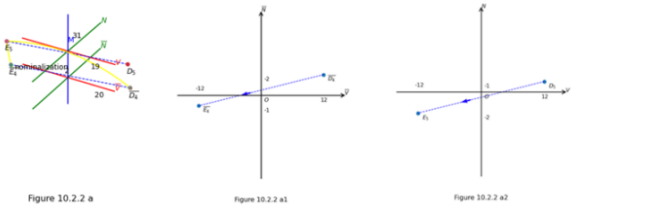


Figure 10.2.2 a

Figure 10.2.2 a1

Figure 10.2.2 a2

Table 13 (Continued)

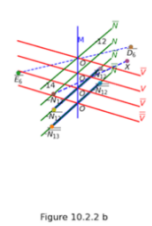
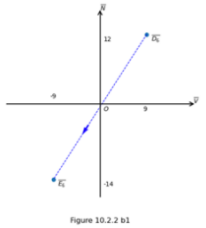
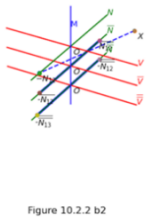
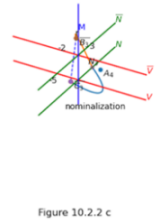
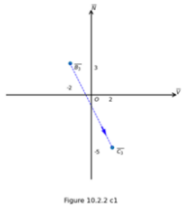
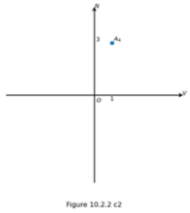
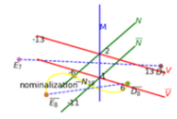
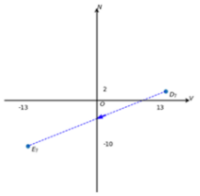
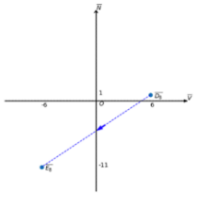
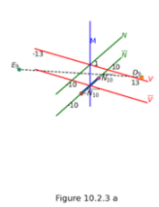
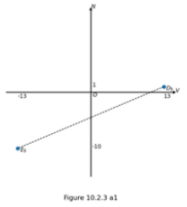
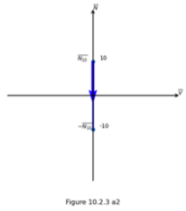
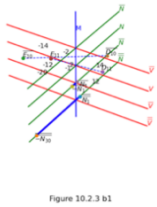
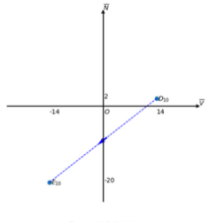
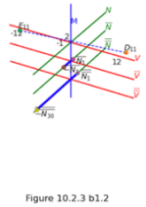
Types of clauses	Examples and Cartesian coordinates	
	 Figure 10.2.2 b  Figure 10.2.2 b1  Figure 10.2.2 b2	
	 Figure 10.2.2 c  Figure 10.2.2 c1  Figure 10.2.2 c2	
	 Figure 10.2.2 d  Figure 10.2.2 d1  Figure 10.2.2 d2	
Adverbial Clause	Mary didn't buy the book, because it was expensive.	(Figure 10.2.3a)
	Opening the door, Tom saw Mary in. (Figure 10.2.3b1) The last bus having gone, Tom had to walk home. (Figure 10.2.3b2) Mary talked about her friends, all of them television stars. (Figure 10.2.3b3)	(Figure 10.2.3b)
	Although told to stop, the driver kept (on) driving. (Figure 10.2.3c1) His homework done, Tom decided to play. (Figure 10.2.3c2)	(Figure 10.2.3c)
	Tom stopped for Mary to speak to him.	(Figure 10.2.3d)
(Figure 10.2.3)	 Figure 10.2.3 a  Figure 10.2.3 a1  Figure 10.2.3 a2  Figure 10.2.3 b1  Figure 10.2.3 b1.1  Figure 10.2.3 b1.2	

Table 13 (Continued)

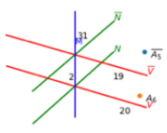
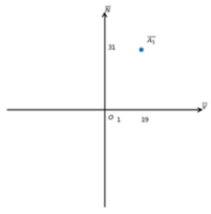
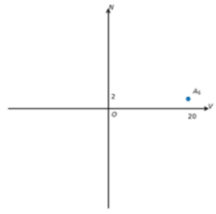
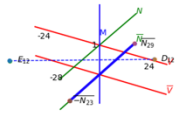
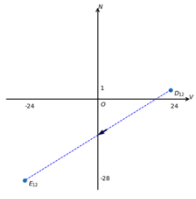
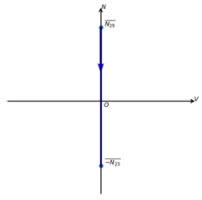
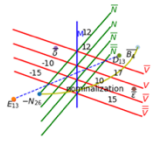
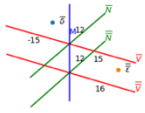
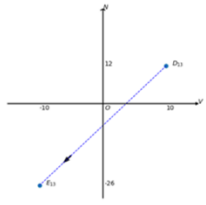
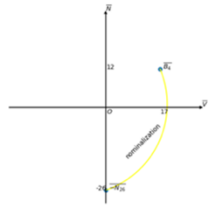
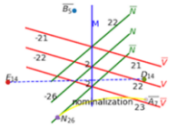
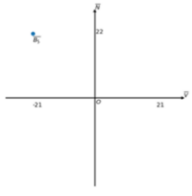
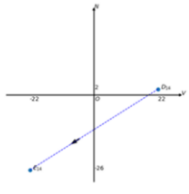
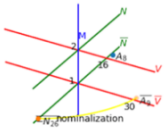
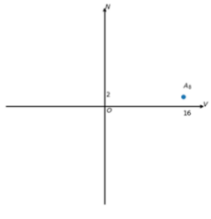
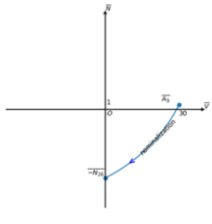
Types of clauses	Examples and Cartesian coordinates
	 Figure 10.2.3 b2  Figure 10.2.3 b2.1  Figure 10.2.3 b2.2
	 Figure 10.2.3 b3  Figure 10.2.3 b3.1  Figure 10.2.3 b3.2
	 Figure 10.2.3 c1  Figure 10.2.3 c1.1  Figure 10.2.3 C1.2  Figure 10.2.3 C1.3
	 Figure 10.2.3 c2  Figure 10.2.3 C2.1  Figure 10.2.3 C2.2  Figure 10.2.3 C2.3
	 Figure 10.2.3 d  Figure 10.2.3 d1  Figure 10.2.3 d2

Table 13 (Continued)

Types of clauses	Examples and Cartesian coordinates
Figure 10.1 Coordinate Clause	
Figure 10.1.1 Sports are beneficial: they keep your pulse hopping.	
Figure 10.1.2 Tom didn't see Mary, but Mary saw Tom.	
Figure 10.2 Subordinate Clause	
Figure 10.2.1 **Nominal Clause** (Figure 10.2.1a/b/c/d+ Figure 10.2.1e <Gerund> + Figure 10.2.1f <Infinitive>)	
Figure 10.2.1a Tom didn't know whether Mary had gone.	
Figure 10.2.1b Wherever Tom once lived was well preserved.	
Figure 10.2.1c The truth is that Mary's grumbling annoyed Tom.	
Figure 10.2.1d The fact has to be faced that the bus station is far away.	
Figure 10.2.1e Mary's grumbling annoyed Tom.	
Figure 10.2.1f It is important for people to learn languages.	
Figure 10.2.2 **Adjective Clause** (Figure 10.2.2a/b/c + Figure10.2.2d <Infinitive>)	
Figure 10.2.2a Mary saw Tom, who didn't see her.	
Figure 10.2.2b The driver hitting the guard-rail ended up in prison.	
Figure 10.2.2c The stones thrown by the boys rolled.	
Figure 10.2.2d Tom bought a book for Mary to learn English.	
Figure 10.2.3 **Adverbial Clause** (Figure 10.2.3a/b/c/+ Figure 10.2.3d <Infinitive>)	
Figure 10.2.3a Mary didn't buy the book, because it was expensive.	
Figure 10.2.3b includes Figure 10.2.3b1, Figure 10.2.3b2, and Figure 10.2.3b3.	
Figure 10.2.3b1 Opening the door, Tom saw Mary in.	
Figure 10.2.3b2 The last bus having gone, Tom had to walk home.	
Figure 10.2.3b3 Mary talked about her friends, all of them television stars.	
Figure 10.2.3c	
Figure 10.2.3c1 Although told to stop, the driver kept (on) driving.	
Figure 10.2.3c2 His homework done, Tom decided to play.	
Figure 10.2.3d Tom stopped for Mary to speak to him.	

Binarity of machine language can be immeasurably powerful in artificial deep neural networks (DNNs), which are designed to train LLMs and have achieved fantastic performance while posing "large-scale risks" that might be out of human control and wanting "urgent" governance [53], as Bengio et al. (2024) point out. Moreover, Bever et al. (2023) maintain that data-driven creativity by DNNs is flawed in that DNNs "receive training that far exceeds any human experience" and "are doomed to be largely useless models for psychological research on language" [54].

To sum up, the binarity of human language and the binarity of machine language may converge where human intelligence and artificial intelligence are balanced and well-governed. At this juncture, Chomskyan linguistics recommends itself.

5.2. Chomskyan linguistics vs. non-Chomskyan linguistics

Chomsky is in pursuit of a simple, optimal, explanatory, and all-embracing theory [55]. Chomskyan linguistics studies language from a perspective that is rational and theoretical to such an extent that it is seemingly intuitive but actually philosophical [15, 55–57]. Linguistic thoughts or theories by Chomsky can be called Chomskyan Linguistics, which is "a continuation of the tradition of Cartesian Linguistics" [58]; despite the questionable "aptness of the term of 'Cartesian Linguistics'", this 1966 term is used to summarize the nature and significance of the ideas on the study of language in the premodern period [58–59]. "The central doctrine of Cartesian Linguistics is that the general features of grammatical structure are common to all languages and reflect certain fundamental properties of the mind", as Chomsky (2009) argues [58]. Chomskyan Linguistics is purely theoretical and human-oriented, and this term is formally proposed herein to alert people to the urgency and probability

of data-dominated LLMs promising to "exceed human abilities" and pose "large-scale risks" [53]. Chomskyan Linguistics and Non-Chomskyan Linguistics are the two sides of the same coin, the latter being more specific and experiential and probably maintaining the view that "language is primarily a tool for communication rather than thought" [60].

Chomskyan Linguistics (an expression already used by some scholars, who attempt to pose challenges from some perspective) [61–63], is worthy of this term because of its human touch, its theoretical and philosophical perfection, and its nature of interdisciplinarity concerning such natural sciences as biology, physics, (physical) chemistry, and mathematics. The notion of language faculty is concerned with biology and, consequently, biolinguistics, which by itself is "an interdisciplinary field with a necessary unifying potential regarding explanatory account of the human language faculty" and which holds that the fundamental purpose of language is the expression of thought rather than communication [64–65]. UG also deals with physics through the lens of Binarity of Language and involves mathematics, as human language can be understood as some form of Boolean algebra (**Table 10**) and can be expressed in Cartesian coordinates (**Table** 12 and **Table 13**, where the axis of M signifies the Chomskyan "Merge").

In short, the bipartite categorization of linguistics into Chomskyan vs. Non-Chomskyan Linguistics mirrors "the dual property of language as expression-for-thought and tool-for-communication", though, ultimately and philosophically, "language, like art, is not 'for' anything, conforming to aesthetic rather than utilitarian principles" since language is a biologically realized and mathematically determined object that exists for its own sake, as is maintained by Watumull (2024) [66–67].

The variety of dead or living human languages, in itself, is a solid fact of the biological realization of language. Language aids communication as language "creates thoughts" [67]. Watumull argues that the structure of language "is determined purely by mathematical law" and language is mainly used by humans in "giving material form to imaginal reality" or thought and encoding humans' physical, biological, and psychological reactions to the world [67]. However, humans have cognitive constraints, under which linguistic communication calls for minimalist linguistic rules that may go through the bottleneck of sequential information processing and follow such principles as the "Behaghel law — that which is mentally closely related is also placed close together" [68]. Therefore, language, unifying "the worlds of abstractions, minds, and bodies", can be a metaverse following the minimalistic law of language or the binarity of language [67].

5.3. Language as metaverse

Language could be understood as a unique metaverse, which is a virtual reality space interacting with the physical world through human cognition, realized by the physical, biological, and psychological mechanisms of human beings. Language is created by means of several prescriptively universal rules that cannot detail the accuracy of the physical, biological and psychological mechanisms, which entails Non-Chomskyan Linguistics as the complement of Chomskyan Linguistics and which is embodied in the human body and thus can be considered to be approached by empirical knowledge or behaviorism, not in the traditionally radical sense, (despite "Noam Chomsky's 1959 review of B. F. Skinner's *Verbal Behavior* (CRS)", "the most important book review thus far in the field of linguistics"), but in the sense of "human action" and "language development" in "people's repeated social-linguistic experiences" and "language learner agency" in sociocultural space or "transnational, transcultural, and translingual spaces", covered in pillars for language education such as "praxeology, humanism, equity, and mixed methods" [69–70]. Meanwhile, in CRS, Chomsky emphasizes the

importance of researching the structure of grammar as a premise for our understanding of verbal behavior [71]. Nevertheless, binarity of language can be the first principle of linguistic structure and the underlying rule of linguistic metaverse.

Moreover, language as a metaverse adds to the complexity of Metaverse in reality, since "A Metaverse is a massively scaled and interoperable meta-ecosystem of other digital ecosystems of real-time rendered 3D virtual worlds which can be experienced synchronously and persistently by an unlimited number of complementors and consumers with an increased user experience caused by a creativity-guided co-creation of goods managed by orchestrators and supported by platform owners" [72].

In addition, the development of the Internet, Metaverse, and AI drives the evolution of human activity space and may reconstruct the paradigm of (foreign) language teaching, ethical and cultural issues of which cannot be covered in the limited space of this paper, but make the availability of the limited rules of a language increasingly significant [73–74].

Besides, these limited rules should be well-tailored in human education and summarized as Pedagogical Grammar (PG) in educational linguistics [75–76]. In the real world, there is a lack of awareness of the significance of these limited rules that are theoretical and abstract in some way. For instance, the student teachers' awareness of teaching the limited rules of a language is often insufficient, as pointed out by Trotzke, who reports on the pan-European practice of teaching "structural properties" of a specific language in addition to the properties of the language per se, names this way of teaching as a new enterprise of "pedagogical linguistics", and, later, confirms the benefits of these theoretical or formal structural concepts in first language education through an intervention study by Hallab and Trotzke [77].

6 Conclusion

This paper probes into the minute details of English grammar that are attributable to the efforts of Jespersen (1924, 1933, 1937), viz., the necessary presence of "verb" in a complete clause and the distinctive notion of "predicative", which are absent in authoritative grammar books such as Quirk et al. (1985) and Zhang (2023). Contrary to descriptivism in traditional English grammars by Jespersen, Quirk et al., and Zhang, prescriptivism is exploited for the new construct of Pedagogical English Grammar (PEG), viz., the limited rules of the English language that generate infinite forms of simple or complex sentences, thoughts, and meanings. PEG paves the way for cognitive binarity or Binarity of Language (BOL) to manifest itself.

BOL, acting as a second new conception in this paper to dissolve the Chomskyan UG conundrum, differs from binarity in artificial neural networks, but both can finally converge on the binary language of computers. In the context of AI developed at a rapid pace of progress, Chomskyan Linguistics is proposed as a third new term for interdisciplinary theoretical linguistics that is human-oriented, in contrast to data-dominated AI linguistics.

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Disclosure statement

The authors declare no conflict of interest.

References

[1] Bloomfield L, 1916, Subject and Predicate. Transactions and Proceedings of the American Philological Association, 1916(47): 13–22.

[2] Jespersen O, 1933, Essentials of English grammar. George Allan & Unwin Ltd, London.

[3] Quirk R, Greenbaum S, Leech G, 1985, A Comprehensive Grammar of the English Language. Longman Group Limited, England.

[4] Chomsky N, 1957, Syntactic Structures (12th printing in 1976). Mouton, The Hague.

[5] Chomsky N, 1965, Aspects of the Theory of Syntax. The MIT Press, Cambridge.

[6] Chomsky N, 1995, The Minimalist Program (third printing in 1997). The MIT Press, Cambridge.

[7] Zhang ZB, 2023, A New Advanced English Grammar (Second Edition). Shanghai Foreign Language Education Press, Shanghai.

[8] Jaszczolt KM, 2023, Understanding Human Time. Oxford University Press, Oxford.

[9] Ambridge B, Blything L, 2024, Large Language Models are Better than Theoretical Linguists at Theoretical Linguistics. Theoretical Linguistics, 50(1–2): 33–48.

[10] Chen GH, 2024, Geoffrey Hinton's Speech Upon Receiving the Ulysses Medal. Contemporary Linguistics, 26(4): 489–495.

[11] Feng ZW, Chen GH, Li YM, et al., 2024, On Hinton & Chomsky: Comments by Chinese Linguists. Chinese Journal of Language Policy and Planning, 2024(6): 5–17.

[12] Ding XM, Feng ZW, 2025, Hinton and Chomsky Disagree on Language Intelligence. Foreign Language Research, 2025(2): 25–33.

[13] Lu JM, 2025, The Distinction between the "Language" in Large Language Model and the Human Language. Chinese Journal of Language Policy and Planning, 2025(1): 1.

[14] Gray J, 2009, Jim Gray on eScience: A Transformed Scientific Method, in The Fourth Paradigm: Data-intensive Scientific Discovery. Microsoft Corporation, Washington, xvii–xxxi.

[15] Cheng G, 1999, Linguistic Universalism. Shanghai Foreign Language Education Press, Shanghai.

[16] Rissanen M, 1999, Syntax, in The Cambridge History of the English Language (Volume III 1476–1776). Cambridge University Press, Cambridge, 187–331.

[17] Seidlhofer B, 2011, Understanding English as a Lingua Franca. Oxford University Press, Oxford.

[18] Labov W, 1994, Principles of Linguistic Change (Volume 1: Internal Factors). Blackwell Publishers Inc, Massachusetts.

[19] Birkeland A, Block A, Craft JT, et al., 2024, Rejecting Nativeness to Produce a More Accurate and Just Linguistics. Language 100(3). e156-e194.

[20] Kern R, 2024, Twenty-first Century Technologies and Language Education: Charting a Path Forward. Modern Language Journal, 2024(108): 515–533.

[21] De Saussure F, 1971, Cours de Linguistique Générale. PAYOT, Paris.

[22] Baskin W, 2011, Course in General Linguistics (by Ferdinand de Saussure). Columbia University Press, New York.

[23] Qian GL, 2021, Language: The Last Homestead of Human Beings. Routledge, London.

[24] Finegan E, 2001, Usage, in The Cambridge History of the English Language (Volume VI English in North America). Cambridge University Press, Cambridge, 358–421.

[25] Fromkin V, Robert R, Hyams N, 2017, An Introduction to Language (11th edition). Cengage Learning, Inc, Boston.

[26] Jespersen O, 1924, The Philosophy of Grammar. George Allan & Unwin Ltd, London.

[27] Jespersen O, 1937, Analytic Syntax. The University of Chicago Press, Chicago.

[28] Hopper PJ, Traugott EC, 2003, Grammaticalization (Second Edition). Cambridge University Press, Cambridge.

[29] Traugott EC, Dasher RB, 2003, Regularity in Semantic Change. Cambridge University Press, Cambridge.

[30] Boye K, 2023, Grammaticalization as a Conventionalization of Discursively Secondary Status: Deconstructing the Lexical-grammatical Continuum. Transactions of the Philological Society, 121(2): 270–292. https://doi.org/10.1111/1467-968X.12265

[31] Thorn A, Page M, 2009, Interactions between Short-term and Long-term Memory in the Verbal Domain. Routledge, London.

[32] Miller GA, 1956, The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information. Psychological Review, 1956(63): 81–97.

[33] Sweller J, Ayres P, Kalyuga S, 2011, Cognitive Load Theory. Springer, New York.

[34] Sweller J, 2023, The Development of Cognitive Load Theory: Replication Crises and Incorporation of other Theories can Lead to Theory Expansion. Educational Psychology Review, 2023(35): 95.

[35] Sweller J, 2024, Cognitive Load Theory and Individual Differences. Learning and Individual Differences, 2024(110): 102423.

[36] Paskaleva B, 2024, Pre-structuralist Semiology: Materiality of Language in Ferdinand de Saussure. Semiotica, 2024(259): 149–183.

[37] Cheng G, 2018, What Should the Lexicon Be Like? A Biolinguistic Perspective. Journal of Foreign Languages, 41(1): 23–30.

[38] Li FYT, 2024, Image Schemas and (POINT)-TO-POINT Event Model for the Macro-event. Review of Cognitive Linguistics, published online, 1–30.

[39] Chomsky N, 2002, Syntactic Structures (Second Edition). Mouton de Gruyter, New York.

[40] Mccawley JD, 1937, Introduction. In Otto Jespersen, Analytic Syntax. The University of Chicago Press, Chicago, xi–xix.

[41] Chomsky N, 2015. The Minimalist Program (20th Anniversary Edition). The MIT Press. Cambridge.

[42] Chomsky N, 2016. What Kind of Creatures Are We? Columbia University Press, New York.

[43] Gardner H, 2011, Frames of Mind: The Theory of Multiple Intelligences. Basic Books, New York.

[44] Chomsky N, 2022. Genuine Explanation and the Strong Minimalist Thesis. Cognitive Semantics, 8(3): 347–365.

[45] Chomsky N, 2021, Minimalism: Where are We Now, and Where Can We Hope to Go. Gengo Kenkyu, 2021(160): 1–41.

[46] Chomsky N, 1993, Language and Thought. Moyer Bell, Rhode Island.

[47] Friederici D, Chomsky N, Berwick RC, et al., 2017, Language, Mind and Brain. Nature Human Behavior, 2017(1): 713–722. https://doi.org/10.1038/s41562-017-0184-4

[48] Eco U, 1995, The Search for the Perfect Language (translated by James Fentress). Blackwell Publishers Ltd, Oxford.

[49] Fortson BW, 2010, Indo-European Language and Culture: An Introduction (Second Edition). Wiley-Blackwell,

Chichester.
[50] Walker J, 2022, Fundamentals of Physics (12th Edition) (Volume One). John Wiley & Sons, Inc, Hoboken.
[51] Shen JX, 2012, Reflections on “Nouny Verbs”: Problems and Solutions. Chinese Teaching in the World, 26(1): 3–17.
[52] Cheng G, Shen Y, 2022. Formal Linguistics: New Perspectives and Development. Tsinghua University Press, Beijing.
[53] Bengio YS, 2024, Managing AI Risks in an Era of Rapid Progress. https://arxiv.org/pdf/2310.17688.pdf
[54] Bever TG, Chomsky N, Fong S, et al., 2023, Even Deeper Problems with Neural Network Models of Language. Behavioral and Brain Sciences, 2023(46): e387. https://doi.org/10.1017/S0140525X23001619
[55] Mei DM, Tong HL, 2019, The Minimalist Program. Shanghai Foreign Language Education Press, Shanghai.
[56] Mei DM, 2017, Encyclopedia of Linguistics and Applied Linguistics. Peking University Press, Beijing.
[57] Mei DM, 2021, On the Development of the Theory of Generative Grammar. Shanghai Foreign Language Education Press, Shanghai.
[58] Chomsky N, 2009. Cartesian Linguistics: A Chapter in the History of Rationalist Thought (Third Edition). Cambridge University Press, Cambridge.
[59] Macgilvray J, 2009, Introduction to the Third Edition, in Cartesian Linguistics: A Chapter in the History of Rationalist Thought (Third Edition). Cambridge University Press, Cambridge, 1–52.
[60] Fedolenco E, Piantadosi ST, Gibson EAF, 2024, Language is Primarily a Tool for Communication Rather than Thought. Nature, 2024(630): 575–586.
[61] Duffley PJ, 2022, Caught between an Empirical Rock and an Innate Hard Place: The Philosophies behind Chomsky’s Linguistics. International Philosophical Quarterly, 62(4): 383–411.
[62] Everett DL, 2007, Challenging Chomskyan Linguistics: The Case of Pirahã. Human Development, 50(6): 297–299.
[63] Lorenzo G, 2021, Otto Jespersen, One More Broken Leg in the Historical Stool of Generative Linguistics. Historiographia Linguistica, 48(2–3): 302–315.
[64] Berwick RC, Chomsky N, 2016, Why Only Us: Language and Evolution. The MIT Press, Cambridge.
[65] Lipij Ana, 2024, Explanatory Account of the Human Language Faculty: The Developmentalist Challenge and Biolinguistics. Philosophy and Society, 35(1): 81–101.
[66] Feng ZW, 2025, The Duality of Thought and Communication Respecting Language. Guangming Daily, February 23, 2025.
[67] Watumull J, 2024, Language is a “Quite Useless” Tool: A Rejoinder to Fedorenko, Piantadosi, and Gibson’s “Language is Primarily a Tool for Communication Rather than Thought”. Biolinguistics, 2024(18): 1–41. https://doi.org.10.5964/bioling.15229
[68] Futrell R, Hahn M, 2025, Linguistic Structure from a Bottleneck on Sequential Information Processing. Nature Human Behavior, preprint, 1–12. https://doi.org/10.1038/s41562-025-02336-w
[69] Newmeyer FJ, 2024, Commentary on Noam Chomsky’s Review of B. F. Skinner’s Verbal Behavior. Language, 100(3): 604–609.
[70] Zheng YY, Ortega L, Doehler SP, et al., 2025, Praxeology, Humanism, Equity, and Mixed Methods: Four Pillars for Advancing Second Language Acquisition and Teaching. The Modern Language Journal, 109(S1): 64–89. https://doi.org/10.111/modl.12977
[71] Chomsky N, 2024. Verbal Behavior by B.F. Skinner (Review). Language, 100(3): 579–603.

[72] Schöbel SM, Leimeister JM, 2023, Metaverse Platform Ecosystems. Electronic Markets, 33(12): 1–10. https://doi.org/10.1007/s12525-023-00623-w

[73] Chen JL, 2020, On the Application of Artificial Intelligence in Foreign Language Teaching. Journal of Beijing International Studies University, 2020(2): 14–24.

[74] Chen JL, Feng Q, 2024, A Tentative Study of Foreign Language Teaching in the Context of Metaverse. Journal of Beijing International Studies University, 2024(1): 99–108.

[75] Hallab A, Trotzke A, 2025, Linguistic Reasoning for Secondary School Students: The Case of Identifying Syntactic Functions in L1 Grammar Education. Linguistics and Education, 90(101467): 1–18. https://doi.org/10.1016/j.linged.2025.101467

[76] Wu BS, Yang XB, 2026, Rethinking Language Education in the Age of Generative AI (Book Review). Language and Education, 40(2): 558–561.

[77] Trotzke A, 2023, Pedagogical Linguistics: Connecting Formal Linguistics to Language Teaching. Language, 99(3): e153–e175.