History of Linguistic Diagrams

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Glossary:

- **configuration**: a meaningful spatial arrangement between two or more *visual entities in a visual *inscription.
- **diagram**: a complex *iconic *inscription of a relational structure, built according to shared conventions that govern the form and the use of *visual entities and *configurations, for exposition, manipulation, exploration and discovery purposes.
- **icon (adj. *iconic*)**: a sign that shares structural similarities with what it *inscribes.
- **inscription (verb *to inscribe*)**: a sign that provides abstract and amorphous knowledge with a specific substance in order to make it perceivable and shareable.
- **visual entity**: a meaningful, visible and discrete figure that is recognized as such in a visual *inscription.

Keywords: configuration, diagram, icon, inscription, knowledge representation, shared practices, visual entity, visual sign

Key points:

- Linguistic diagrams are semiotic objects that use visual means to inscribe theoretical models or analyzed materials that pertain to linguistic epistemology.
- Linguistic diagrams are historical objects that must be interpreted with respect to related linguistic theories.
- The origins of the conventions that linguistic diagrams follow are extrinsic to the field. Such conventions become fully integrated to the field when they become shared practices in the community.
- There exist traditions of linguistic diagrams, but the search of pioneers who would have invented or imported them is less fruitful than the examination of the climate of thought in which they developed.

1 Introduction

Linguists, and grammarians before them, have been using diagrams for centuries — some graphical depictions of grammatical conceptions appear in medieval manuscripts. However, the independent exploration of the topic is a new direction in the field of History of linguistics. The importance of specific diagrams has been pointed out in various works, but research papers focused on the history of such graphical objects are not frequent. Therefore, rather than presenting a synthesis of the current state of the art on the history of linguistic diagrams, this contribution will mainly focus on major theoretical, methodological and philological issues, illustrating them with case studies whenever

possible. Section →2 is dedicated to the description of diagrams as semiotic objects. Section →3 deals with historical issues. The conclusion summarizes the most significant points of this article (→4).

2 Linguistic diagrams as semiotic objects

In order to evaluate the methodological challenge of historical studies about linguistic diagrams, one must first assess their general properties. Diagrams are a class of signs that represent relational structures (→2.1). They express knowledge in a visual way (→2.2). Linguistic diagrams are diagrams that express linguistic properties in accordance with linguistic epistemology (→2.3).

2.1 Diagrams are icons of relations

Diagrams are visual icons of relations (→2.1.1) that represent a specific content and that can be regarded as objects on their own (→2.1.2).

2.1.1 Icon of relations

Generally speaking, the word *diagram* has many synonyms in English: *plot*, *chart*, *figure*, etc. The same is true in many languages (Bubenhofer 2020; François 2022). A specific definition of the term needs to be established in order to clarify the topic of this article. Many experts use Charles Sanders Peirce's (1839-1914) conception of diagrams as an inspiration to find a common ground. Although his works are subject to interpretation, Peirce defines diagrams as *icons of relations* that are logically conceivable (Pietarinen 2016, 129–33), i.e. *formal relations*. Diagrams are complex and heterogeneous signs that encode every relevant piece of an analytic process; they can be broken down into smaller signs that may be symbols, and even indices (Ambrosio 2020, 361–62). The main characteristic of such complex signs is that the relations between their components allow for dynamic manipulations and inferences that cannot be derived from a text (Larkin and Simon 1987; Shimojima 2015).

2.1.2 Diagrams as *representamen* vs. diagrams as objects

There are debates on the representational nature of diagrams: do they represent some phenomenon, or do they consist of their own objects (Ambrosio 2020, sec. 3)? It is important to consider that diagrams can do both. As far as linguistics is concerned, Ferdinand de Saussure (1857-1913) stated that the nature of objects is completely framed by an epistemological stance. Linguistic units, relations and classifications are but abstract concepts. In a linguistic perspective, diagrams encode such linguistic concepts in ways that make them perceivable. Syntactic trees, for instance, encode phrases and words by means of their written forms and the relations between them through the use of strokes; the layout of such trees encodes a grammatical hierarchy.

2.2 Linguistic diagrams are visual inscription

One may retain the idea of *icon of formal relations*, but the definition needs to be narrowly constrained in order to be usable. The *théorie du support* (Bachimont 2007) states that the means of expressing knowledge are *inscriptions*. Knowledge in itself is an abstraction. It has to take a material shape (to be *inscribed*) in order to be communicated. Inscriptions can be of many kinds: an oral explanation, body gestures, drawings, etc. Generally speaking, inscriptions share the quality of being perceivable and interpretable. They also have a material aspect that makes knowledge "sensual" (Wise 2006). They convey their contents through their substance, which, conversely, constrains what can be expressed (Mazziotta 2020b); e.g., colors cannot appear by carving a blue stone, and the drawing of dependency trees must take into account the bidimensionality and the boundaries of the page (see e.g.

Tesnière 1959, chap. 3.14 and 4). The argumentative power of diagrams is also restricted: as noted by Antoine Culioli (1924-2018), diagrams lack dialogic potential (Ducard 2016, 118–19).

Peirce's semiotics is very inclusive: everything humans can interpret is meaningful, and signs may refer to other signs in a seemingly never-ending chain (Benveniste [1969] 1974). Accordingly, Peirce has a very wide conception of diagrams (Stjernfelt 2007): a metro map representing the relations between stations and lines is a diagram, a musical score is a diagram, an algebraic notation is a diagram (Chauviré 2008, 44 and note 109), etc. Non-visual (auditory, haptic, etc.) diagrams do exist; e.g. a karate kata consists of patterns of movements that are kinetic diagrams. Moreover, it can be argued that fully acknowledging Peirce's semiotics leads to considering language and grammar themselves as diagrams (Jakobson 1965) — although Peirce distinguishes between language and proper diagrams (Pietarinen 2016, 129–30). In a sense, any metalinguistic discourse could be understood as a diagrammatic representation of language. Although it is theoretically possible to create diagrams out of many substances, studies that focus on linguistic diagrams, such as Stewart's *Graphic representation of models in linguistic theory* (1976), Roggenbuck's *Die Wiederkehr der Bilder* (2005) or Bubenhofer's *Visuelle Linguistik* (2020), as made perfectly clear by their titles, mainly deal with visual objects that are drawn on a two-dimensional plane, including algebraic notations. Richard Hudson's personal website (<https://dickhudson.com/sentence-diagramming/>) does the same. Objects that linguists actually recognize as linguistic diagrams are encoded in a visual medium.

This subsection is subdivided in three parts: the first one deals with visual entities, the units of visual inscriptions (→2.2.1); the second briefly focuses on configurations, i.e. the way units combine on the plane (→2.2.2); the third part mentions difficulties associated with the semasiology and the onomasiology of entities and configurations (→2.2.3).

2.2.1 Visual entities

Linguistic diagrams are visual inscriptions. As visual objects, they are made of *visual entities* (or graphical entities, Mazziotta 2020a; inspired by Groupe μ 1992), i.e. discrete figures that are perceivable by the sense of sight, such as strokes, dots, citation forms and labels that are used to inscribe concepts and analyzed materials. Fig. 1 illustrates this with diagrams by Lucien Tesnière (1893-1954) and by Saussure.

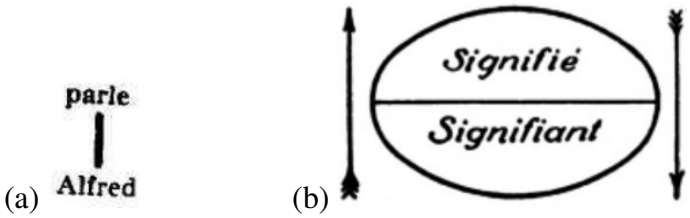


Figure 1. — (a) Tree-like diagram of the dependency between *Alfred* and *parle* in the sentence *Alfred parle*, by Tesnière (1959, chap. 2.7). The word *parle* governs the word *Alfred*. (b) Diagram of the structure of the linguistic sign with *signified* (Fr. *signifié*) and *signifier* (Fr. *signifiant*), by Saussure ([1916] 1995, 158).

In Fig. 1a, the stroke is a visual entity that inscribes a dependency relation between the two words *parle* and *Alfred*, which are inscribed by a citation form. The inscription of contents through visual entities can be called *reification* in the framework proposed by Kahane and Mazziotta (2015). Similarly, in Fig. 1b, the concept of sign is reified by a bubble that contains two labeled compartments, and the processes of encoding and decoding are inscribed by arrows. Such visual entities are perceived and recognized by the viewer, who has learned to categorize them and to ignore incidental phenomena (such as the smudging of the ink).

What is reified and what is not depends on the conceptual framework, but the granularity of the description may vary (see also Sowa 2000, 270–71 for an example of different levels of reification in the treatment of verbal frames). The only way to make further diagrammatic assertions on units is to reify them (Mazziotta 2022b). For instance, in Fig. 1a, one could add a label (Tesnière sometimes adds a label "1", that roughly corresponds to the notion of *subject*) near or on the stroke that reifies the dependency. In Fig. 2, the reification of a transformational relation between the syntactic dependencies of the active and the passive structures is made possible by the fact that syntactic relations are reified.

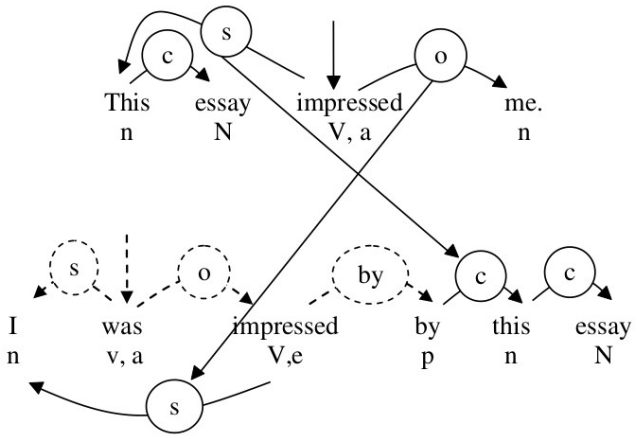


Figure 2. — Word grammar (Hudson 2010, 315) diagram of the passive transformation between the linearized dependency tree of *This essay impressed me* and the linearized dependency tree of *I was impressed by this essay*. Dependency relations are reified by labeled arrows between words (the labels appear inside of bubbles interrupting the arrows). The passive transformation is partly expressed by arrows pointing from one bubble to another — "s" stands for "subject", "o" is for "object" and "c" is for "complement" (Hudson 2010, 295).

Linguists may overtly express why they want to reify relations or not and how they do it (see the famous example of Tesnière 1959, chaps. 1–4; and Ducard 2016, 117–18 on Culioli's choices).

2.2.2 Configurations

The layout of the plane follows specific *configurations*, i.e. meaningful relative arrangements involving two or more visual entities. In Fig. 1a, the governor is placed higher than its dependent, and both appear at each extremity of a single vertical stroke. In Tesnière's classical system, the direction of the stroke combines with the position of the words in a meaningful way: an horizontal stroke between two words inscribes a relation that corresponds to equivalence rather than hierarchy (Tesnière 1959, pt. 2). Fig. 2 inscribes the linear sequence of words by ordering citation forms on the traditional horizontal writing line; consequently, the direction of the strokes is less important than the relative position of the words with respect to arrow heads, which point toward dependents in Word grammar.

2.2.3 General caveats regarding visual entities and configurations

The conventional nature of the diagrams has consequences for their semasiology and for their onomasiology. The term *visual entity* corresponds to the identification of a meaningful discrete figure, but the meaning of an entity (what it inscribes) heavily depends on the system it belongs to. A *visual entity* is merely a recognizable signifier, such as a stroke, an arrow or a bubble. As far as interpretation is concerned, there is no such thing as a "natural meaning" of entities and configurations, but some cultural habits may emerge: a stroke in a table generally inscribes a separation, whereas it inscribes a union in a syntactic tree (Roggenbuck 2005, 267). Nevertheless, even in diagrams that look similar, the semasiology of entities greatly differ: the stroke of Fig. 1a has not the same value as a stroke in a tree that inscribes the phylogeny of languages (→3.2). A stroke may even be used to inscribe some

concept or unit that would not qualify as a relation — such as a word in some American sentence diagrams (Mazziotta 2020b, 69–70). Consequently, when diagrammatic system are transmitted, notational habits often have to be explained alongside the theory (→3.1).

From an onomasiological perspective, entities and configurations are two concurrent means of representing knowledge. The same concepts may be inscribed by either means: e.g. syntactic dependencies may be inscribed by a stroke between entities that inscribe units or by aggregating them (Mazziotta 2022b), some of Tesnière's draft inscribe word order by a chain of arrows pointing from one word to the next rather than by linearizing the sentence as in Fig. 3 (Mazziotta 2022a), etc.

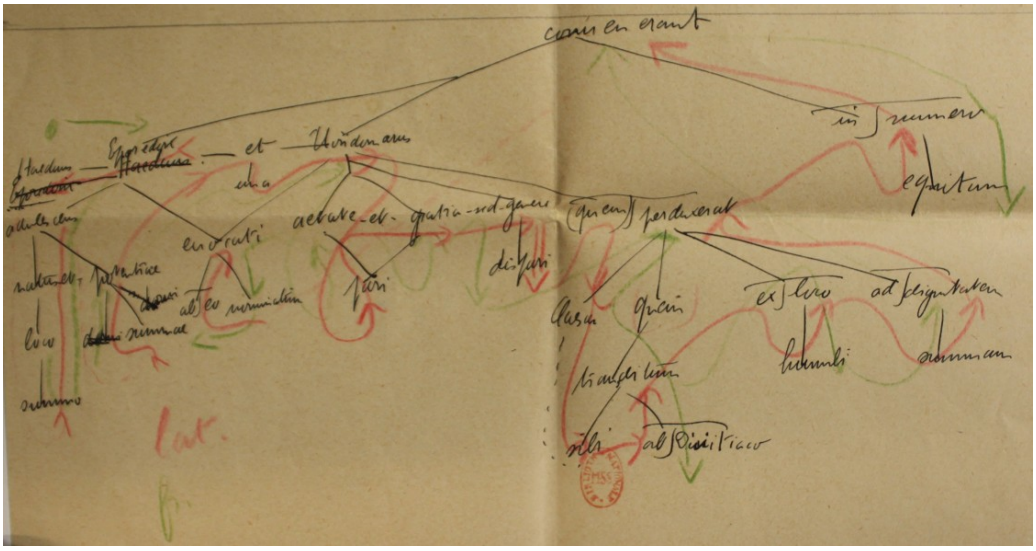


Figure 3. — A stemma by Tesnière inscribing both dependencies and word order of the Latin sentence *Eporedorix Haeduus, summo loco natus adulescens et summae domi potentiae, et una Viridomarus pari aetate et gratia, sed genere dispari, quem Caesar ab Diviciaco sibi traditum ex humili loco ad summam dignitatem perduxerat, in equitum numero convenerant nominatim ab eo evocati* (Julius Caesar, *Commentarii de Bello Gallico*, 7.39.1.1) (BnF, NAF 28026, box 63, 68). Dependencies are inscribed by black strokes, whereas Latin word order is inscribed by red arrows, and the corresponding French word order by green arrows. Photograph by Sylvain Kahane and Nicolas Mazziotta.

2.3 Linguistic diagrams express linguistic relations

Linguistic rationales pertain to linguistic epistemology (→2.3.1). Diagrams may combine linguistic rationales with other types of rationales (→2.3.2). Linguistic diagrams are sometimes qualified as metalinguistic tools (→2.3.3).

2.3.1 Linguistic rationales

Let us focus on how diagrams are used rather than on what they ontologically are (Giardino 2013; Pietarinen 2016, 126-27). All diagrams “are given with an intention” to a community that shares common practices (Giardino 2013, 141). Diagrams are defined by the types of manipulations they make possible. As far as linguistic diagrams are concerned, they describe the properties of language(s) or linguistic units according to linguistic epistemology. That is, relations that are inscribed in such diagrams are of linguistic nature. Syntactic trees, semantic maps and formulaic notations (such as ICA rewriting rules or Culioli’s axioms) are linguistic diagrams, because inscribed relations correspond to linguistic properties. These devices are built to allow the reader to make inferences that pertain to linguistics. Conversely, when figures are built following statistical rationales, it is only the interpretations of such figures that unveil linguistic properties (Badir and Polis 2023). Biplots, statistical charts or factorial spaces are arranged with respect to mathematical properties based on statistical calculations. Learning how to read those kinds of graphics is a common practice to any

analyst who uses numeric data. It does not correspond to any stance specific to linguists working on their core topics. They are not linguistic diagrams, but diagrams about linguistic data that are made up of numerical indices of the behavior of linguistic units. This quantitative nature is not intrinsically linguistic. The same claim can partly be made about geolinguistic maps: geographic space combines with linguistic information to account for diatopical distributions of linguistic units, i.e. to express the correspondence between a non-linguistic criterion (space) and linguistic properties (phonology, morphology, lexical variation, etc.).

2.3.2 Composite diagrams

Since statistical graphics and linguistic diagrams share a common substance, they can be merged in composite diagrams that pertain to multiple rationales at once. For instance, the clustering of points on Fig. 4 is the result of a mathematical process, but the identification of named categories pertains to semantics.

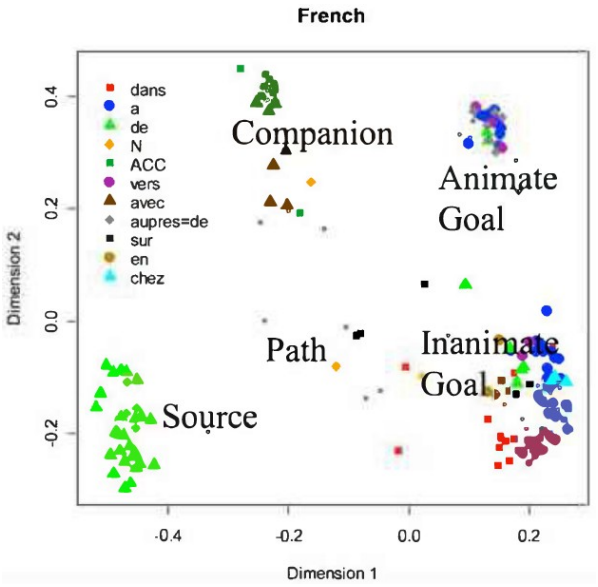


Figure 4. — Multidimensional scaling map (dimensions 1 and 2) of the use of prepositions in French (Wälchli 2010, 348; *apud* Badir and Polis 2023, 60). The map is built using mathematical vectors in order to represent individuals that share a similar behavior next to each other.

The categories written with a serif font on the biplot have been added by hand by the researcher. The five semantic categories form a linguistic diagram that distributes over the same space as a mathematical diagram about linguistic data. Such diagrams are composite from an epistemic perspective.

2.3.3 Metalanguage

Depending on their theoretical stances, linguists may or may not consider that their diagrams are metalinguistic devices (Rey-Debove [1978] 1997, chap. 2). Linguistic diagrams are used to describe specific languages and the faculty of language in general; as such, they compete with metalinguistic texts, and they serve the same purpose. Logical or formalist approaches such as Culioli's qualify their own diagrams as *metalinguistic* (see Ducard 2016). On the other hand, in linguistics, *metalanguage* is a subset of *language* (Mel'čuk and Milićević 2014a, 89–90). Hence, a strictly linguistic approach acknowledges that diagrams are not of linguistic nature (they do not function as language does); the prefix *meta-* is not appropriate. Therefore, the message they convey, as meaningful devices, is not strictly metalinguistic.

3 Linguistic diagrams as historical objects

Given the conventional and social status of diagrams, it is of utmost importance to evaluate how they are used collectively to understand them correctly. Much as any historical object, they are to be described "in context" in order to avoid anachronisms: subsection →3.1 deals with the internal approach of linguistic diagrams within a specific theory; subsection →3.2 deals with the extrinsic origin of linguistic diagrams; subsection →3.3 deals with the transmission of diagrammatic systems within subfields of linguistics.

3.1 Theory-internal approach

Some theories and analyses heavily rely on diagrams, whereas others do not (→3.1.1). Individual diagrams must always be interpreted according to the theoretical framework they integrate, sometimes up to the point of retro-formalization (→3.1.2). Not understanding a diagram may lead to over-interpretation (→3.1.3).

3.1.1 Formal prominence

The main issue is the evaluation of how much of a given theory or analysis is inscribed by diagrams, and up to what level of relative accuracy with respect to the discursive expression of the theory or the analysis. Pottier's semantic theories are mainly expressed graphically (Pottier 2018), formal phrase-structure analyses are mainly inscribed by sets of rules or tree-like diagrams, linguistic atlases may consist solely of maps, or these maps may be accompanied by lengthy tables and discursive syntheses (Baiwir 2024). Authors themselves can make statements about their visual devices and their limitations: Stephen W. Clark (1810-1901), one of the first grammarians to introduce the use of syntactic diagrams notes that, despite their usefulness, they do not "constitute any essential part of the Science of Language" (1847, iv); Ronald Langacker (b. 1942) highlights the non-systematic nature of his diagrams (2008, 9–12); Chomsky reckons that mathematical set notations are more straightforward than tree-like diagrams (personal communication).

Ideally, diagrammatic systems consist of formalisms, i.e. closed systems of units and rules for combining them that allow computations (Bachimont 2007, 50; Mazziotta and Kahane 2023). André Martinet (1908-1999) considers that his diagrams are of formal nature (Gregov and Mazziotta 2023), and so does Culioli (Ducard 2016). For authors who adopt a similar stance, diagrams are a way to firmly assert their theories through rigorous scientific forms. However, Langacker's visual inscriptions challenge the definition of diagrams as icons of relations that correspond to such mathematical/logical concepts. Some typological attempts emphasize the level of systematicity of visual inscriptions to qualify them as proper diagrams, or schemata or sketches (François 2022). That level of systematicity and the theoretical status of diagrams may vary through time for a single author: Guillaume's first diagrammatic attempts are less structured and less consistent than his further uses of visual inscriptions (Valette 2009).

3.1.2 Interpretation

Linguistic diagrams are part of a specific paradigm, and correspond to habits of mind (Margolis 1990). Users have to learn to make use of specific visual entities and configuration rules, at the very least in order to extract information (Winn 1991; 1993). Diagrams may also crystallize *entrenchments* in specific paradigms of thought (Margolis 1990). Comparing diagrams helps understand why some theories are understood as incompatible with one another (Kuhnian incommensurability). The best known paradigmatic incompatibility in syntax, between ICA and dependency-based models, appears clearly when comparing the values of the strokes and the linguistic forms in the trees: strokes in ICA

diagrams correspond to constituency relations, whereas strokes in dependency diagrams correspond to dependencies. Of course, tree formalisms can be procedurally altered to “reconcile” theories from a formal point of view (Lecerf 1961; Kahane and Mazziotta 2015), but such a transformation goes along with deep alterations of the meanings of the entities that demonstrate the epistemological gap between those schools of syntax.

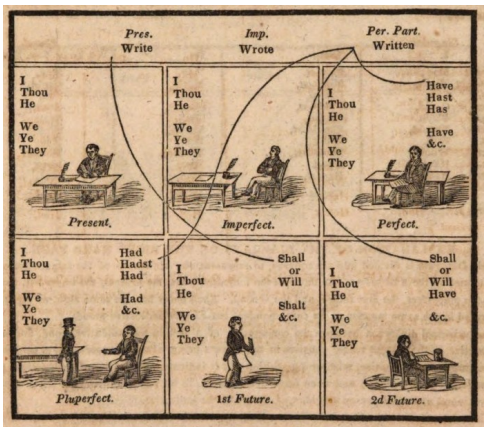
The hermeneutical process involved with respect to to ancient diagrams must first take into account the theory that makes use of them. Understanding the diagrammatic system can be crucial to understanding the theory, and since visual conventions are not naturally interpretable, authors who make extensive use of a consistent diagrammatic system need to introduce it. Consider a textbook on generative syntax (e.g. Carnie [2002] 2007, 62–64) or a book dedicated to the transmission of generative theory in the French-speaking community (e.g. Ruwet 1968, 107–12): both intend to make their readers discover the theory; hence, both have to explain the conventions at work to inscribe the corresponding analyses.

Interpretation can take the form of *retro-formalization*, i.e. a transposition from the evaluated system to another one, for the purpose of isolating relevant entities and configurations. For instance, Tesnière's system can be modeled following notations pertaining to set theory (Mazziotta 2014), Otto Jespersen's (1860-1943) analyses based on his “rank theory” can be diagrammed using arrows similar to the ones used in dependency-based frameworks (Cigana 2020). That approach is possible only if the diagrams are built on the ground of consistent conventions or if discursive statements supplement the system, and if their number is high enough to draw conclusions from recurrent uses.

3.1.3 Over-interpretation

When interpreting a diagram, one has to understand what entities and relations are relevant to comply with the theory and to reproduce the same value they carry (from a Saussurian perspective). When the link between the theory and the diagram is not expressed discursively, some entities and configurations remain opaque. The risk of over-interpretation is a known drawback of diagrams in general (Shimojima 2015, chap. 3), even in the case of a sound and well-described system. A closer look at Fig. 5 illustrates that too quick an evaluation of ancient (and not so ancient) diagrams can be misleading.

(a)



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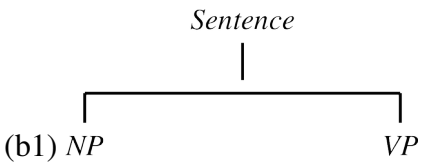

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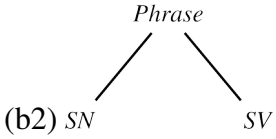


Figure 5. — Incidental characteristics: (a) Diagram describing the use of auxiliaries in English (Greene 1830, 29). The strokes appear to connect individual citation forms, but they each connect a citation form to

a paradigm. Scanned by Google; (b1) Copy of an excerpt of Chomsky's diagram of *The man hit the ball* in the second edition of *Syntactic structures* ([1957] 2002); (b2) Copy of an excerpt of the diagram in the French translation (Chomsky [1957] 1969). The differences between the strokes used to inscribe part-whole relations in B1 and B2 are incidental.

In Fig. 5a, curved strokes are used to connect individual forms (namely, "present", "imperfect" and "perfect participle") to entire paradigms of auxiliaries with the aim of explaining which single form must be combined with different auxiliaries. However, although strokes appear to connect entities that inscribe words, each of them actually connects one of the individual forms to an entire paradigm inscribed in a specific box on the lower part of the table. In Fig. 5b, except for the fact that the labels are either in English or in French, the two ICA trees convey exactly the same content. The differences between them are incidental and should not be interpreted (Mazziotta, François, and Kahane 2024, sec. 4.1).

3.2 Extrinsic origin of inscriptional conventions

Linguistic diagrams often originate from other fields of knowledge (→3.2.1). The success of the import of a type of diagram into a subfield of linguistics is evaluated by its epistemological integration (→3.2.2). Some types of diagrams are so widespread that it is impossible to evaluate their path through different disciplines (→3.2.3).

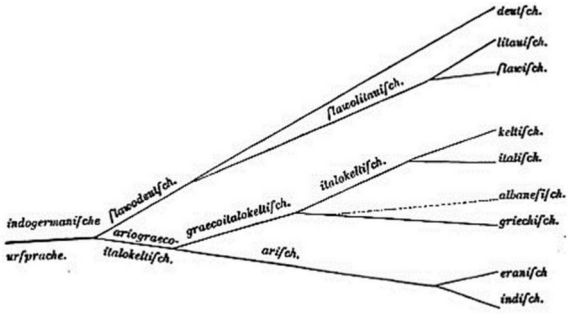
3.2.1 Metaphors and displacement of diagrams

Scientific modeling and discovery involve the use of metaphors that "displace" old concepts from the common conceptual ground in order to apply them to new situations which, in turn, lead to corrections or expansions of the old concept (Schon [1963] 2001). One often considers metaphors through their linguistic aspect (words as metaphors of other words or concepts that have no names), but diagrams can also be understood as metaphors (Roggenbuck 2005, chap. 2). Firstly, their iconicity is somewhat metaphorically connected to what they inscribe; secondly, previous graphical habits are constantly adapted to new situations, accompanying scientific history. Diagrams in general model relevant relations that have been selected by the actors of a specific field to build a shared representation of knowledge (Giardino 2013, 141). This collective dimension is grounded in a conceptual community that allows researchers to adapt and create the diagrammatic systems they need to communicate.

3.2.2 Epistemological integration

Several practices are well documented. For instance, in his *Compendium der vergleichenden Grammatik*, August Schleicher (1821-1868) suggests inscribing the genealogy of languages by a tree *(1866, 9)*. The latter results from a biological interpretation of the nature of language that ultimately corresponds to a metaphoric adaptation of Charles Darwin's (1809-1882) conception of phylogeny (Roggenbuck 2005, chap. 4.2-4.3). If the importation of an extrinsic concept is fruitful, it generates canonical diagrams (François 2023) from which authors derive new diagrams that remain understandable by their community. Fig. 6 shows that Hugo Schuchardt's (1842-1927) phylogenenic tree of romance languages (Schuchardt 1866, 82) is very similar to Schleicher's tree of Indo-European languages.

(a)



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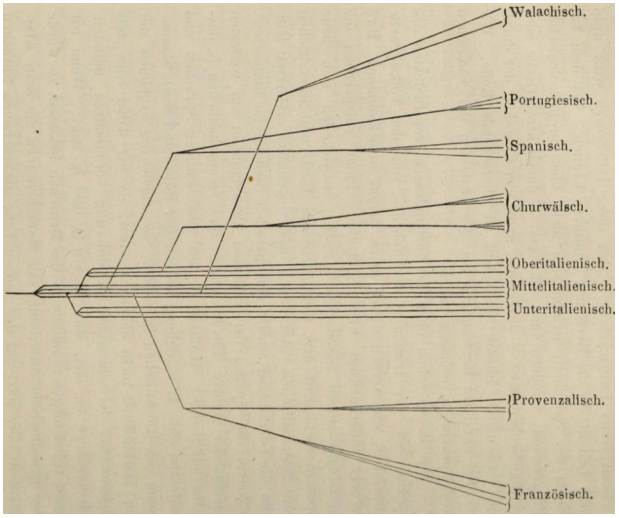

Figure 6. — Phylogenetic tree-like diagrams: (a) Schleicher's phylogenetic tree of Indo-European languages. Scanned by Google. (b) Schuchardt's phylogenetic tree of Romance languages. Scanned by Google.

Despite interesting differences that will not be investigated here (see François 2023), Schuchardt uses entities and configurational rules that resemble Schleicher's enough. Schuchardt inherits from an established shared practice that his readers can easily relate to Schleicher and to Darwin because he mentions both scholars and includes a quotation of Darwin's views on the genealogy of languages in his text (Schuchardt 1866, 81–82). Since other scholars of the field have made use of it until now, it seems obvious that the model of tree-like diagram has become fully integrated into historical linguistics.

Similarly, in “Die Syntaktische Konnexität” (1935), Kazimierz Ajdukiewicz (1890-1963) metaphorically imports algebraic notations that pertain to the representation of fractions (with so-called *numerator* and *denominator)* into linguistics (Mazziotta and Kahane 2023). His suggestions are rooted in well-established rules of interpretation in logic and algebra, and are corrected, extended and developed by other scholars such as Yehoshua Bar-Hillel (1915-1975) and Joachim Lambek (b. 1922). The latter wrote “The mathematics of sentence structure” (Lambek 1958) with an audience of mathematicians in mind, thus demonstrating the interdisciplinary benefits of conventional notations that are understood by different scientific communities. Such inscriptional decisions correspond to an idealistic view of another science, namely physics, as a model that linguistics must imitate: a science that describes its empirical objects by the means of mathematics, and confronts its theoretical findings with experiments. Logical and algebraic notations in models such as Noam Chomsky's (b. 1928) (Chomsky 1956; [1957] 2002) or Montague's (1930-1971) grammars follow the same principle: representing abstract operations that can be computed. On the other hand, mathematical reasoning can also rely on topology and visual modeling. Such is the path followed by Bernard Pottier (b. 1924) with some of his semantic graphs (see, e.g., Pottier 1992; 2018, 13). Pottier extends the topological diagrams suggested by René Thom's (1923-2002) mathematical *Catastrophe theory (Fr. Théorie des catastrophes, Thom 1972)*. In all these cases, mathematical diagrams have been displaced in order to generate linguistic ones.

3.2.3 Widespread practices

However, the path followed by the dissemination of diagrammatic practices from one field of knowledge to another is not often straightforward. General-use diagrams such as graph-like diagrams and tables are so widespread that they are constantly reused with ever-adapting conventions. Although formal linguists acknowledge (e.g. Mel’čuk and Milićević 2014b, 294–98) that tree- and graph-like

diagrams correspond to the mathematical concept of *graph* (Biggs et al. 1998), such structures were conceived and graphically inscribed (Roggenbuck 2005; Lima 2014) long before the mathematical concept of *graph* began to be investigated by Leonhard Euler (1707-1783) in his seminal paper published in 1736 on the bridges of Königsberg (see Biggs et al. 1998, 1–11). More specifically, early occurrences of tree-like inscriptions of grammatical knowledge, e.g. declension tables, occur in 13-century copies of the works of Alexander de Villa Dei (b. 1175-1240/1250) and other medieval scholars (Even-Ezra 2021, chap. 4.3). The name of this type of diagram itself (*tree*) indicates that it originates in the conceived structure of natural objects that have been part of the environment since the dawn of humanity.

3.3 Traditions

Diagrammatic traditions can be retraced by considering scientific influences between authors of the same field (→3.3.1). Some similarities that prove to be incidental are distinguished by evaluating the epistemological and social context in which they appear (climate of thought) (→3.3.2). It may appear that the paternity of some original ideas is impossible to determine, in particular when social parameters are at stake (→3.3.3).

3.3.1 Paths of transmission

Linguists may overtly acknowledge that their diagrammatic conventions originate from other fields of knowledge. They may also belong to communities of researchers who gradually develop a new model that goes with innovative graphical practices. Leonard Bloomfield's (1887-1949) description of immediate constituents analysis ([1933] 1983, chap. 12) originally contained no diagrams, but the conceptual model drew inspiration from Wilhelm Wundt's (1832-1920) *Völkerpsychologie* (1904; see Percival [1976] 2007), which contains tree-like diagrams such as Fig. 7.

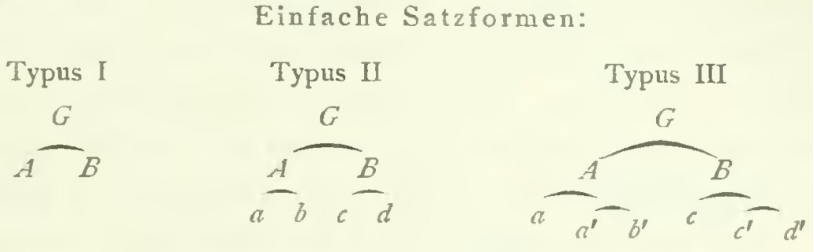

Figure 7. — Diagrammatic inscription of the semantic structure of simple sentences in Wundt's *Völkerpsychologie (Wundt 1904, 1(2):329)*. The diagrams do not exactly correspond to trees from a mathematical perspective, since edges may connect to other edges (e.g. the diagram describing the Type II structure connects the edges labeled A and B with another edge labeled G). Scanned by Google.

Bloomfield's textbook is followed by many works that convey similar ideas about constituency, a.o., by Rulon S. Wells's (1916-2008) paper on immediate constituents (1947), Chomsky's *Syntactic structures* ([1957] 2002), Charles Hockett's (1916-2000) textbook (1958) and Eugene Nida's (1914-2011) book on English syntax (1966). Henry Allan Gleason's (1917-2007) *Introduction (1955)* also incorporates many different diagrams relying on the same grounding idea of immediate constituents. All of these works introduce numerous graphical devices in order to inscribe part-whole relations (Mazziotta and Kahane 2017). Between those scholars, the transmission path is clear. Numerous schools of thought follow similar paths: phylogenic trees evolve from Schleicher's (→3.2); Gustave Guillaume (1883-1960) introduces his original diagrams in books ([1929] 1993) and lessons that have inspired his followers (Wilmet 1972), and some of them, such as Bernard Pottier, have adapted and derived his ideas into other diagrams, which, in turn, can be “enhanced” by others (Desclés 2012); Tesnière has inspired dependency linguists to elaborate various applications of his system to specific languages (e.g.

Happ 1977; Weber [1992] 1997); *Syntactic structures* contains a constituent tree that debuted a huge production of diagrams drawn by authors who clearly draw inspiration from Chomsky's works; etc. Diagrams are epistemologically integrated into common scientific practices in their ever-evolving (sub)field. That characteristic justifies viewing them as a set of diagrams linked by a shared tradition.

3.3.2 Incidental similarities

However, the reconstruction of transmission paths can prove to be complex and similarity may prove to be misleading. Diagrams that follow phrase-structure rationales, such as Fig. 8, can be found in Frederick Barnard's (1809-1889) *Analytic grammar* (1836) (Brittain 1973, 14; Mazziotta and Kahane 2017).

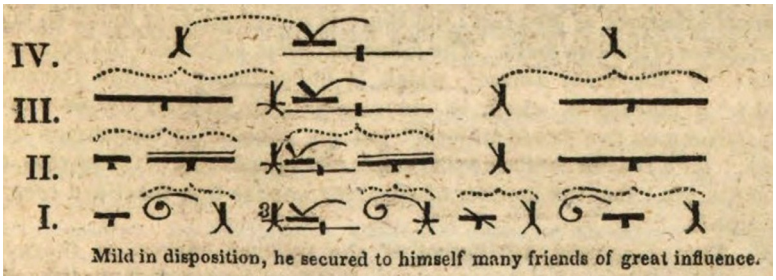

Figure 8. — Syntactic diagram inscribing a part-whole analysis of the sentence *Mild in disposition, he secured to himself many friends of great influence* (Barnard 1836, 245). Scanned by Google.

In this case, there is no reason to conclude that modern scholars drew inspiration from Barnard's work. The fact that modern ICA diagrams rely on the same concept of *part-whole relations* does not suffice to integrate Barnard's attempt into the modern tradition. Although the use of diagrams to inscribe syntactic relations corresponds to the transition from word-based to sentence-based approaches at the time, especially in the context of teaching English to deaf and dumb people (Mazziotta 2022b), the ICA components of his proposals do not fit into a collective elaboration of the field that could be retraced to American structuralists.

Similar problems arise when it comes to attributing the paternity of diagrammatic conventions to a specific author. For instance, it has been suggested that Tesnière's stemmas and Heimann Hariton Tiktin's (1850-1936) diagrams might be inherited from Franz Kern's (1830-1894) (Coseriu 1980; Osborne 2020). Nonetheless, as far as Tesnière's stemmas are concerned, they might as well relate to American sentence diagrams (Mazziotta and Kahane unpublished). The amount of personal innovation – or "displacement" (Schon [1963] 2001) – on the ground of previously-existing materials is often difficult to evaluate, and it has been demonstrated that the sole search for the "first occurrence" of grammatical ideas in the works of a "hero" is sterile (Koerner 1976). It is much more fruitful to investigate how "climates of thought" (*ibid.*) evolve and generate new trends in linguistic description. In the case of Tesnière, his diagrams are bound to key notions about syntax that crystallize a trend to separate logic from psychologism. That distinction developed independently among various authors to reach the same conception of grammatical relations (Sériot 2020).

3.3.3 Non-theoretical stakes

However, some diagrams are much more original because they combine visual entities in ways that have not been seen before. In syntax, the diagrams found in Clark's *Practical grammar* (1847) make use of a novel system that inscribes relations between words with bubbles aggregating with each other (Mazziotta 2016). Brittain's thesis on sentence diagramming in America (1973) gathers enough materials to demonstrate that many diagrammatic systems follow the same original rationales with slight variations (Fig. 9). Clark's proposal (Fig. 9a) is the most ancient, and the one by Alonzo Reed

(d. 1899) and Brainerd Kellogg (1834-1920) is the most successful (Fig. 9b), as it has long remained in use — it is still presented in Gleason's textbook on English grammar (1965, 142–51).

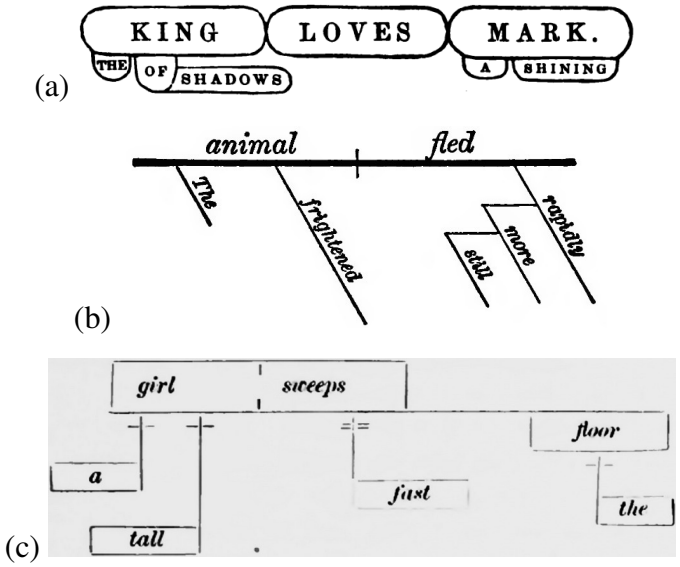

Figure 9. — American sentence diagrams: (a) Clark's diagram of the sentence *The king of shadows loves a shining mark* (Clark 1847, 29). Scanned by Google. (b) Diagram of the sentence *The frightened animal fled still more rapidly*, by Reed and Kellogg ([1876] 1879, 35). Scanned by Google. (c) Storrs's diagram of the sentence *A tall girl sweeps the floor fast* (Storrs 1881, 149). Scanned by Google. All these diagrams distinguish between the "principal" elements of the sentence (subject, verb, object), which are aligned horizontally, and the "adjuncts" elements, which are placed below the word they complement. Most diagrams of the time are built following these basic rules.

It is clear that the issue of intellectual property is not related to science alone, since it had obvious commercial sequels. Clark sold a massive amount of his textbooks (40 editions are known from 1847 to 1865 according to Görlach 1998, 82–83). The system proposed by Reed and Kellogg is patented by Reed and O. H. Hall (dates unknown) in 1868 (Reed and Kellogg [1876] 1880, 5). Richard Salter Storrs (1830-1884), whose diagrams are illustrated by the sample in Fig. 9c, claims that he had similar ideas independently (see Mazziotta 2022b). That kind of context makes investigating the exact traditional path of diagrams impossible: for the sake of money or fame, it is highly likely that some of those authors were not telling the exact truth.

4 Conclusion

Diagrams are complex iconic inscriptions of relational structures (→2.1). Linguistic diagrams are visual representations that, as objects, are built according to shared conventions that govern the form and the use of visual entities and configurations (→2.2). Linguistic diagrams are collectively used for exposition, exploration, manipulation and discovery of linguistic units and concepts, and their properties. As such, they are sometimes qualified as metalinguistic tools (→2.3). As historical objects, linguistic diagrams have to be understood and interpreted within the context of the theory they serve. Not all linguistic diagrams achieve the same level of formalization, which may lead to difficulties for readers who have not learned to interpret them. Consequently, the study of ancient diagrams carries the risk of over-interpretation (→3.1). Diagrams used in linguistics often originate from other areas of knowledge through a process of displacement that fits them into linguistic fields, thus serving a community of scholars who share similar interests and practices (→3.2). Within linguistics, paths of transmissions of diagrammatic habits may be clear, but their evaluation can be obfuscated by incidental similarities (which may be distinguished by careful examination of the contemporary climate of thought) and by underhand behaviors that are justified by non-scientific moves (→3.3).

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