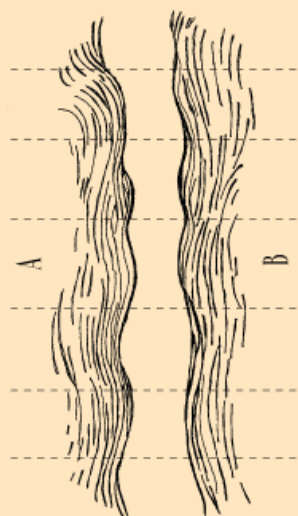


Le Cours de Linguistique Générale 1916-2016

Genève - Paris • 2016 - 2017



TRAVAUX DES COLLOQUES LE COURS DE LINGUISTIQUE GÉNÉRALE, 1916-2016. L'ÉMERGENCE, LE DEVENIR

Éditeurs scientifiques : Daniele
GAMBARARA, Fabienne REBOUL

Oliver SCHLAUDT, « Signs,
arbitrary or operational ? Lessons
from studies on algebraic logic and
planned languages in the work of
Louis Couturat »

Communication donnée dans l'atelier de Jean-Yves Beziau,
The Arbitrariness of the Sign, au colloque **Le Cours de
Linguistique Générale, 1916-2016. L'émergence**,
Genève, 9-13 janvier 2017.

CERCLE FERDINAND DE SAUSSURE

N° D'ISBN : 978-2-8399-2282-1

Pour consulter le programme complet de l'atelier de Jean-Yves Beziau,

The Arbitrariness of the Sign :

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Signs – arbitrary or operational?

Lessons from studies on algebraic logic and planned languages in the work of Louis Couturat¹

ABSTRACT: I will use insights from Louis Couturat's studies on algebraic logic and from his work on planned languages to spell out the thesis that construction rules for complex words impose “horizontal” constraints on a language and thus qualify the arbitrary character of its signs. I will further suggest that this regular, “proto-algebraic” character of a language is of importance in regard of its cognitive function, permitting the language to serve as a cognitive tool rather than providing a mere expression of ready-made thoughts.

1. Introduction

Arbitrariness seems to be an essential feature of linguistic signs, for there is hardly anything within the human realm that could more easily – or more harmlessly – be identified as “conventional” (standards of aesthetic, moral, and alethic value are less easily said to be “purely” conventional, despite the obvious historical and sociological truth contained in this kind of judgement). Ferdinand de Saussure made arbitrariness an essential ingredient of signs in his seminal *Cours de linguistique générale* of 1916 (1916/1995, 100). In this context, arbitrariness is understood in a “vertical” way, i.e. the signifier is understood to be arbitrary vis-à-vis the signified. Contrary to the case of a symbol, which is tied to the symbolized by a “rudimentary natural link”, there is nothing about a table, say, that compels us to call it a table, and there is nothing about a beautiful object that obliges us to use the word “beautiful”. Couldn't we just as well call the table a chair, and use the word “good” instead of “beautiful”?

However, the work of French philosopher Louis Couturat (1868-1914), in particular his work on algebraic logic and planned languages, suggests that there can be other than “vertical” constraints on linguistic signs. This is what I am going to explore in this paper. Once revealed, the basic idea can easily be expressed: the arbitrariness of the sign means that every word of a given language can in principle be replaced by every other word of that language. If, however, there proves to be any regularity in the way the words of that language are formed, any change in a complex word would necessitate (for the regular character of the language to be preserved) an adjustment in the corresponding construction rule, and this again would induce a corresponding change in all other complex words constructed according to that rule. To give an example, we could easily permute the words “*beau*” and “*bon*” in French; but if we were to substitute “*beau*” for “*beauté*” and vice versa, for the sake of coherence we would have to do the same with “*bon*” and “*bonté*” and all other pairs of words covered by the rule which says that the suffix “*-té*” signals a noun derived from an adjective (nouns of the form “*x-té*” are defined by the dictionary of the French Academy as “the quality of that which is *x*”). The adjusted rule then would mean that, in an exact reversal, “*-té*” now signals an adjective derived from a noun, just as the suffix “*-ful*” does in the English words “beautiful” or “graceful” (the *Oxford Dictionary* typically defines words of the form “*x-ful*” as “having or showing *x*”). Regularity in construction thus imposes limits on the arbitrariness of the sign. Since these constraints do not concern the “vertical” relation between the signifier and the signified, but rather act within a language and relate to the practical working of it, we may call them “horizontal”.

In what follows I will use insights from Louis Couturat's studies on algebraic logic and from his

¹ The author is indebted to Sophie Roux and Michel Fichant for helpful discussions.

work on planned languages to spell out the thesis outlined above. This will enable us, in particular, to understand why the regular character of a language should be considered valuable at all. After an outline of Couturat's life and work (section 2), I will proceed in three steps. First, I will show how Couturat analyzed the practical value of regularity in artificial, algebraic languages (section 3). Second, I will explain how Couturat applied this algebraic approach to the construction of a planned language, Ido. We will follow him especially in localizing the regular character of language in the derivation of words rather than in grammar or syntax (section 4.1). In a third and last step, I shall briefly discuss the extent to which these insights, drawn from artificial algebras and planned languages, are also true for natural languages (section 4.2). Here, planned languages are used as a sort of bridge leading from artificial (and exclusively written) algebras to natural (and primarily spoken) languages.

2. A note on Louis Couturat

Louis Couturat (1868-1914) was a philosopher of the French Third Republic. He began a typical university career but, thanks to his private funds, soon gave up his university position and continued working as a private scholar. Like many leading intellectuals of his time in France, he was a bourgeois progressive or “liberal”, in both his political and his philosophical convictions. In his political views he was anti-clerical and militantly internationalist and pacifist, with a discreet socialist undertone; as a philosopher, he was a rationalist with a strong neo-Kantian influence, oriented towards mathematics and the natural sciences. He was opposed to both positivism and mysticism, and pushed the agenda of gaining insight into the structure of mind by studying its most noble outcomes, the mathematical sciences. He was part of the group of young scholars around Xavier Léon, who founded the influential *Revue de Métaphysique et de Morale* in 1893 as well as the *Société française de philosophie* in 1901, and who organized the First International Congress of Philosophy, which took place in Paris in 1900. At the latter, Couturat took responsibility for the logic section. The name of the journal *Revue de Métaphysique et de Morale* appears in some ways misleading. But the term “metaphysics” actually referred rather precisely to the agenda described above, which was shared by Couturat's collaborators, though perhaps in a more temperate form.

As I have argued elsewhere in more detail (Schlaudt 2016), Couturat's work can be divided into three periods, each with a different focus:

1. from 1892 to 1897 he concentrated on mathematics (arithmetization of mathematics, theories of quantity), non-Euclidean geometry, and physics;
2. from 1898 to 1906 he turned almost exclusively to algebraic and mathematical logic and its history;
3. from 1907 until his early death by accident in 1914 he devoted himself to the propagation of an international auxiliary language, the construction of the language Ido (derived from Esperanto), and introduced himself to linguistics (in particular, he attended the lectures on linguistics given at the *Collège de France* in 1911/12 by de Saussure's disciple Antoine Meillet).

There is an internal coherence to these diverse topics, as all of them are framed by Couturat's original agenda of gaining insight into the structure of mind by analysing its “manifestations”. The particular manifestations Couturat was interested in changed over time, from mathematical science to algebraic logic to language and grammar.

One no less important aspect of Couturat's work that should be mentioned is that he willingly served as a kind of “disseminator” of new ideas. He was in touch with philosophers, mathematicians, logicians and other scholars all over the world, from Argentina to Russia, and was happy to keep his colleagues informed about the advances of their peers in other parts of the world (it was he in particular who introduced Russell to Peano at the *First International Congress of*

Philosophy in Paris, thus launching Russell's interest in symbolic logic).²

Although Couturat has always succeeded, far beyond his untimely death in 1914, in attracting readers who appreciate or even admire his work (as indicated by two memorial volumes published in 1983 and 2017), he never managed to be recognized as an important figure in the philosophy of the early 20th century. His early work on geometry, mathematics, and measurement, though still of interest, has never been fully explored or explicated (Schlaudt 2017). When interested in logic, Couturat himself thought of himself as a pure “*vulgarisateur*”, a popularizer. He fought to introduce his compatriots to modern logic, spreading contemporary developments in this field, and established logic classes in French higher education (he devoted his lecture at the *Collège de France* in 1905/06, when he replaced Bergson, to the history of mathematical logic). But since he never contributed to the development of logical theory itself, historians of the field consider him (if at all) as a secondary figure. The last phase of Couturat's working life from 1907 onwards is usually reduced to his tireless propaganda for an international auxiliary language; what is overlooked, though, is that he developed a genuine philosophical interest in linguistics. Bertrand Russell, whose *Principle of Mathematics* had inspired Couturat to publish a reduced French version under the same title (*Les principes des mathématiques*, 1905), expressed the following opinion of Couturat in a letter to Ottoline Morel:

Then when my “Principles of Math’s” came out, he wrote a short book professing to explain its doctrines simply to the French public. He left out all the doubts and difficulties, all the places where consistency had led me into paradox, and everything which he imagined calculated to shock, and at the same time put the thing forward as a dogmatic doctrine finally solving a host of difficulties. In consequence he made me appear absurd, and took to the international language, which now occupies him wholly (quoted in Couturat 2010, 10).

Thus, the aim of the present paper is also to correct this view by showing that the late work of Couturat provides interesting insights into the philosophy of language.

3. Couturat on “algorithmic logic”

Let us start with Couturat's work on algebraic logic, from which the practical value of a language's regular character will become apparent.

Couturat became interested in logic in the late 1890s, when the Italian mathematician and historian of science Giovanni Vacca indicated to him the existence of a large corpus of unpublished works on the subject in the papers of Leibniz. Couturat went to the library at Hanover, where Leibniz's papers are kept, and produced two books out of his studies: a systematic study, *La logique de Leibniz*, 1901, in which he tried to show that Leibniz's conception of logic constitutes the very foundation of his metaphysics, and an edition of a selection of the unpublished manuscripts, *Opuscules et fragments inédits de Leibniz*, 1903.

2 On Couturat's vast correspondence, see Schlaudt/Schmid 2017 and the published letters, especially Schmid 2001 and Luciano and Roero 2005.

- $s \in K. \circ :$
15. $f \in s|s. x \in s. \circ. f^1x = fx.$
 16. $\triangleright \triangleright . m \in \mathbb{N}. \circ. f^{m+1}x = f^mfx.$
 17. $\triangleright . m \in \mathbb{N}. \circ. f^m \in s|s.$
 18. $\triangleright . m, n \in \mathbb{N}. \circ. f^mf^n = f^{m+n}.$
 19. $f, g \in s|s. fg = gf. m, n \in \mathbb{N}. \circ. f^mg^n = g^n f^m.$
 20. $\triangleright \triangleright . m \in \mathbb{N}. \circ. (fg)^m = f^m g^m.$
 21. $a, b \in K. f \in b|a. y \in b. \circ. \bar{f}y = \bar{a} \in (fx = y).$
 - 21'. $\triangleright \triangleright \triangleright . \circ : x \in \bar{f}y. = . fx = y.$
 22. $\triangleright . \circ : f \in (b|a) \text{ sim.} = . f \in b|a. \bar{f} \in a|b.$
 23. $f \in (s|s) \text{ sim.} . x \in s. \circ. \bar{f}fx = x. \bar{f}fx = x. \bar{\bar{f}} = f.$
 24. $\triangleright . a, b \in Ks. \circ : a \circ b. = . fa \circ fb.$
 25. $\triangleright \triangleright . \circ : a = b. = . fa = fb.$
 26. $\triangleright \triangleright . \circ : f(a \cap b) = (fa) \cap (fb).$
 27. $\triangleright . m \in \mathbb{N}. \circ. \bar{f}^m = \bar{\bar{f}}^m.$
 28. $f, g \in (s|s) \text{ sim.} \circ. \bar{g}\bar{f} = \bar{\bar{f}}\bar{g}.$
 29. $\triangleright . fg = gf. \circ. \bar{f}\bar{g} = g\bar{f}. \bar{\bar{f}}\bar{\bar{g}} = g\bar{\bar{f}}.$

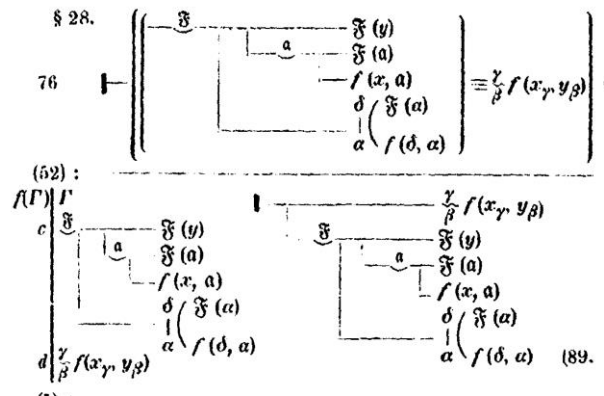


Fig. 1: Excerpts from symbolic systems criticized by Couturat. Left: Peano's *Formulaire* of 1895. Right: Frege's *Begriffsschrift* of 1879: “obscure, artificial, inconvenient, complicated, unreadable”.

It was already during his study of Leibniz's premature attempts to establish a symbolic logic³ as the heart of a universal language, the “*characteristica universalis*”, that Couturat was particularly fascinated by the idea of reducing inferences to simple mechanical manipulations of signs, the “*calculus ratiocinator*” or “algebra of thought” (1901, ch. 3 and 4). This ideal of “computability” became the yardstick which Couturat used when expressing his appreciation for forays into symbolic logic by his contemporaries. As he was in contact with logicians such as Hugh MacColl, Giuseppe Peano, Ernst Schröder, Christine Ladd-Franklin, and Gottlob Frege and followed the progress of their efforts, he was familiar with the new logical systems *in statu nascendi* and did not hesitate to criticize them resolutely (cf. fig. 1). Referring to Peano's symbolic logic, he commented in a letter to Bertrand Russell: “I do not think that [this symbolic system] possesses much utility”; rather, it proves to be “inconvenient” [*incommode*] and has “a horribly obscure and complicated form which is, in a word, unreadable”.⁴ As regards Frege's *Begriffsschrift*, Couturat confided to Russell: “I now vacillate between a lively admiration for his logical rigour and an insurmountable aversion to his horribly obscure and complicated symbolic systems. [...] It is really impossible to choose signs which are more inconvenient, more artificial, and less appropriate for the ideas represented.”⁵

The criteria applied by Couturat in these critical comments are clearly of a purely practical order. But are such considerations not external to logic, as logic is concerned with truth and validity rather than with practice and applicability? The answer is ‘no’, and the challenging character of the new idea of computation seems to reside to a large extent precisely in the fact that it demolishes the dichotomy of validity and practicability. For according to the ideal of computation – at least in the incomplete and perhaps trivial form it took before the 1930s, a notion of recursive axiomatizability being either absent or at most implicit – the notion of validity is defined as derivability according to a given set of mechanical rules.

3 In the following, the words “symbol” and “symbolic” are not used in de Saussure's sense. From a linguistic point of view, the symbols used in logic are signs, not symbols.

4 Schmid 2001, letter to Russell of January 3, 1904.

5 Schmid 2001, letter to Russel of February 11, 1904.

Accordingly, it is hardly surprising that the ideal of a “fruitful” (*féconde*) and “convenient” set of “manageable” (*maniabte*) and “expressive” signs, which Couturat contrasted with the symbolisms he criticized⁶, amounts to nothing else than a symbolic system which makes it possible to establish a *calculus*, i.e. with which to formulate mechanical rules for the purpose of manipulating signs, or at least to state these rules in a simple form. Couturat referred to the historical examples of François Viète’s algebra, to the infinitesimal calculus, and also to the “algebra” of chemical formulae.⁷ The most striking example, which Couturat may have borrowed from Cournot (Cournot 1847/1989, 3 and 10), surely is the common Hindu-Arab decimal notation of numbers which enables complicated calculations to be effected so easily on paper and, on that basis, also in the mind. Roman numerals also enable calculation in an algorithmic manner, though the rules take a much more complicated form (Detlefsen et al. 1976).

The heart of Couturat’s philosophy of logic thus turns out to be the notion of the calculus (as he made clear when referring to the algebra of logic as “algorithmic logic”, cf. Couturat 2010). He owed his notion of the calculus to Alfred North Whitehead, of whose *Treatise on Universal Algebra* he published an extensive review. Here, we read:

“A calculus is the art of manipulating and combining certain substitutional signs according to a set of rules in such a manner that the result of the operations, having been interpreted, expresses a proposition about the objects designated” (Couturat 1900, p. 324).

It is immediately clear how this notion applies to standard algorithms for the elementary operations of arithmetic, or to chemical equations in which the permutation of signs according to rules makes it possible to describe chemical reactions and to predict their outcomes. For the sake of our discussion of the regular character of planned and natural language, I will enumerate here the essential features of the calculus as understood by Couturat and explained in detail in his review of Whitehead. A calculus in a language *L*:

- (1) rests on a set of signs
- (2) and consists in a set of algebraic rules for manipulating the uninterpreted signs;
- (3) these rules are themselves not interpreted and are applied in a purely mechanical manner
- (4) but they correspond to real combinations of the things signified (derivations in logic, chemical reactions, relations between numbers etc.): “parallelism”
- (5) and thus leads from interpretable expressions in *L* to interpretable expressions in *L* (in the particular case of a logical algorithm they will never lead from a true to a false sentence in *L*)
- (6) and, unlike an approach based on insight and understanding, makes it possible to avoid errors.

What becomes clear from this brief analysis is that the key feature of a calculus is its practical value. Intellectual efforts are simply externalized or outsourced. Once the calculus is established, it suffices to “turn the crank” and the machinery will yield what otherwise could have been obtained only as the result of intellectual effort. This already hints at the answer to our first question, namely, why the regular character of a language should be considered valuable at all. Quite simply, a regular language works for us (I will be able to render this claim more precise in the concluding section of the paper). I also want to stress that, although Couturat’s notion of the calculus comes second-hand from Whitehead, the insight that calculi rest on well-matched sets of “manageable” and “expressive” signs is his original contribution. This idea was only worked out several decades later

6 Cf. 1901, p. 87, and Schmid 2001, II/351, letter of 11.02.1904.

7 Cf. Schlaudt 2016; the analogy to chemical formulae is also stressed by Ehrenfest 1910/2011.

in semiotics (e.g. Krämer 1991) and, as Dutilh Novaes stresses (2012), has been substantiated in current empirical research in the cognitive sciences, in particular within the framework of “embodied cognition”. The manageability of signs, which “serve the purpose not only of *representing* [...] but also of providing a medium to be *operated* on” (Dutilh Novaes 2012, 73), can be understood in this framework in a surprisingly concrete manner as a sort of affordance, namely, to “incite sensorimotor manipulations” (ibid., 28).

4. The algebraic nature of languages, planned and natural

I now turn to language and to the question of whether Couturat's insight into the logical calculi somehow applies to this field of study also, so that a similar set of ‘horizontal constraints’ to the arbitrariness of the sign might be discovered there too.

This projects demands a degree of circumspection, for there are several dichotomies to be overcome on the way from algebras to natural languages: (1) algebras are only written and lack a verbal counterpart while, conversely, natural languages are mainly verbal and have only developed in a few historical cases into a writing practice as well; (2) algebras are ‘artificial’ whereas languages are ‘natural’; (3) algebras apply only to some highly specialized fields, largely in science, whereas languages are universal.

As Dutilh Novaes argues, one should not be too concerned about these dichotomies, for they might turn out to be mere differences of degree (Dutilh Novaes 2012, pp. 40-52). The least substantial one might be the dichotomy between the natural and the artificial, because both algebras and natural languages are the outcome of conscious *and* unconscious efforts, and it seems that the main difference lies only in the typical timescale of their emergence.

These are profound philosophical considerations but, as I explained in the introduction, I shall exploit a peculiarity of Couturat's work in order to circumnavigate them, using Couturat's work on planned languages in order to bridge the gap between algebras and natural languages. Planned languages share with algebras the character of being artificial and with natural languages that of being verbal and oral.

4.1 Ido vs Esperanto: An algebraic theory of derivation

Let us try, then, to locate the analogy between algebras and (planned) languages. There is a tempting resemblance in the fundamental structure of both, which consists in the fact that both algebras and languages consist in a “vocabulary” (a set of basic signs) and a “grammar” (a set of rules of composition and/or a syntax). But to rely on this analogy would mean straightforwardly equating algebras with natural languages. If we keep with Couturat's philosophy, this seems, though not completely wrong, yet misleading.

The analogy is not completely wrong since Couturat, drawing on Antoine Meillet's convictions (with which he widely agreed), stressed the fact that the natural languages tend to converge in their historical development towards a universal “general grammar” (Couturat 1912a, 2; 1913, 139), found to coincide with basic categories from modern (post-Aristotelian) logic (“modern” logic here means the logic of relations which allows for sentences that are not reducible to the Aristotelian “logic of genus and species” and thus to the form “subject-copula-attribute” Couturat 1908, 768; 1912a, 7). However, the empirical claim of a convergence towards a general grammar seems to be based on poor evidence. In a quite eclectic manner, Couturat cherry-picked the evidence conducive to his argument and explained any lack of evidence by referring to “conservative forces” which hinder the languages' “natural” development (Couturat 1911, 510, note 1). Put in these terms, the claim proves to be completely arbitrary. In his *Le langage*, Joseph Vendryes, who was present at the

regular discussions of Couturat's theses during the sessions of the *Société française de philosophie*, put much effort into demolishing this claim, replacing it with a more careful empirical approach (Vendryes 1921, 127 and 133-5).

But apart from this dubious sense in which an analogy between logical algebras and natural languages might be held to exist, Couturat himself warns us about exaggerating this claim. Contrary to Leibniz, where the *calculus ratiocinator* was meant to be a part of the universal language, Couturat carefully distinguished between language and calculus, and even understood them in a certain respect as complementary: a calculus is precise, but not universally applicable, whereas language is universal, but lacks precision.⁸ In *Histoire de la langue internationale*, Couturat and Leau distance themselves from the project of a *characteristica universalis* and stress that the belief in it was rooted in metaphysical convictions of the 17th century which are no longer accepted today. Accordingly, Couturat and Leau poured cold water on all attempts to establish a planned language which might serve as an “algebra of thought” (Couturat and Leau 1903, 113 and 547).

This seems to frustrate any attempt to extend Couturat's criticism of the arbitrariness of the sign from algebraic logic to spoken languages. But upon closer inspection, we discover a restricted area within languages where the search for an analogy with logical algebra might be more readily justified. In a first step, we said that languages consist in a vocabulary and a grammar. In general, however, the vocabulary itself does not simply consist in a list of admissible items but rather in a set of roots, a set of affixes (mainly prefixes and suffixes, but also infixes and other varieties) and, finally, a set of construction rules for complex words (depending on the grammar, there may also be a set of morphemes for the declination and inflection of words). That is, within the vocabulary – or, to be more precise, in the system of derivation – we stumble upon the same dual structure of a set of signs and a set of rules.

“Without a system of derivation”, Couturat declares, “a language would only be a dust of words” (“*poussière de mots*”, i.e. a conglomerate of individual words without structure nor cohesion). The words could then be chosen in a purely arbitrary manner or even replaced by numbers or other conventional signs (as is done with the international maritime signal flags); conversely, for every new notion, a completely new word would have to be invented (Couturat 1911, 513; this, by the way, is the only occasion when Couturat makes clear that his philosophy of language is incompatible with the doctrine of the arbitrariness of the sign).

Whether or not the system of derivation of natural languages actually is algebraic in character is, for the moment, an empirical question. (Couturat tended to blame natural languages for their inconsistencies and the lack of regularity in their derivations.⁹) But for the particular case of Ido, the planned language which Couturat derived from Esperanto, this question can be answered unambiguously in the affirmative. The simple reason for this is that Couturat faulted Esperanto precisely because of the ambiguities and incoherence in its derived vocabulary; he attempted, with Ido, to establish a planned language distinguished by the perfect regularity of its derivations (1911, 515).

The interesting point for us is that a perfect system of derivation satisfies Couturat's notion of a calculus as explained above, as we shall see in a moment. Couturat takes care to lay open the very principles on which, according to him, a planned language should be based. The most fundamental principle is Ostwald's “principle of univocality” (*principe d'univocité*) according to which “a

8 Cf. Schmid 2001, I/217, letter of January 3, 1901, as well as my more detailed analysis, Schlaudt 2010, p. 27.

9 In French, for example, “*dessaler*” (to remove the salt from something) is the contrary of “*saler*” (to salt), but “*détrôner*” (to dethrone) is not in the same manner opposed to “*trôner*” (to sit on the throne, to take center stage); in German, “*köpfen*”, a verb derived from “*Kopf*” (head), means to decapitate, whereas “*ochsen*”, a verb derived from “*Ochse*” (ox), means to labour, to work like an ox (Couturat 1912a, 11).

univocal and reciprocal correspondence holds between the ideas and the morphemes expressing them” (1908, 762). As a first corollary, Couturat states the “principle which dominates the entire structure of the I[n]ternational L[anguage]”, namely, that “each element of a word (i.e. each morpheme) always represents one and the same elementary idea, such that *the sense of a combination of elements is determined by the corresponding ideas*” (1908, 762, my italics). A second corollary consists in the “principle of reversibility”, according to which “if one can pass from one form to another form in virtue of a certain rule, it must be possible to get back to the first form without ambiguity in virtue of an exactly inverse rule” (1908, 762; 1912a, 13).¹⁰

In these two corollaries, the algebraic character of the system of derivation is palpable. Indeed, we can verify point by point that our above characterization of the calculus applies to a linguistic theory of derivation as based on this corollary. The theory of derivation

(1) rests on a set of signs

[This set of signs comprises roots, derivational morphemes (the affixes) and inflectional morphemes. As Couturat stresses, languages “essentially are systems of signs” (1908, 762, and 1912a, 12)]

(2) and consists in a set of algebraic rules for the manipulation of the uninterpreted signs.

(3) These rules are themselves not interpreted and are applied in a purely mechanical manner

[The rules determine the construction of new words by combining the roots with different affixes. As Couturat stressed, a language “shows its qualities first and foremost in its system of derivation, since, in truth, what constitutes a language is less its grammatical system than its derivations” (1911).]

(4) but they correspond to real combinations of the things signified (“parallelism”)

(5) and thus lead from interpretable expressions in L to interpretable expressions in L

[These two points hold by virtue of the corollary of the principle of univocity: the idea expressed by a derived word is determined by the sense of its constituents. Couturat underlines the “parallelism” involved therein: “a *formal* derivation must correspond to a derivation of the *meaning*” (Couturat 1908, 762).]

(6) and, contrary to a proceeding based on insight and understanding, make it possible to avoid errors.

This last feature may appear to be less prominent in the case of linguistic derivation, but it is nonetheless mentioned occasionally by Couturat: in a well-designed system of construction “there is no possibility to err or to go astray” (Couturat 1908, 766); “complex words must be formed in a regular way, so that they can be fabricated without potential error” (Couturat and Leau 1903, 557; 1911, 514).

In his paper of 1908, Couturat himself drew the analogy to logic and algebra (though not explicitly to the algebra of logic): “It becomes evident that, lacking a single suffix, a derivation becomes confused and illogical, just as a single paralogism in a line of reasoning, or a single false equation in an algebraic calculus, leads to blatant absurdities” (1908, 768). In a similar spirit, Meillet compared the composition of new words with the way the typographer handles moveable types (Meillet 1921,

10 For example, a verb cannot be derived directly from the noun standing for the person acting, because the noun which, inversely, is immediately derived from the verb stands for the action, not for the person acting.

65), a nice metaphor for the mechanical aspect of derivation. In the work of Couturat the algebraic view of derivation can be traced to the notion of the morpheme. Whereas Baudouin de Courtenay, for example, defined the morpheme as the smallest *indivisible* unit of meaning and hence as the end point of semantic analysis, Couturat – quite to the contrary – always referred to morphemes as “invariable elements” or “elements of fixed meaning”, i.e. as starting points for the construction of words whose meaning will not be modified by their combination (de Courtenay 1895, 10; Couturat 1908, 761-2; Couturat 1911, 515).

Overall, then, it is my view not only that we see a real algebraist at work in the construction of Ido but that the model system of derivation really does have the character of an algebra. The most serious limitation to the analogy with the algebra of logic consists perhaps in the fact that the rules of derivation probably have their logical counterpart only in the logical rules of *formation*, not in the logical rules of *transformation* (on the distinction between “*Formregeln*” and “*Umformungsregeln*” cf. Carnap 1934, 2, and Dutilh Novaes 2012, 58 and 90). The “algebra of language” governs the construction of words, not the construction of chains of reasoning.

4.2 From planned to natural languages?

We thus come to the final question posed in this paper, namely, to what extent Couturat's claims about artificial systems of derivation also apply to natural languages, or at least lead to some interesting insights about the latter.

Seen through Couturat's eyes, this claim is relatively unproblematic. On different occasions and at different places he formulated four arguments in favour of a smooth transition from planned to natural languages rather than an essential difference between them:

(1) Ido, the planned language on which the above considerations are based, belongs to the class of *a posteriori* planned languages, as opposed to *a priori* constructions. The latter, which prevailed early in the history of international languages and are rooted in the metaphysical systems of the 17th century, start ‘from scratch’, as it were, without any borrowing from natural languages. *A posteriori* languages, by contrast, rely on existing languages and, despite all modifications carried out on them, remain close to them. This leads to the second argument: (2) A common conviction shared by Couturat and Meillet was that natural languages converge in their historical evolution towards a rational “universal grammar” and a minimal set of symbols (1912, 62-3). Planned languages of the *a posteriori* kind merely anticipate this natural evolution but do not deviate from it (1912, 53 and 62-3). (3) Modifications of natural languages must have appeared all the more legitimate to Couturat, as he had an “instrumental” notion of language: “A language is an instrument of thought, and thought can manufacture a language which is more perfect than the natural languages” (1912, 75). (4) If languages are “instruments of thought”, their function, as understood by Couturat, is to express thoughts (Couturat 1911, 512). Planned languages are believed to perform this function better, but it is clear that, for Couturat, they still serve the same function as natural languages.

The latter claim was discussed animatedly in the sessions of the *Société française de philosophie* where Couturat presented his papers (cf. Roux 2017). Some criticized an over-intellectualization of language and pointed to the fact that language also has sensitive, emotional, poetic and instinctive aspects. Lévy-Bruhl cautiously remarked that languages are “complex” entities in which “intellectual elements exist alongside sensitive, motor and emotional ones” (Couturat 1912b, 63).

5. Conclusion

Whether or not one shares Couturat's vision of language, one might nevertheless concede that natural languages are not a mere “dust of words” but often display a sort of proto-algebraic

character in their system of derivation. And to the extent that a language shows this regular character, this regularity imposes a constraint on the arbitrariness of the sign, at least for complex words.

There is one obvious practical advantage in this regular character: a language with a regularly built vocabulary is easier to learn, easier to handle and richer in its expressive power, allowing for the improvised creation of new words from existing material. This is stressed by Couturat (1911, 513-4) as well as by Dutilh Novaes, who places it in an evolutionary perspective: “compositionality [...] is perhaps not a necessary condition for something to count as a language, [...] but] the iterated process of learning a language through generations selects and produces languages which are highly compositional because they are easier to learn and to operate with” (Dutilh Novaes 2012, 37).

However, we may go further and see whether the proto-algebraic character of languages might shed some interesting light on the cognitive function of language. Relying on the thesis of extended cognition, Dutilh Novaes argues that written artificial languages, in particular algebras, are “cognitive technologies” which enable us to “externalize” cognitive work (Dutilh Novaes 2012, ch. 5). Insofar as spoken natural languages also display a proto-algebraic character in their system of derivation, we are led to assume that a similar claim may also hold for them. In order to properly spell out this thesis, it is crucial to remember that the analogy between systems of derivation and formal languages only covers the rules of formation but not the rules of transformation, as noted above. Formal languages comprise both, and it is for this reason that they can serve as fully-fledged cognitive technologies. Natural languages thus cannot externalize thought to the same extent, though they can render us a service by providing words that stem from purely mechanical processes of combination. If philosophers can argue about the essence of “beauty” (from French “*beauté*”), this is simply due to the fact that language provides a black-boxed word for it. It is sufficient to add a “-té” to “*beau*”, and we are done. In such cases, i.e. in cases of *abstract* discourse, language does not simply serve as a tool for *expressing* our thoughts, as Couturat would have it. It seems instead that language *enables* thought. Means (words) and ends (expression of thought) alternate their roles dialectically. Language first creates the means of expression, and then we see what we can express with them. Perhaps this is an important, but underestimated aspect of the practical value of a regularly built, proto-algebraic language.

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