Recursion as a Human Universal and as a Primitive

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This contribution asks, in an empirical rather than formal perspective, whether a range of descriptive phenomena in grammar usually characterized in terms of 'recursion' actually exhibit recursion. It is concluded that empirical evidence does not support this customary assumption. Language, while formally recursive, need not be recursive in the underlying generative mechanisms of its grammar. Hence, while recursion may well be one of the hallmarks of human nature, grammar may not be the cognitive domain where it is found. Arguments for this claim are briefly exposed and then discussed with respect to a selection of talks from the DGfS workshop on *Foundations of Language Comparison: Human Universals as Constraints on Language Diversity* that led to this special issue.

1. Introduction

Much recent discussion around language evolution has focused on recursion as a putatively universal design feature of language, in such a way that claims that some languages do not exhibit this feature have proved highly controversial (Everett 2005). According to Everett, cultural considerations enter into the determination of whether recursion is present in a language, resulting in a return to early 20th century claims about the culture-relativity of human nature. Dietmar Zaefferer, too, at the workshop, underlined the 'dual' biological and cultural underpinnings of modern *homo sapiens*, and limitations of the extent to which the current 'biolinguistic' program is comprehensive enough to answer all core questions about human language. Against Everett, and despite Zaefferer's cautionary words, we maintain a biolinguistic approach to recursion as a human universal, though 'deconstructing' it into a number of independent and more primitive factors that we argue underlie it.

The claim that I-languages are recursive devices has been one of the hallmarks of generative theory and the basis for its implementation of the Humboldtian dictum that language makes 'infinite use of finite means': The recursive devices are the finite means in question. With recursive rules in place, a grammar has the power to generate a potential infinity of sentences, when, as Chomsky

put it over 50 years ago, otherwise it would be "prohibitively complex" (Chomsky 1956: 116). This employment of recursion in generative grammar was part of a more general inspiration of the theory of grammar by recursive function theory. Recursive definitions were a useful device that simplified an analytical framework (Tomalin 2007). Later, the notion of recursion acquired biological and cognitive connotations, and the adoption of an intensional perspective was emphasized, according to which not the result of a computation matters, but how in fact it happens. The proper object of linguistic investigation, on this cognitive view, is the one specific way (of potentially infinitely many) in which the mind/brain generates the expressions of a language. The claim that language is recursive is now the empirical claim that this particular algorithm is a recursive function (reflecting standard observation in linguistics that a linguistic expression of a particular syntactic, semantic or phonological category may become part of another one, of the same category). That it is has been a central claim in generative grammar to this day. In Minimalism, in particular, recursion became encapsulated in the definition of the basic combinatorial operation Merge, which moreover was identified as the prime and potentially single biological innovation in the evolution of language (Hauser *et al.* 2002): A universal and language-specific element of human cognition as well as a primitive, not reducible to anything else. This sense of recursion as instantiated in Merge, where the value of a function is added to its domain, is the one under discussion in the present paper.

In our presentation, we claimed that:

1. Language uncontroversially displays recursive capacities: It can generate an infinite sequence of embedded expressions of the same category. But what gives rise to this recursivity is the confluence of a number of different factors in language design, all having to do with the interfaces that the computational system of grammar forms with other linguistic and certain extra-linguistic systems (e.g., the discourse representation, the lexicon, the planning capacity). There is no clear empirical evidence of recursivity of the structure-building mechanism of grammar in isolation or autonomously from these interfaces, notably the syntax-discourse interface (hence, there is no recursion in the faculty of language in the 'narrow' sense of Hauser *et al.* 2002).

2. Considering syntax to be the module, or aspect, of grammar that drives the structure-building processes in language, 'direct' recursion — the immediate embedding of one and the same syntactic category in itself — never occurs within the structure-building grammatical computations, which speaks in favor of a templatic view of this process (similar to views of language in certain types of construction grammar). As elaborated in more detail in the next section, we consider as direct recursion only those cases where unmediated embedding of one syntactic category in itself is attested, as well as ones where other categories interfere between the one occurrence of the category in question and the other but still all takes place within a single cycle of syntactic computation.

3.   Recursive structures as they arise from interface effects derive from the more primitive properties: The cyclicity of derivations, the categoriality of syntactic constituents, and the way reference to discourse entities is determined at cyclic boundaries.

We do not deny that potentially infinite embedding in language, illustrated in (1), is for real. Rather, we argue that it only emerges as the consequence of a conspiracy of syntactic structure-building and the interfaces, and that it cannot be achieved by the former alone.

(1)   a.   [I saw the woman [that saw the woman [that saw the woman…]]]
      b.   [[The window [[the neighbor [the dog bit]] broke]] fell down]
      c.   [John knew [that Peter believed [that Mary liked him]]]

We argued that approaches to grammar assuming some version of Multiple Spell-Out — for instance, the phase-theory of Chomsky (2001, 2008b) — are forced to represent the narrow structure-building syntactic procedures as essentially non-recursive. In this view, every one of the embedded constituents in (1) is spelled out when completed and then interpreted at different interfaces, involving further processes outside the narrow syntactic derivation. Only a truncated constituent is included in any further structure-building operations in narrow syntax. As Chomsky (2008a, 2008b) argues, after Spell-Out, each constituent is structurally reduced to a structural primitive (comprising the head and the left edge of the spelled-out phase) which does not carry along any information about its complement. This means that any category embedded within a spelled-out chunk of structure becomes inaccessible for further computations, except for interpretively irrelevant processes of Agreement, as Chomsky (2001: 14) points out.

We presented arguments that direct recursion can never be observed in the operations constituting the structure-building (i.e. narrow syntactic) component of the language faculty, neither within nor between phases in cyclic computations. We discussed a number of different empirical regularities, from sequence of tense phenomena to complement clauses, in support of the argument that narrow syntax is non-recursive, in fact bans recursion. We pointed out facts as in (2), where embedded expressions of the same category show certain deficiencies: Clauses lack truth values, nominal expressions contribute descriptions, not immediate reference, and tenses lose the capacity to determine their own reference times.

(2)   a.   C–in–C
            [John suspected   [that Mary believed [that he was a police agent]]]
            truth value   *no truth value*   *no truth value*
      b.   D–in–D
            The vase on the table was green.
            John's mother plays basketball.
      c.   T–in–T
            John said Bill was tired.

Possible counterarguments, such as the seemingly unrestricted compounding in the nominal domain, are shown to obey the same restrictions: Direct recursion must be avoided by a Spell-Out to the discourse and other interfacing domains, a special kind of this intermediate step being the storing of a compound in the lexicon before further compounding may take place.

We argued in the light of such facts that a templatic view of the structure-building component is better than the standard one based on the operation Merge. While the templatic nature of the phase-internal structure is not far from some of the prominent views of grammar within the minimalist community (especially in the so-called cartographic approaches, stemming from Cinque 1999), we argue that at the level of embedding of phases in one another, the same kind of templatic patterns plays a central role as well.

Section 2 discusses the relation between the contents of our talk and the contents of the talks taking the perspective of theoretical syntax. In section 3, we discuss how the papers in the domain of cognitive neuroscience relate to our views of recursion in language. Section 4 concludes.

2.   Grammar Architecture and the Core Properties of FLN

Our conclusion is that recursion is not an element of UG or of the 'faculty of language in the narrow sense' (Hauser *et al*. 2002), that is, not an element that is specific to grammar or characterizing language in some essential sense. This conclusion can be abstractly compared to a conclusion that Bever (2009) has suggested regarding such putative UG-principles as the 'EPP'. Rather than being a core universal constraint of language design, Bever argues that it reflects a non-domain specific constraint on learnability. Put differently, the EPP is an epi-phenomenon of learning: It is merely a descriptive universal, the overall result of recurrent statistical patterns in linguistic data that find its true causes in con-straints on acquisition. In the words of Bever, the EPP is a property of "the connection between the narrow faculty of language and the acquisition interface" (p. 280). In an analogous way, we say that recursion is truly a property of the interface between the narrow faculty of language and the discourse in which language use takes place. Specifically, the EPP is the result of a 'Canonical Form Constraint' for Bever, which makes the learner identify statistically frequent tem-plates in the linguistic input, which are then internalized and become a part of a speaker's I-language. This stance interconnects with our stance regarding the foundational significance of syntactic templates as opposed to the operations of unrestricted Merge in language.

While we argued against the central role of recursion in the narrow language faculty (FLN) by showing that the recursive nature of computations in language is epiphenomenal — it comes from its interface with external systems (such as discourse representation) — Joanna Roselló argued that the duality of the architecture of language, its double articulation, is a more essential property of FLN than recursion itself. Her main line of argument relies on the fact that recursive computations are found in other capacities, such as music or arithmetic, and that it is very hard to eliminate the possibility that these capacities are to

some extent independent of language. On the other hand, these two capacities may be difficult to motivate in terms of selective pressure, and also be parasitic on language (e.g., Hinzen 2008). In that case, however, we need to consider that capacities like planning or spatial cognition, which are both older than language and more broadly distributed in the animal world, are argued to include recursive computations (Arsenijević 2008, van Lambalgen 2008, and note especially the Sapir-Whorfian close relation between syntax and planning argued for at the workshop by Rainer Dietrich, Werner Sommer & Chung Shan Kao). This makes it quite hard indeed to see recursion as the core property of FLN. The final bearing of Roselló's talk on Hauser *et al.* (2002)'s view of recursion as the core of FLN is essentially the same: We argue that this view is untenable — for us because recursion in language is epiphenomenal and dependent on other modules instead of being internal to FLN, and for Roselló because there is a better candidate, which is an exclusive property of FLN, unlike recursion.

With Roselló, we also share the internalist view of language and the way it relies on computational capacities, as well as the approach to syntactic computations, in which they are taken as an instantiation of the general structure-building capacity of human cognition, hence as closely related to propositional thinking as they are to language. However, we have a slight reserve towards Roselló's view which puts the double patterning of language in the centre of FLN. There are cognitive capacities that we share with animals, which also involve the kind of duality of patterning that language involves. Such is the case, for example, with the planning capacity, where structures of plans always map between actions (sensory-motoric, just like the phonetic side of language) and goals (abstract representational, just like the semantic, or discourse side of language). Similarly, in the spatial capacity, there is the sensory-motoric and the cognitive map component.

Andrew Nevins discussed the possibility that there is a language that for cultural or other reasons lacks any recursive structures. Although this is highly unlikely, given that FLN is typically described as essentially recursive, he argued that this is still possible, and that it should be taken as not more than a rare accident. From the perspective of our view of recursion, as an epiphenomenon arising from the nature of the syntax-discourse interface, such an accident is not particularly unlikely — it only requires a certain version of that interface, which will block the patterns of interaction leading to the generation of surface — or formally recursive structures.

Another point of Nevins' talk was that even in languages where syntactic recursion seems to be missing, recursive computations are needed to deal with pronouns and paratactic expressions whose the semantic interpretations would involve embedding structures. In other words, even when recursion is expelled from the sentence, it is present in the discourse. This again fits our argument, insofar as we exactly claim that recursion in language comes from the interaction of syntax with the discourse.

Ljiljana Progovac presented a view of small clauses in which this class is at the root of not only syntactic derivations in a synchronic view of grammar, but also at the root of the evolution of syntax as we have it today. She presents small clauses as the first step in the derivation of any sentence, and as the first real

syntactic construction ever. Moreover, she shows that this primitive syntactic structure is still generated and used by humans, and that there are certain pragmatic and semantic domains in which it is still the first choice.

(3)   a.   John considers [her happy].
       b.   Her happy?!
       c.   *John considered [Bill see [her fall]].

Progovac discusses a number of special properties of small clauses, among which that they cannot be produced recursively, as illustrated by (3c).

An important question in this respect is that of the discourse-integration of bare small clauses, as in (3b). Are they treated as fully specified, that is, as expressions with a particular type of interpretation, determined by the structure and the content of the very expression, or are they treated as underspecified expressions, bearing a number of unspecified features, which get their specification in the discourse? The latter seems to be the correct view. Irrespective of the expressive content of the small clause in (3b), it is interpreted as expressing some attitude of the speaker towards the referent of 'her' in the relevant discourse being considered by the relevant subjects to be happy *at the time specified by the discourse/ context*. This means that in the discourse, this expression binds a referent for its subject, and also gets a tense in a similar way (considering that tense behaves similar to pronouns). In the discourse, therefore, it behaves as a tensed expression.

From the aspect of our view of recursion, where recursivity emerges when a structure is taken from the discourse and used as an atomic (i.e. non-structurally complex or phrasal) element in syntactic generation, it is natural that small clauses do not recursively embed. Once integrated in the discourse, they receive tense and other specifications, and are not present as small clauses any more — especially considering that in our view only full phases can be turned into atomic elements that can form an input from the discourse to a new cycle of generation — a unit that presents only a root of a phase can never be taken as such an input.

3.   **Neuro-Cognitive Aspects**

The talk 'Linguistics and the future of the neurosciences' by David Poeppel discussed the still quite long distance between these two disciplines, stressing in particular the problem of different granularities: While linguistics works on fine-grained distinctions among different representations and computations, neurosciences use rather broad-stroke conceptual distinctions to characterize linguistic phenomena, and has its own lower-level vocabulary, possibly incommensurable with the linguistic one. The first step in solving this and related problems would be a sufficiently formal and abstract systematization of the ontologies and processes involved in grammar, which would allow for the modelling of neural populations responsible for their memorization and the execution of these ontologies and processes respectively.

Michael Ullman argued that there is a competition between different ways

of handling certain linguistic operations, and that although this involves a degree of redundancy, it also brings in considerable advantages in handling tasks of different kinds. In particular, Ullman argued that two distinct systems, one based on lexical memorizing, and one on productive generations, are engaged in the computation of expressions with morphologically or lexically marked functional features such as tense or definiteness.

In our interpretation, this view implies that the neurocognitive reality of grammar is somewhere between the more fully generative models such as the Minimalist Program (Chomsky 1995) and Construction Grammar (Goldberg 1995) in which there is a significant role of memorization of larger structures. Moreover, Ullman reports on evidence of a more frequent utilization of processing strategies compared to memorization in children, and in turn a more prominent role of memorization in adult speakers. This is in agreement with the option we discussed in our presentation, that even relatively large cartographic structures, specifying the full projection capacity of a certain category, are memorized by adult speakers, and then used as templates, but that they all still need to be generated a sufficient number of times before they are memorized due to their frequency.[1] This pre-memorizing productive generation takes place in the L1 acquisition period. This hopefully presents a step towards more commensurability between linguistics and neurosciences, in respect of Poeppel's concern.

Although this rule-based view is often discarded by neuroscientists taking network approaches, on the grounds that they are too discrete in nature to appear as a product of neural activities, Friedemann Pulvermüller presented a possible neuronal model capable of representing and executing discrete rule-based operations such as those typically defined by phonologists, syntacticians, and semanticists. He also presented a possible way of handling recursive rules within network approaches in neuroscience, an important requirement being the sensitivity of the system to the intensity of activation, which is somewhat related to our claim that recursion appears only once the structure-building capacity has reached the interface with the discourse, stored its output there, and read a new package of input from it. The execution of a procedure matching a certain operation of syntax or phonology in itself cannot produce a recursive structure; such a structure can be generated only once the system is made sensitive to the outputs of earlier executions.

4.   Conclusion

Although coming from very different domains of inquiry into the nature of language, presentations at the workshop converged on a large number of questions. In some cases, these questions are left open, or different answers were advocated for them in different talks, but there was also a great degree of convergence on the central issues of the conference topic: For example, the nature

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[1]   Note that these are in fact not particularly large structures, but rather ordered linear sequences of 10 to 15 category labels. They may be thought of in terms of, for example, Gärdenfors' (2000) conceptual dimensions, which he also presents as ordered linear structures.

of recursive computations was one of the central topics in most of the talks, and it was approached in different ways and from different perspectives. If we are right, recursivity is present in language but not truly causally efficacious and not language-specific: Language-specific are specific restrictions on what ultimately templatic structures can be built in this particular domain. Most of the data, and most of the theoretical views presented were compatible with our view, sometimes clearly supporting it or meeting its predictions.

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