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1 Syntactic complexity across interfaces

1.1 Introduction

Syntactic complexity has always been a matter of intense investigation in formal linguistics. Since complex syntax is clearly evidenced by sentential embedding and since embedding of one sentence in another is taken to signal recursivity of the grammar, the capacity of computing syntactic complexity is of central interest to the recent hypothesis that syntactic recursion is *the* defining property of natural language (Hauser et al. 2002). In the light of more recent claims according to which complex syntax is not a universal property of all living languages (Everett 2005), the issue of how to detect and define syntactic complexity has been revived with a combination of classical and new arguments (Nevins et al. 2009).

The existing collections on the nature of syntactic complexity either deal with syntactic complexity from a functional-typological perspective (Miestamo et al. 2008; Sampson et al. 2009) or place a premium on the property of syntactic recursion (van der Hulst 2010; Sauerland and Trotzke 2011; Roeper and Speas 2014). In contrast, the current volume makes a new contribution to the ongoing debate by taking into account the recent development in linguistic theory to approach UG 'from below' by referring to both grammar-internal and grammar-external interfaces when explaining design features of the human language faculty (Chomsky 2007). According to this shift in perspective, it is reasonable to assume that UG only contains properties such as recursive Merge, binary branching structure, and the valued-unvalued feature distinction. All other properties of grammar might follow from the interaction between UG and other components within the model of grammar (the phonological and the semantic component; i.e. grammar-internal components) and from the interplay between UG and grammar-external components such as the performance and acquisition systems. As for the interaction with grammar-internal components, the new division of labor among the components of the model of grammar raises new issues for defining and detecting syntactic complexity. In particular, the question of the complexity of grammar has to be answered separately for 'narrow syntax' and for the grammar as a whole, including the interface components (Trotzke and Zwart 2014). As for the interaction with grammar-external components, Trotzke et al. (2013) show that systematic properties of performance systems (the 'performance interface', according to their terminology) can play an important role within the research program outlined by Chomsky (2005, 2007). In particular, investigations of the performance interface can revise current conceptions of UG by relegating widely assumed grammatical constraints to properties of the performance systems, as recently argued, for instance, by Bever (2009) for the Extended Projection Principle or by Hawkins (2013) for the Final-Over-Final Constraint (Biberauer et al. 2014).

Given this conceptual background of approaching the issue of syntactic complexity from the perspective of recent linguistic theory, the volume starts with two contributions that deal with the formal complexity of natural languages in terms of the Chomsky hierarchy, the most prominent complexity measure in formal language theory. These two contributions set the scene for the volume by discussing general aspects of grammar architecture and by turning to the question of whether languages can vary as to their formal complexity. The two papers are followed by three contributions that address specific issues of clausal embedding (small clauses, parentheses, peripheral adverbial clauses, and right dislocation/afterthought constructions). The last part of the volume contains three papers that provide accounts of how to address topics revolving around syntactic complexity in terms of grammar-external interfaces in the domain of language acquisition.

1.2 Syntactic complexity and formal language theory

In contrast to the recent typological-functional literature, the comparative complexity of languages is not an issue in formal language theory. The question relevant in this context is where the grammar of natural language is to be placed in the 'Chomsky hierarchy', a complexity hierarchy of formal languages. In the 1950s, Noam Chomsky developed formal language theory as a mathematically precise model of language. Chomsky established that behaviorist accounts of language were insufficient to account for the computational properties of natural languages, whereas the phrase structure grammars Chomsky introduced stood a chance to be sufficient. In particular, Chomsky (1956, 1959) showed that the property of self-embedding involves the kind of complexity that requires (at least) context-free grammars, rather than less complex types of grammar (specifically, finite-state devices). Following the lead of Chomsky, theoretical linguists developed concrete phrase structure grammars for specific languages. Crucially, and as should be clear from the above, the discussion in formal language theory focuses on general computational properties of 'narrow syntax', a core component of the model of grammar that can be equated with the faculty of language in the narrow sense as defined in Hauser et al. (2002). In addition to this component that applies simple rules merging elements, the model of grammar includes interface components dealing with sound and meaning. Accordingly, the question of the complexity of the grammar has to be answered separately for the grammar as a whole and for the individual components (including narrow syntax); with different answers forthcoming in each case. In recent literature, it is an open question which phenomena are to be associated with which component of the grammar, with current proposals relocating seemingly narrow syntactic phenomena such as head movement and inflectional morphology to the interface with phonology (e.g. Chomsky 2001). By discussing notions of formal language theory, the following two contributions investigate which properties of the grammar should be relegated to the

interface components and which features of natural language should be considered as belonging to narrow syntax and, therefore, should be evaluated according to the Chomsky hierarchy.

In his contribution "Against complexity parameters," **Uli Sauerland** addresses the recent proposal that languages can vary concerning their formal complexity in terms of the Chomsky hierarchy. According to Sauerland, such accounts are essentially proposing that this variation is a parameter choice – the 'complexity parameter'. Sauerland argues that parameterizing languages in this regard is unwarranted and not supported by the evidence. Based on a discussion of languages such as Swiss German, Standard German, and English, Sauerland makes two claims. First, he argues that certain word order differences between these languages should not be addressed in terms of the Chomsky hierarchy. Instead, as Sauerland argues, these variations can be addressed by independently established word-order parameters, belonging to the domain of the phonological interface and not to narrow syntax. After relegating this issue to variation in the domain of linearization, Sauerland turns to a second argument against complexity parameters by referring to the semantics interface. He claims that the semantics of a non-context-free language would need to radically differ from that of a context-free language. Specifically, he argues that the semantics of language is inherently context-free, and, as a consequence, the standard semantics of scope requires at least a memory system that supports context-free grammars. Since Sauerland takes it for granted that the semantics of natural languages should not vary, he concludes that these properties of the semantics interface provide important evidence against complexity parameters.

Jan-Wouter Zwart also takes the Chomsky hierarchy as a starting point. In his paper, "Top-down derivation, recursion, and the model of grammar," he adopts the strong focus on the role of the interfaces from recent minimalist literature and argues that the issue of syntactic complexity of the grammar has to be answered separately for the grammar as a whole and for the individual components (including 'narrow syntax'). Given this theoretical background, he claims that linguistic recursion should be understood as the interface-related treatment of a complex string as a single item within another complex string. In particular, he demonstrates that this simplex/complex ambiguity is due to separate derivational sequences ('derivation layers'). He argues that the grammar creating those strings ('narrow syntax') may be of the minimal complexity of a finite-state grammar. Zwart claims that competing views suffer from the unmotivated assumption that the rules and principles of grammar are fed by a homogeneous set of symbols. In contrast, he proposes that the symbols in the alphabet/numeration may themselves be the output of separate derivations. Based on this clarification, he concludes that arguments against the finite-state character of generating phrase structure lose their force. As a consequence, the complexity of natural language should not be addressed, in the first place, in terms of the types of grammar rules, but in terms of interaction among derivation layers, crucially involving the interfaces.

1.3 Syntactic complexity and clausal embedding

The following three contributions address specific issues of clausal embedding: small clauses, parentheses, peripheral adverbial clauses, and right dislocation/afterthought. The three papers ask to what extent grammar-internal interface conditions and properties can help to detect and define syntactic complexity. Do interface properties concur with the syntactic complexity ascribed to the phenomena in question? Or do interface-related features of the data even exclude an analysis in terms of syntactic complexity?

Leah S. Bauke deals with the issue of small clauses, a prominent case for which syntactic complexity is notoriously difficult to define. Working with a minimalist perspective, she focuses on the question of how basic syntactic operations are determined by interface conditions. In her paper "What small clauses can tell us about complex sentence structure," she argues for a revised analysis of small clauses. In particular, she claims that agreement between the small clause constituents can be established directly upon Merger and need not be mediated by a functional head. However, within minimalist theory, cases of XP-XP Merger are considered problematic because they pose labeling ambiguities. As a consequence, the input to the operation Merge is suggested to be constrained with the effect that at least one element must be or must count as a lexical item. Bauke demonstrates that this constraint poses no problem for her analysis, in which small clauses are generated by direct Merger of the two constituents that make up the small clause. She adopts the approach that complex syntactic objects already merged in the course of the derivation can be shrunk to lexical items, and, based on this account, she proposes an analysis of so far unaccounted for extraction and subextraction patterns in Russian and English small clauses.

The contribution by **Werner Frey and Hubert Truckenbrodt** focuses on the syntax-phonology interface. In their paper "Syntactic and prosodic integration and disintegration in peripheral adverbial clauses and in right dislocation/afterthought," they analyze different clausal dependencies in German by bringing together their respective work on peripheral adverbial clauses and on right dislocation and afterthought constructions. Frey and Truckenbrodt analyze these phenomena within a single set of analytical assumptions that relate to the notions of 'integration' and 'root sentence'. In the first part of their paper, they demonstrate that peripheral adverbial clauses require high syntactic attachment. Put more technically, peripheral adverbial clauses are either in the specifier of their host clause or are adjoined to their host clause. The authors show that this converges with phonological evidence. Both prosody and information structure of peripheral adverbial clauses reflect their borderline status between integration and disintegration. In the second part, they show that right dislocated or afterthought constituents are 'added' to the clause in the sense that they do not occupy a thematic position in their clausal host. However, these constituents show c-command relations like the elements they resume ('connectedness effects'). Based on evidence from the prosody and information structure

of right dislocation and afterthought constructions, the authors show that a syntactic adjunction analysis, if it aims at generalizing across right dislocation and afterthought constructions, cannot represent the properties of disintegration in a principled way. As an alternative, they propose a deletion analysis, which captures both the property of disintegration and the connectedness effects.

Marlies Kluck starts her contribution with the observation that syntactic complexity that does not involve subordination, such as coordinate structures and parentheticals, is still poorly understood. In her paper "On representing anchored parentheses in syntax," she turns to the questions of how and where 'anchored parentheses' are represented in grammar. By 'anchored' parentheses, Kluck refers to parentheses that are not freely attached somewhere in their host, but are attached at the constituent-level to an 'anchor'. In this sense, nominal appositions, nominal appositive relative clauses, amalgams, and sluiced parentheticals belong to this category. Contra 'orphan' approaches, which put parentheticals outside the domain of syntax, Kluck argues on both conceptual and empirical grounds for anchored parentheticals as represented at the level of syntax. In particular, she provides two reasons for this claim: First, anchored parentheticals must be part of syntax under common assumptions about the model of grammar. Parentheticals are linearized in their hosts and interpreted relative to their hosts. Second, since anchored parentheses are related to a specific constituent in their host, namely the anchor, their integration should not take place at a post-syntactic level.

1.4 Syntactic complexity and the acquisition interface

While the contributions sketched above deal with the interaction between syntax and grammar-internal interfaces, the following three papers focus on grammar-external interfaces in the domain of language acquisition. To keep UG as slim and simple as possible, these interfaces have recently been analyzed as external third factor effects (Trotzke et al. 2013), and include, according to Chomsky (2005: 6), "(a) principles of data analysis that might be used in language acquisition and other domains; (b) principles of structural architecture and developmental constraints [...] including principles of efficient computation." Following Bever (2009: 280), we use the term 'acquisition interface' to refer to these grammar-external conditions in the context of language acquisition (i.e. to specific constraints on learnability). Given this interface notion, the following three contributions ask to what extent grammar-external acquisition processes can contribute to the debate on how to detect and define syntactic complexity. The contributions deal in particular with (i) different acquisition processes operative in the development of syntactic subordination, (ii) the identification of different scales of syntactic complexity by means of acquisition devices such as semantic bootstrapping and (iii) the application of minimalist economic principles to the acquisition problem.

Tonjes Veenstra argues that the pidgin-creole cycle provides crucial insights into the development of subordination in natural language. In his paper "The development of subordination," he starts with the observation that interlanguage varieties and pidgins both lack subordinative structures, and that creoles, by contrast, do exhibit such structures. On the basis of a comparison between Saramaccan (an English/Portuguese-based creole spoken in Suriname) and Fòngbe (its major substrate language), Veenstra shows that the creole patterns cannot be accounted for by substrate influence alone. Concentrating on sentence-embedding predicates and their associated syntax, he argues that the mismatches between the creole and its substrate are due to processes of incipient (second) language learning. Given different acquisition processes operative in creole genesis, Veenstra claims that incipient learning, i.e. early second language acquisition, plays a substantial role. Specifically, he argues that incipient learning accounts both for variable selection patterns of clausal embedding and for the absence of morphologically marked verb forms in embedded contexts. On the other hand, non-incipient learning, i.e. more advanced second language acquisition, accounts for the appearance of an unspecified subordinator. Relexification can explain the specific properties that this subordinator exhibits.

Tom Roeper also focuses on the acquisition interface. In his paper "Avoid Phase: How interfaces provide critical triggers for *wh*-movement in acquisition," he discusses the claim that both small clauses and infinitives lack a CP. More specifically, he focuses on the fact that Germanic languages generally do not permit a *wh*-word in an indirect infinitival question, while English, as an exception, does. In the context of evidence from first language acquisition, Roeper argues that the child acquiring English can posit a zero scope-marker in the matrix CP and need not posit a new infinitival CP. In support of this view, Roeper presents experimental evidence according to which the child more often interprets the medial *wh*- as covertly moved to the matrix CP with an infinitive than with a tensed clause. In addition, he refers to the notion of 'acquisition efficiency' and postulates 'Avoid Phase' as a general economic principle that converges with assumptions in minimalist theory. Adopting the notion of periodic 'Transfer' of syntax to a semantic interface interpretation, he claims that periodic Transfer is psychologically costly, and, consequently, the child should limit the number of Transfers by limiting the set of phases (thus the term 'Avoid Phase'). In other words, the child will maintain a more economical representation by positing as few phases as possible. Given this background, Roeper argues that tensed clauses initiate an interface transfer, while the default representation of infinitives, lacking a CP, does not.

Like Roeper, **Misha Becker** deals with data from first language acquisition. In her paper "Learning structures with displaced arguments," she starts with the assumption that sentences in which an argument has been displaced with respect to the position associated with its thematic/semantic role are more complex than sentences without such displacement. By focusing on this issue, Becker looks at how children acquire two constructions that involve such a more complex alignment of thematic relations: 'raising-to-subject constructions' and '*tough*-constructions'. Becker claims that inan-

imate subjects provide a clue to the detection or postulation of a complex structure. Essentially, she extends the scope of semantic bootstrapping and argues that not only can an animate NP serve as a cue to canonical subjecthood, but an inanimate subject can serve as a cue that the subject is displaced, and therefore that the structure is more complex. Becker supports her claims with two types of data: (1) naturalistic input data (child-directed speech from the CHILDES corpus) and (2) controlled experimental input data in simulated learning tasks with both children and adults.

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