

Syntactic Theory and the Evolution of Syntax

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Contemporary work on the evolution of syntax can be roughly divided into two perspectives. The incremental view claims that the evolution of syntax involved multiple stages between the non-combinatorial communication system of our last common ancestor with chimpanzees and modern human syntax. The saltational view claims that syntax was the result of a single evolutionary development. What is the relationship between syntactic theory and these two perspectives? Jackendoff (2010) argues that “[y]our theory of language evolution depends on your theory of language”. For example, he claims that most work within the Minimalist Program (Chomsky 1995) is forced to the saltational view. In this paper it is argued that there is not a dependency relation between theories of syntax and theories of syntactic evolution. The parallel architecture (Jackendoff 2002) is consistent with a saltational theory of syntactic evolution. The architecture assumed in most minimalist work is compatible with an incremental theory.

Keywords: evolution; language; syntax; theory

1. Introduction

There are roughly two contemporary views on the evolution of syntax, the incremental view and the saltational view. The incremental view claims that the evolution of syntax involved multiple intermediate stages between the communication system of our last common ancestor with chimpanzees and full-blown modern human syntax. The saltational view claims that syntax was the result of just a single evolutionary development.

What is the relationship between contemporary theories of syntax and these two perspectives on the evolution of syntax? Jackendoff (2010) argues that there is a dependency between theories of language and theories of language evolution: “Your theory of language evolution depends on your theory of language”. Building on earlier work (Jackendoff 1999, 2002, 2007a, 2007b; Culicover & Jackendoff 2005), he describes two types of architecture for the human language faculty, *syntactocentric* architectures (e.g., most work within the Minimalist

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Program; for background, Chomsky 1995) and the *parallel* architecture (Jackendoff 2002). According to Jackendoff, syntactocentric architectures are associated with the claim that syntax is the sole source of combinatoriality in the human language faculty, whereas the parallel architecture claims that there are independent combinatorial systems for, at least, phonology, syntax, and conceptual (semantic) structure. Jackendoff has argued in several publications (Jackendoff 2002, 2007a, 2010, 2011) that the parallel architecture lends itself to an incremental view of language evolution, whereas the syntactocentric approach is forced to the saltational view.

The focus of this article is the evolution of syntax, and, in particular, the relationship between syntactic theory and the two views on the evolution of syntax described above. I argue that there is not a dependency between syntactic theory and views on syntactic evolution. The parallel architecture is compatible with a saltational view on syntactic evolution that involves just one evolutionary development. Syntactocentric architectures consistent with minimalist assumptions are in harmony with an incremental view on the evolution of syntax. In section 2, I discuss the parallel architecture. In section 3, I turn to minimalism. Section 4 is the conclusion.

2. Parallelism

2.1. *The incremental view of syntactic evolution*

Gradualism was a feature of Darwin's perspective on natural selection (Sober 2011: 19; see also Fitch 2011: 3). On his view, natural selection is an incremental stepwise process in which the steps are small and numerous (Sober 2011: 19). Gradualism has characterized a great deal of work on language evolution. For example, Pinker & Bloom (1990: 713) assume that "language is a complex system of many parts, each tailored to mapping a characteristic kind of semantic or pragmatic function onto a characteristic kind of symbol sequence". For them, the building blocks of grammars include major lexical categories, major phrasal categories, phrase structure rules, rules of linear order, mechanisms of complementation and control, *wh*-movement, etc. They argue that this complex system arose via a series of small steps.

How do we tell an instance of incremental evolution apart from a saltational one (see section 3 for further discussion of the saltational view)? This may not always be possible in practice. The result of a single genetic macromutation may be difficult to distinguish from the result of an incremental process comprising numerous steps. However, many researchers would argue that an incremental account is preferable to a saltational account, even in situations where the available data does not distinguish between the two: "[A]lthough the outcome of a slow additive series of steps can be indistinguishable after the fact from a macromutation causing an immediate and radical change, the latter is evolutionarily highly unlikely" (McMahon & McMahon 2013: 195).

On the incremental view, the evolution of syntax involved a sequence of innovations, where the "sentence-forming word-combining powers of humans started small, and evolved to be more extensive" (Hurford 2012: 587). Each of

these innovations increased the expressive power of the system making it a target for natural selection (Progovac 2010a: 248, Jackendoff 2011). To illustrate, the following sequence of steps for the incremental evolution of syntax is adapted from Johansson (2005). Each step in the sequence is a functional communication system.¹

(1) *Incremental view of syntactic evolution:*

1. one-symbol (i.e. phonology + meaning, but no combinatoriality)
2. two-symbol
3. hierarchical phrase structure
4. recursive hierarchical phrase structure
5. full modern human syntax (i.e. recursive hierarchical phrase structure plus functional categories and inflection)

(adapted from Johansson 2005: sect. 11.4)

In the remainder of this section, I discuss stages 1–5 in detail and then turn to evidence that has been used to support the incremental view.

At stage 1, early hominins produced monopropositional, non-combinatorial single-symbol utterances (Givón 1979, cited in Jackendoff 2002: 239 and Hurford 2011: 605). (The term *hominin* refers to “[a]ll species, living or extinct, on the ‘human’ side of the evolutionary tree after our last common ancestor with chimpanzees divided into the two lineages that would produce modern humans and modern chimpanzees” (Coyne 2009: 248).) The symbols themselves were monomorphemic at this stage and could be used in a non-situation-specific fashion to designate objects and events outside the sensory range of the sender and the receiver(s). As Hurford (2012: 587) puts it, “all linguistic knowledge [at this stage] was in terms of specific lexical items ... there was no knowledge of constructions other than words”.

At stage 2, a group of hominins produced monopropositional, multisymbol utterances. These utterances involved string-concatenation of symbols: [A B], [A B C], [A B C D], [A B C D E], etc. The sequences uttered were just a few symbols in length (“say, a maximum of three to five”, Bickerton 1998: 347). Semantic and pragmatic factors such as Agent First and Focus Last (Jackendoff 1999, 2002, 2011) constrained the relative order of these symbols.²

¹ Note that each step is characterized in terms of the structures that early humans had and used in communicative interactions, rather than in terms of the computational mechanisms that generated those structures. Lobina (2011a, 2011b; see also Lobina & García-Albea 2009) argues that we need to be careful to distinguish between the expressions that languages manifest and the mechanisms that operate over those expressions. This is especially important when discussing the role of recursion in the evolution of language: “Non-recursive mechanisms are in fact capable of processing recursive structures” (Lobina 2011b). Even if recursive syntactic structure emerged at a particular stage in the evolution of language, it does not follow that recursion is a property of the computational system underlying language at that stage (and vice versa).

² Casielles & Progovac (2010) argue that the Agent First constraint should be reconsidered in light of verb–subject structures from languages such as Spanish. They argue that verb–subject structures are better and simpler candidates than subject–verb structures for primary structures in the evolution of syntax.

These sequences were not associated with any features of modern human syntax such as hierarchical phrase structure. Only prosody serves as an indicator that the symbols in these sequences comprise a single unit (Progovac 2009b). Stage 2, in which words were strung together with no syntactic organization whatsoever, is sometimes referred to as *proto-language* (Bickerton 1990; Hurford 2012: 638). Symbol sequences at this stage are comparable in complexity to the multi-symbol non-hierarchical sequences uttered by Kanzi, a language-trained bonobo, using a combination of lexigrams on a keyboard (Savage-Rumbaugh & Lewin 1994, Savage-Rumbaugh *et al.* 1998).

Stage 3 introduced hierarchical phrase structure: [A B], [C [A B]], [D [C [A B]]], [E [D [C [A B]]]], etc.³ This breakthrough might have involved “the grouping of words into headed units [such as a noun phrase—BC], and the application of structural rules [such as passivization and raising—BC] to headed units as a whole, rather than to individual words” (Johansson 2005: 234–235, expanding upon the proposal in Jackendoff 1999).⁴

Linear order within the syntactic units was not constrained by autonomous syntactic principles, but rather by semantic and pragmatic factors like those discussed above for stage 2. There were no recursive structures at this stage. (A recursive structure is a structure characterized by self-similar syntactic embedding (Tomalin 2011: 306). For example, in the structure [_{NP1} the linguist who created [_{NP2} the Na’vi language]], a noun phrase, NP2, is embedded within a phrase of the same type, the noun phrase NP1.)

Kinsella (2009: 121) observes that recursive structure is often confused with or subsumed under the notion of hierarchical phrase structure. As she points out, “recursion [= recursive structure] is not directly entailed by such hierarchical structuring; a structure can be hierarchical without being recursive. Recursion [= recursive structure] only arises when the specific phrases that are embedded inside each other are of the same type”. The communicative behavior of certain non-human animals such as some birdsong arguably involves complex hierarchical structure (e.g., nightingale song; see Todt & Hultsch 1998, Hurford 2012: 57–62, and Berwick *et al.* 2012 for discussion). There is no evidence, however, that this hierarchically structured non-human animal communicative behavior encompasses recursive structures.

Stage 4 was the breakthrough into recursive syntactic structure.⁵ Stage 5 is

³ Hurford (2012) does not treat the transition from stage 2 to stage 3 as a single step, but, instead, as a “continuous growth toward syntactic organization” (p. 607). At first, symbols are strung together with no clear boundaries. Then, strings of symbols are divided up into chunks — sentence-sized units — with clear boundaries. He proposes that the initial part of the two-word stage was governed by the principle ‘Say first what is most urgent to convey, then what is next uppermost in your mind, and so on’. Berwick (2012) critiques Hurford’s evolutionary story.

⁴ Hornstein (2009: 114) similarly speculates that a crucial development in the evolution of syntax was the emergence of endocentric labeling.

⁵ Lobina (2011b: 21, drawing on Moro 2008) argues that, at the appropriate level of abstraction, structural recursion is a property of any type of syntactic structure: “[E]very syntactic phrase (NPs, VPs, etc.) accords to the same geometry, an asymmetric structure of the following kind: [Specifier [Head–Complement]]”. For example, a clause (a CP) is a complex [Specifier [Head–Complement]] structure containing structurally equivalent [Specifier [Head–Complement]] structures.

modern human syntax including functional categories and inflections. According to some incremental accounts such as Pinker & Bloom (1990; see also Pinker 2003), the mechanism driving the transition from one stage to the next was natural selection for communication in a knowledge-using, socially interdependent lifestyle. It is possible that some of these transitions (e.g., the transition from stage 4 to 5) involved processes of language change, rather than biological evolution (see below for discussion).⁶

Two primary sources of evidence for the incremental view of the evolution of syntax are language acquisition and language creation (see Hurford 2012: 590–595). Both processes have been claimed to involve the gradual development of syntactic structure. For example, Aronoff *et al.* (2008) discuss the linguistic organization of Al-Sayyid Bedouin Sign Language, a language that arose about 70 years ago in a small, insular community with a high incidence of deafness. Al-Sayyid Bedouin Sign Language displays the existence of certain syntactic properties (such as recursive hierarchical phrase structure), but not others (e.g., overt syntactic markers such as complementizers). They argue that “the existence of certain syntactic mechanisms and the lack of others [in Al-Sayyid Bedouin Sign Language] suggest that language does not appear all at once, but rather develops incrementally. Even syntax is not an ‘indecomposable bloc’; instead it builds up over time” (Aronoff *et al.* 2008: 149).

Certain linguistic constructions (‘fossils’; Jackendoff 2002: 236) have also been used to bolster the incremental view that syntactic evolution involved pre-syntactic but combinatorial stages (Jackendoff 1999, 2002; Progovac 2009a, 2010b). These constructions can be found in modern human grammars but are argued to be simpler than canonical syntactic constructions, yet display clear continuity with them. They are claimed to be traces of earlier stages in the evolutionary development of syntax. Examples are root small clauses (*Him worry?*), verb–noun exocentric compounds (*scare-crow*, *pick-pocket*), and paratactic combinations of small clauses (*nothing ventured*, *nothing gained*) (Progovac 2009a, 2010b). These constructions have been hypothesized to be structurally similar to those uttered at a stage in the evolution of human syntax in which two elements could be loosely combined, with prosody indicating that they form a single utterance (the two-word stage discussed above).

2.2. *Parallelism and the incremental view*

Jackendoff (2010) holds that the parallel architecture for the human language faculty lends itself to the view that the human language faculty evolved incrementally, each stage “adding an increment to the system’s communicative efficiency and flexibility” (Jackendoff 2010: 71). In the remainder of this section, I discuss the parallel architecture that Jackendoff has presented in various publications, focusing on the syntactic component of the architecture. I argue that the architecture is compatible with both incremental and saltational views on the evolution of syntax.

⁶ Arbib (2012) argues that the transition from proto-language to language was a matter of cultural rather than biological evolution.

In the parallel architecture, the human language faculty has the tripartite organization illustrated in Figure 1 (from Jackendoff 2011: 609). Phonology, syntax, and conceptual structure are independent parallel systems connected by interfaces. Interface principles authorize correlations between structures in the three parallel systems. For example, interface principles ensure that “a syntactic head (such as a verb, noun, adjective, or preposition) corresponds to a semantic function and that the syntactic arguments of the head (subject, object, etc.) correspond to the arguments of the semantic function” (Jackendoff 2007a: 49). These interface principles are the Head Rule and the Argument/Modifier Rule. The Head Rule (Culicover & Jackendoff 2005: 163) says that a semantic function *F* in conceptual structure canonically maps to the head *H* of a syntactic phrase *HP* (for example, the head *N* of an NP) in syntactic structure. The Argument/Modifier Rule (Culicover & Jackendoff 2005: 163) states that the syntactic arguments and modifiers of the head *H* of a syntactic phrase *HP* canonically map to arguments and modifiers of a corresponding semantic function *F* in conceptual structure. A linguistic expression “is well-formed if it has well-formed structures in all components, related in well-formed fashion by all relevant interface [principles]. The theory is named the *parallel architecture* on the basis of this characteristic” (Jackendoff 2007b: 358).

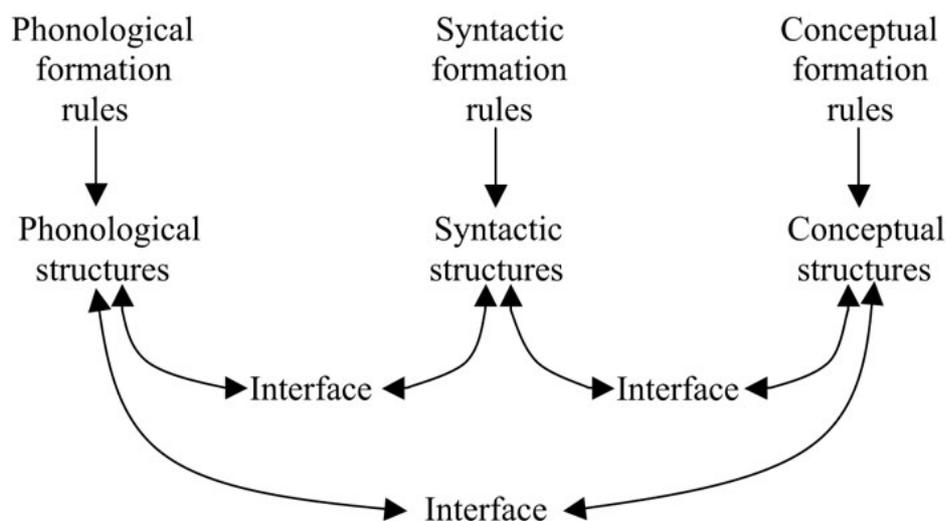


Figure 1: The tripartite parallel architecture (Jackendoff 2011)

Jackendoff (2011) motivates the parallel architecture by arguing that it better integrates with what is known about brain computation and other aspects of human cognition than other conceptions of the language faculty, particularly syntactocentric architectures such as that assumed by much work within the Minimalist Program (see section 3).⁷ Further, Jackendoff claims that the parallel

⁷ In their review of Jackendoff (2002), Phillips & Lau (2004) discuss limitations of Jackendoff's arguments on behalf of the parallel architecture and, in particular, dispute his claim that the

architecture makes available a much more plausible approach to the evolution of language than syntactocentric approaches (Jackendoff 1999, 2002, 2007a, 2007b, 2010, 2011).

In order to understand the relationship between the parallel architecture and the evolution of syntax, we need to be clear about the role of syntax in the parallel architecture. Culicover & Jackendoff (2005) describe the syntactic component of the parallel architecture in detail (see Merchant 2009, forthcoming for a critical discussion of Culicover & Jackendoff's non-structural approach to ellipsis). They defend the following hypothesis (Culicover & Jackendoff 2005: 5):

(2) *Simpler Syntax Hypothesis*

The most explanatory syntactic theory is one that imputes the minimum structure necessary to mediate between phonology and meaning.

For Culicover & Jackendoff, syntactic knowledge consists of syntactic features and a body of principles that place constraints on possible syntactic structures. Formally, these principles are pieces of syntactic structure stored in memory. The components in (3) are attributed to human syntactic knowledge:

- (3) a. Syntactic features like category (NP, S, etc.), tense, number, and count.
 b. Principles of constituency that place constraints on possible hierarchical structures. For example, "a phrasal node typically has a unique lexical node as its head; all its other dependents are either phrasal or minor categories" (i.e. $\{_{XP} \dots (X) \dots\}$; see Culicover & Jackendoff 2005: 110).
 c. Principles of linear order that place constraints on possible arrangements of constituents. For example, $[_{VP} \{ V \dots$ (the setting of the head parameter for the English VP) (Jackendoff 2007: 59).

Principles of the syntax–conceptual structure interface also play an important role in Culicover & Jackendoff's (2005) theory. These principles license connections from parts of syntactic structure to parts of phonological and conceptual structure. The Head Rule and the Argument/Modifier Rule (discussed above) are interface principles of this sort. Figure 2 (adapted from Jackendoff 2007a: 50) gives (part of) the syntactic and conceptual structure of the NP *the cats*. The numerical subscripts indicate links between different parts of syntactic and conceptual structure. Interface principles such as the Head Rule license those links.⁸

parallel architecture approach is superior to syntactocentric approaches on psycholinguistic grounds. See Jackendoff (2007b: 359–366, 382–387) for a reply to Phillips & Lau's review.

⁸ In addition to syntax, phonology, and conceptual structure, Culicover & Jackendoff (2005: chap. 6) propose a separate layer of the human language faculty — the Grammatical Function Tier (GF-tier) — that constrains the realization of direct NP arguments. This layer of grammar mediates between conceptual structure and syntactic structure. The basic idea is that the semantic arguments that are to be expressed as direct NPs (grammatical functions such as subject and object, as well as certain oblique arguments) are correlated with positions in the GF-tier ($[_{Clause} GF (> GF (> GF))]$). These positions are then associated with particular positions in syntactic structure. Culicover & Jackendoff (2005: 232) propose that the GF-tier emerged late in the evolution of language:

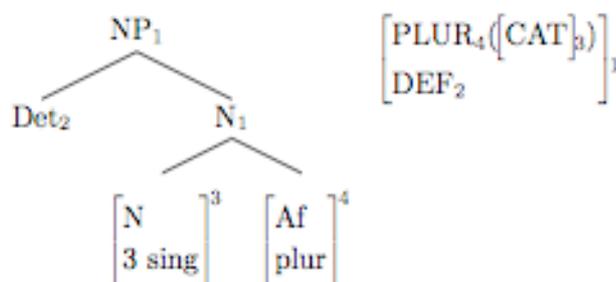


Figure 2: Syntactic and conceptual structure of the cats (Jackendoff 2007)

Syntax plays a central role in the parallel architecture: “What distinguishes true language from just collections of uttered words is that the semantic relations among the words are conveyed by syntactic and morphological structure” (Jackendoff 2007a: 63). Syntax “is the solution to a basic design problem: semantic relations are recursive and multidimensional but have to be expressed in a linear string ... [syntax] is a sophisticated accounting system for marking semantic relations so that they may be conveyed phonologically” (p. 64).

I argue below that, for Jackendoff, the key innovation in the evolution of syntax was the emergence of principles of constituency (i.e. hierarchical phrase structure), principles that impose constraints on possible hierarchical structures. What about other aspects of syntactic knowledge such as syntactic features (e.g., syntactic categories) and principles of linear order? As I discuss below, on Jackendoff’s assumptions about the architecture of grammar, principles of linear order might be better understood as principles constraining the syntax–phonology interface rather than as autonomous syntactic principles. Hence, the emergence of principles of linear order might not have been a stage in the evolution of syntax, strictly speaking, but rather a byproduct of the interaction between the syntactic and phonological components of the human language faculty. Further, the evolution of certain aspects of syntax such as functional categories might be better accounted for in terms of processes of language change such as grammaticalization, rather than as a consequence of biological evolution.

Given that its properties depend heavily on the particular properties of the syntax–semantic interface, we do not see how it could possibly have been adapted from some other cognitive capacity. We conclude that the GF-tier is part of the narrow faculty of language in Chomsky’s sense, and that the ability to infer a GF-tier from primary language data must be innate. We speculate further [...] that the opportunities offered by the GF-tier for enhanced communication are what made it adaptive in the course of the evolution of the human language capacity. Given that the GF-tier logically depends on so much of the rest of the system being already in place, we would be inclined to see it as a relatively recent stage in the evolution of language.

The GF-tier plays an important role in Culicover & Jackendoff’s formulation of argument structure and certain constructions such as the passive construction and the raising construction. While recognizing the central role that the GF-tier and principles of the syntax–semantic interface play in Culicover & Jackendoff’s theory, I restrict my attention primarily to their claims concerning the syntactic component of the human language faculty and how they relate to different perspectives on the evolution of syntax.

In various publications, Jackendoff (1999, 2002, 2007a, 2007b, 2011) discusses how language might have evolved gradually. Figure 3 is from Jackendoff (1999; see also Jackendoff 2002: 238 and 2007b: 393) and is a hypothesis about how the entire human language faculty (including, but not limited, to syntax) might have evolved, given parallel architecture assumptions.

Independent steps appear side by side; dependencies among steps are indicated vertically.

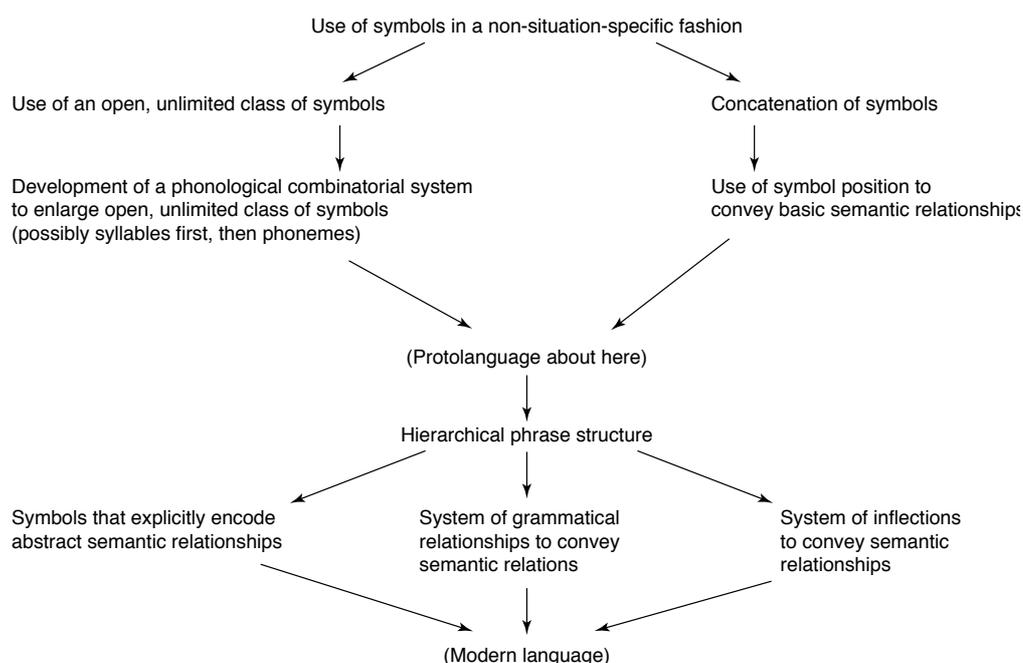


Figure 3: Summary of incremental evolutionary steps (Jackendoff 1999)

Each step in Figure 3 is communicatively adaptive. The model in Figure 3 can be roughly divided into four stages (see Jackendoff 2007a: 74):

(4) *Incremental view of language evolution:*

1. symbolic use of simple vocalizations, without grammatical organization
2. regimentation of vocalization along the lines of phonological structure
3. concatenation of symbols into larger utterances
4. syntax emerges, making more complex semantic relations among the words of an utterance more precisely mappable to linear order in phonology

(Jackendoff 1999)

Stages 1 and 2 comprise the one-word, no grammatical organization stage discussed above. Stage 3 is the two-word stage (sequences of symbols, but no hierarchical organization). The transition to Stage 4 is the transition to modern human syntax.

Figure 3 encompasses all of language evolution. What about the evolution of syntax in particular? As Jackendoff (2007b: 393) observes that “[t]he most significant cut” is between proto-language and hierarchical phrase structure (see Jackendoff 2002: 252 for discussion of this stage). In Figure 3 there are no intermediate stages between proto-language and hierarchical phrase structure. Other aspects of syntax (such as functional categories and inflection) emerged subsequent to the development of hierarchical phrase structure.

Culicover & Jackendoff (2005: 230–231) flesh out the parallel architecture approach to the incremental evolution of syntax, where “each successive layer adds further precision and flexibility to the system offered by the layers above it” (p. 231):

- (5) *Incremental evolution of syntax:*
1. unstructured collection of symbols (*proto-language*) pieces of the same constituent adjacent to each other rather than scattered throughout the utterance (*principles of constituency, principles of the syntax conceptual structure interface*)
 2. certain pieces of the same constituent are always in a predictable order (*principles of linear order*)
 3. fixed order for direct NP arguments (*principles of the GF-tier; see fn. 8*)
 4. flexibility of NP argument position to meet demands such as processing and information structure (*principles of the GF-tier; see fn. 8*)
- (adapted from Culicover & Jackendoff 2005)

At stage 1, conceptual structure has been carved up into symbols. (This process is often referred to as *lexicalization*.) The communicative system at this stage is what Bickerton (1990) considers proto-language. Symbols can be concatenated by string-concatenation to build larger utterances, but without headed hierarchical phrase structure. This stage is characterized by semantically-based principles of word order such as Agent First and Focus Last (see Jackendoff 2002: 247–249).

Next, at stage 2, we have the emergence of hierarchical phrase structure (principles of constituency) such as “an XP has an X somewhere within it” ($\{_{XP} \dots (X) \dots\}$). Interface principles correlate embedding in conceptual structure to embedding in syntactic structure. For example, the Head Rule requires that semantic functions canonically map to the heads of syntactic phrases (Culicover & Jackendoff 2005: 162–163).

Stages 3–5 involve further refinements of hierarchical phrase structure. At stage 3, the linear order of heads, arguments, and modifiers is imposed by principles such as “NPs precede PPs within VP” (principles of linear order). The next two stages concern the GF-tier, the aspect of grammar that constrains the realization of direct NP arguments (see fn. 8). At stage 4, the linear order of NP arguments of verbs is determined by a subsystem of grammatical functions that is sensitive to (among other things) the thematic hierarchy (Actor/Agent > Patient/Undergoer/Beneficiary > non-Patient theme > other; see Culicover & Jackendoff 2005: 185). At stage 5, the subsystem of grammatical functions is further manipulated by particular constructions like raising and passive.

As noted above, each stage in this model is assumed to be an innovation that increases the expressive power of the system. How important are the details of human evolutionary history to this approach to syntax and its evolution? At various points, Jackendoff suggests that evolutionary considerations might play a (limited) role in constraining claims about the architecture of the human language faculty: “*Evolutionary considerations do lead us to seek a theory that minimizes demands on the genome — but not at the expense of a rigorous account of the modern language faculty*” (Jackendoff 2011: 589, emphasis added).

However, Jackendoff makes very little attempt to relate his model of language evolution to hominin pre-history. For example, he does not discuss how the different stages of his model relate to estimates about when the language faculty emerged during human evolution. As discussed in section 3 below, many researchers (both linguists and non-linguists) assume, not uncontroversially, that the syntactic component of the human language faculty evolved within the last 200,000 years.⁹ If we assume that syntax evolved recently (in evolutionary time), then, it has been argued (see section 3), we should prefer models that minimize what had to evolve biologically in syntactic evolution.¹⁰

In fact, in Jackendoff’s model (Figure 3) just a single evolutionary step gives rise to hierarchical phrase structure, a key feature of modern human syntax. The communication system prior to hierarchical phrase structure is proto-language, which involves string-concatenation. There are no intermediate stages between proto-language and hierarchical phrase structure. What evolutionary change gave rise to this feature of syntax (hierarchical phrase structure)?

Exaptation is the end-product of an evolutionary change in function where an adaptive trait was coopted to serve a new function (Gould & Vrba 1982; Fitch 2011). For example, the organs that evolved into bird and insect wings started out as temperature regulators and were exapted for a completely different function (flight). As a further example of exaptation, “the wings of alcids (birds in the auk family) may be considered exaptations for swimming: these birds ‘fly’ underwater as well as in the air” (Futuyma 2009: 294). Exaptations can be further modified by natural selection (e.g., the modification of penguin wings into flippers for efficient underwater locomotion; Futuyma 2009: 294).

Exaptation plays an important role in Jackendoff’s view of the evolution of hierarchical phrase structure. For him, there is a close relationship between hierarchical structure in syntax and hierarchical structure in conceptual structure (i.e. thought): “recursive conceptual structure accounts for why recursive syntax is useful, namely for EXPRESSING recursive thoughts” (Jackendoff 2010: 608). On his view, the precursor mechanism for hierarchical structure in human syntax is hierarchical structure in conceptual structure. Hierarchical structure in conceptual structure was coopted to serve a new function in syntax: the expression

⁹ Boeckx (2011: 45): “[E]veryone seems to grant that the FL emerged in the species very recently (within the last 200,000 years, according to most informed estimates)”.

¹⁰ There is ample empirical evidence for rapid evolutionary change in which significant changes occur in just tens of generations, maybe even faster (see Számadó & Szathmáry 2012 for discussion and references). That being the case there is no reason, given the evidence that is currently available, to rule out the possibility that human language syntax was the product of multiple evolutionary innovations within the last 200,000 years. We just don’t know.

of conceptual structure. Jackendoff (2011: 616) argues that combinatoriality in conceptual structure is evolutionarily ancient, shared by both humans and non-human primates. In Culicover & Jackendoff's model, stage 2 involved the emergence of principles of constituency such as "an XP has an X somewhere within it" constraining headed hierarchical structures. These principles are skeletal pieces of hierarchical phrase structure stored in memory that can be unified with the symbols from stage 1 of their model. Outside of conceptual structure, the headed hierarchical structures recruited by syntax can be found in syllabic structure and musical structure (Jackendoff 2007a).

As discussed above, interface principles such as the Head Rule and the Argument/Modifier Rule (Jackendoff 2002; Culicover & Jackendoff 2005) constrain the association of conceptual structure with syntactic structure ("a syntactic head [...] corresponds to a semantic function and [...] the syntactic arguments of the head [...] correspond to the arguments of the semantic function"; Jackendoff 2007a: 49). These interface principles are the result of the association of two components of the human language faculty, conceptual structure and syntactic structure, where the emergence of syntactic structure involved the recruitment of embedding structures originally used in conceptual structure for syntactic structure.

Jackendoff's single-step view of the emergence of hierarchical phrase structure can be contrasted with more strictly incremental views such as that presented in Hurford (2012: 607–608) (see fn. 3) in which the evolution of hierarchically structured syntax involved continuous growth toward syntactic organization. At the initial stage, words are simply strung together with no clear boundaries. At later stages, strings of words are chopped into chunks (first, sentence-sized units with clear boundaries and, then, later, smaller sub-sentential units).

What about the remaining steps of the evolution of syntax? On Jackendoff's view, the emergence of hierarchical phrase structure was just one stage among several in the evolution of syntax, each perhaps a product of a separate biological change. Aspects of syntax that developed subsequent to hierarchical phrase structure were principles of linear order, syntactic features (like tense, number, count, and category), systems of inflections to convey semantic relationships, symbols that explicitly encode semantic relationships, and a system of grammatical relations to convey semantic relations (the GF-tier; see fn. 8).

It is possible that the development of these other aspects of syntax did not involve the biological evolution of syntax per se, but rather were the outcome of interfacing separate components of the human language faculty or processes of language change. Jackendoff (2007b; see also Jackendoff 2011: 616) discusses how much of syntactic evolution can be attributed to sources other than separate genetic mutations. He speculates, for example, that symbol concatenation and the use of linear order to express semantic relations might have been cultural inventions, rather than the consequence of genetic mutations. Hierarchical phrase structure, grammatical categories, inflectional morphology, and grammatical functions (subject, object, and indirect objects) are hypothesized by Jackendoff to have a genetic basis.

Stage 3 of Culicover & Jackendoff's incremental model — the emergence of principles of linear order (e.g., [_{VP} { V ...}], the setting of the head parameter for the

English VP) — is a stage in the evolution of the syntax–phonology interface. According to some contemporary work on syntax, the linearization of syntactic structure is an interface requirement imposed by the cognitive systems that we use to hear and speak language (see Hornstein *et al.* 2005: 219 for discussion). For example, Yang (1999) proposes a PF interface condition for the linearization of terminal nodes and argues that cross-linguistic variation in linear order is instantiated at the level of morphophonology, not syntax, strictly speaking. On this view, there are no autonomous syntax principles or operations in the syntactic component of the human language faculty that make reference to linear order or directionality.¹¹ This view is not incompatible with the parallel architecture, where principles of linear order could be understood as principles of the syntax–phonology interface constraining the alignment of syntactic structures with phonological ones.¹²

What about the other aspects of syntax discussed by Jackendoff such as syntactic categories and inflection? Can these be explained by processes other than the biological evolution of syntax? Jackendoff (2007b: 394) proposes that the vocabulary for relational concepts such as spatial relations and time might have been a cultural invention rather than requiring a genetic change.

That leaves the evolution of grammatical categories, inflectional morphology, and grammatical relations. Heine & Kuteva (2007) discuss the role of grammaticalization in the evolution of grammar after the emergence of the earliest human language(s). Grammaticalization is a process in language change involving the development of grammatical forms from lexical ones, and even more grammatical forms from grammatical ones. For example, the English modal *will* marking future (*I will go tomorrow*) was grammaticalized from the Old English main verb *willan* ('want to'). Grammaticalization theory is an account of the development and structure of functional categories. Heine & Kuteva use grammaticalization theory to explain the gradual emergence of syntactic categories and inflectional material such as case and agreement markers. They propose that all syntactic categories arose through the process of grammaticalization with the noun–verb distinction as the starting point. Hurford (2003, 2012) similarly discusses the role of grammaticalization in the evolution of word classes and morphological inflections after the biological evolution of hierarchical phrase structure.

In sum, the parallel architecture is compatible with the saltational view that syntax is the product of one evolutionary innovation.¹³ This innovation was the

¹¹ Some recent work conducted within the minimalist program (e.g., Chomsky 2012) speculates that linearization is a property of externalization, the mapping of the structured expressions generated by the syntactic component of the language faculty to the cognitive systems that humans use for sound and/or gesture (the sensorimotor interface). I discuss externalization in section 3.

¹² The notion that the principles constraining word order are of a different type than those that constrain hierarchical phrase structure has ample precedent in the literature. Curry (1961) distinguished between the *tectogrammatcs* and *phenogrammatcs* of language. Tectogrammatcs concerns the underlying structure of language (i.e. the steps by which a sentence or subsentential unit is built up from its parts); phenogrammatcs concerns the form of language (i.e. how linguistic elements are combined, the order in which they are combined, etc.). See Dowty (1996) and Muskens (2010) for discussion.

¹³ However, the parallel architecture is arguably incompatible with a saltational view of the

recruitment for syntax of hierarchical phrase structure from elsewhere in cognition (conceptual structure). Later stages in the development of modern human syntax, such as the evolution of syntactic categories, might have been the outcome of interfacing separate components of the human language faculty or language change processes such as grammaticalization.

3. Minimalism

3.1. *The saltational view of syntactic evolution*

A saltation is a discontinuous mutational change in one or more traits, typically of great magnitude (Futuyma 2009). Gould (1980: 127) once suggested a saltational origin for vertebrate jaws:

I envisage a potential saltational origin for the essential features of key adaptations. Why may we not imagine that gill arch bones of an ancestral agnathan moved forward in one step to surround the mouth and form proto-jaws?

According to most evolutionary biologists, saltations play a minor role in evolution (“my own betting money goes on a minor and infrequent role”; Gould 2002: 1146).

On the saltational view of the evolution of syntax, the emergence of syntax was at once and abrupt (see Kinsella 2009: 13–14 for further discussion). “[A] single evolutionary development can account for all the major mechanisms of syntax” (Bickerton 1998: 341). This development involved just a single genetic mutation. The mutation had a large effect, producing most, perhaps all, of the properties of human language syntax in one fell swoop. For example, Berwick (1997, 1998, 2011; Berwick & Chomsky 2011) has argued that the appearance of a recursive combinatorial operation (*Merge*; see below) accounts for many of the design features of syntax. These design features include:

- (6) *Design features of syntax*
- a. digital infinity and recursive generative capacity (i.e. the familiar ‘infinite use of finite means’)
 - b. displacement (e.g., *This student, I want to solve the problem*, where *this student* appears at the front of the sentence instead of after the verb *want*)
 - c. locality constraints (e.g., *who* cannot be interpreted as the subject of *solve* in *Who do you wonder Bill thinks solved the problem*)
 - d. restricted grammatical relations (e.g., no analog to ‘object-of’ like ‘subject-object-of’, where the subject and object of a sentence must agree)

(from Berwick 2011: 69–70)

evolution of the human language faculty as a whole. Jackendoff (2002) assumes that phonology, conceptual structure, and the phonology–conceptual structure interface existed prior to syntax.

As discussed in section 2, the saltational view is typically associated with the assumption that syntax evolved very recently (maybe even only 50,000 years ago). Given this assumption, it is argued that the saltational view is more plausible than the incremental view. The incremental view posits multiple stages in the biological evolution of syntax. This would demand a longer evolutionary time period than the historical record suggests (but see fn. 10).

3.2. *Minimalism and the saltational view*

The saltational view of the evolution of syntax is most strongly associated with generative work on syntax, particularly recent work in the Minimalist Program (henceforth, *minimalism*). In this section, I discuss the relationship between minimalism and the evolution of syntax. I argue that minimalism is compatible with both saltational and incremental views on the evolution of syntax. More generally, my goal in this section is to establish that even accounts (such as Berwick's) that are typically characterized as saltational are, in fact, committed to there being several stages in the evolution of syntax.

Minimalism (Chomsky 1995; Marantz 1995; Belletti & Rizzi 2002; Hornstein *et al.* 2005; Boeckx 2006) grew out of the success of the Principles and Parameters approach to syntax. It explores the idea that the basic operations of the human language faculty are simple and few in number, and that the attested complexities of natural language are a byproduct of the interactions of simple subsystems (Hornstein 2009). Some recent work in minimalism proposes that syntactic knowledge involves only two components and that the interaction of these two components can explain all of the apparent complexity in modern human syntax (Boeckx 2011). The two components are:

- (7) a. words¹⁴ (understood as bundles of features)
 b. a single, simple recursive operation, Merge, that glues together words and word complexes, thus forming larger units

(Boeckx 2011: 50)

Merge is a grouping operation which combines two syntactic objects α and β to form a labeled set $\{L, \{\alpha, \beta\}\}$, where L is the label of the syntactic object resulting from Merge (Chomsky 1995, 2008; see also Boeckx 2006: 78, 2011: 52).¹⁵ Merge has (at least) the properties in (4) (adapted from Longa *et al.* 2011: 599):

¹⁴ In contrast to the parallel architecture. A key feature of the parallel architecture is that the basic units can be both words and multi-word phrases (Jackendoff 2002, 2010).

¹⁵ Hornstein (2009) and others have argued that the operation Merge should be distinguished from the operation of labeling. On this view, Merge is simple concatenation: It takes a pair of simple syntactic objects (atoms) and combines them. Labeling identifies one of the two inputs to Merge as the label of the resulting concatenate.

- (8) a. binarity (i.e. Merge combines exactly two elements)¹⁶
 b. (asymmetric) labeling (i.e. the label of the syntactic object resulting from Merge is identical to one of its constituents)¹⁷
 c. structural preservation (i.e. labels are not tampered-with and the basic structure of the tree remains unchanged over the course of a derivation)¹⁸
 d. unboundedness (see discussion below)
 e. flexibility (see discussion below)

Merge has the property of recursion. It is an operation that can take the output of a previous application of the operation as part of the input for the next application. The output of a system including Merge is, in principle, unbounded (property (8d)) because Merge has the property of recursion.¹⁹

The claim that Merge has the property of flexibility (8e) amounts to the (controversial) claim that “phrase structure-building and movement are special instances of the same basic operation — Merge (External and Internal Merge, respectively) — there is no fundamental distinction between movement and phrase structure construction” (Drummond & Hornstein 2011: 247). Each new application of Merge either draws from the lexicon (External Merge) or from within the expression constructed by Merge (Internal Merge, i.e. movement) (Chomsky 2004; Berwick & Chomsky 2011: 31).²⁰

In minimalism, a sequence of applications of Merge constitutes a sentence derivation. Figure 4 gives a conceptual overview. Figure 5 gives a more detailed derivation of the sentence *the guy drank the wine*. The derivation involves multiple applications of Merge to words (understood as bundles of features) and word complexes, resulting in the syntactic structure for the string *the guy drank the wine*. This syntactic structure is passed off to the cognitive systems that humans use for sound and meaning. Figures 4 and 5 are from Berwick (1997).

¹⁶ Yang (2009) and Chametzky (2000: 124–130) discuss the requirement that Merge always applies to exactly two syntactic elements, resulting in uniformly binary branching structures. Culicover & Jackendoff (2005: chap. 4) argue that the uniform binary branching assumption is deeply flawed.

¹⁷ Chametzky (2000: 127–128) discusses the status of labels in minimalism and argues that they should not be included as parts of syntactic objects.

¹⁸ Phillips (2003) challenges this claim. He argues that syntactic structures are built incrementally and that an incremental derivation can destroy certain constituents that existed at earlier stages in the derivation.

¹⁹ Progovac (2010b) suggests that specialized functional categories underwrite recursion. For example, the presence of complementizers might have enabled clausal embedding. We should keep in mind here the distinction between computational mechanisms like Merge and the structures that those mechanisms operate over. Progovac is suggesting that recursive structures become possible only with the development of certain functional categories. Merge, a recursive operation, was already in place before the development of those functional categories.

²⁰ It has not been demonstrated formally that Internal Merge (movement) and External Merge are reducible to a single operation. Rather, External Merge and Internal Merge have been shown to be related. Internal Merge is sometimes analyzed as being decomposable into an operation Copy and the operation (External) Merge (Nunes 1995, Hornstein 2001). Hunter (2011) analyzes External Merge as decomposable into an operation Insert and the operation Internal Merge.

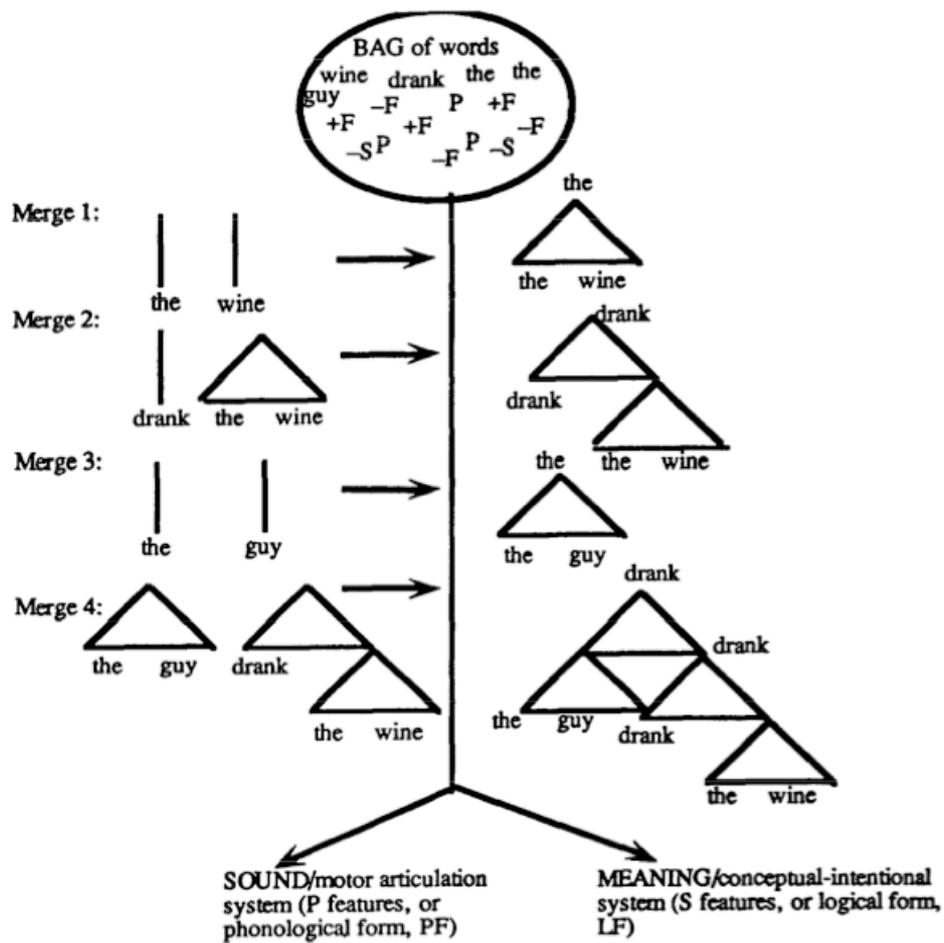


Figure 4: Sequence of Merge operations (Berwick 1997)

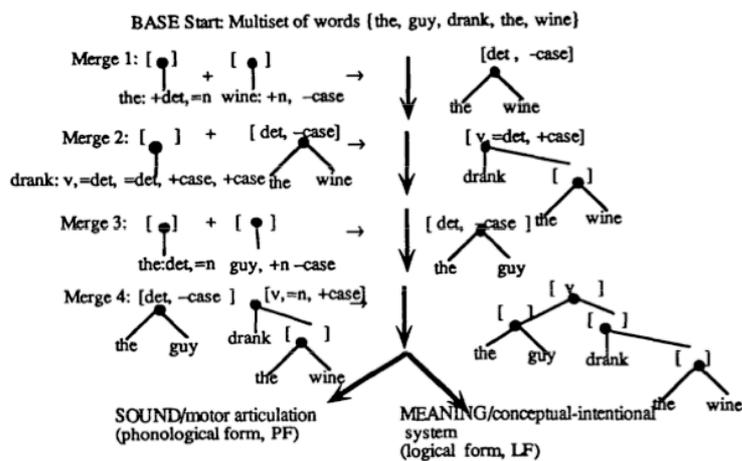


Figure 5: Sentence derivation in the Minimalist Program (Berwick 1997)

Berwick and others have claimed that there is no room for proto-syntax (stages between proto-language — a system involving string-concatenation — and modern human syntax) in minimalist approaches to the evolution of syntax. For example, Berwick (2011: 99) asserts that there is no possibility of an intermediate system between single-symbol utterances (or multi-symbol sequences involving string-concatenation) and full natural language syntax given minimalist assumptions: “[O]ne either has Merge in all its generative glory, or one has effectively no combinatorial syntax at all, but rather whatever one sees in the case of agrammatic aphasics: alternative cognitive strategies for assigning thematic roles to word strings”, where combinatorial syntax is a syntax involving hierarchical structure, not simply the concatenation of symbols.²¹ Berwick & Chomsky (2011: 31) continue: “[T]here is no room in this picture [i.e. the picture that language involves just a single recursive operation Merge] for any precursors to language— say a language-like system with only short sentences” (i.e. a system that outputs hierarchical structures that are bounded in size).

Kinsella (2009: 65–66, 87, 91–95, 160) argues that minimalism only permits a saltational account and is, consequently, evolutionarily improbable (on the assumption that an incremental account of the evolution of syntax is more plausible than a saltational one): “The simple minimalist system is furthermore evolutionarily improbable by virtue of permitting only a saltational account: the usual gradual adaptive processes of evolution leading to greater complexity than minimalism admits” (p. 160).

Some work in the Minimalist Program goes further, arguing that there is no conceptual reason for the postulation of proto-language. For example, Piattelli-Palmarini (2010) argues that there was no non-compositional proto-language involving string-concatenation of words because there could not be any words (defined as mergeable sound-meaning pairs) without syntax: “Words are fully syntactic entities and it’s illusory to pretend that we can strip them of all syntactic valence to reconstruct an aboriginal non-compositional proto-language made of words only, without syntax” (p. 160).²²

Minimalism is, in fact, compatible with both the incremental view and the saltational view of the evolution of syntax. First, I discuss the saltational view and minimalism. Next, I discuss how the incremental view can be reconciled with minimalism.

Arguments for the saltational view of the evolution of syntax have appeared in various forms in the minimalist literature (see, for example, Berwick 1997, 1998, 2011; Berwick & Chomsky 2011). The version of this argument that I present here is adapted from Hornstein (2009: 4–5; see also Hornstein & Boeckx 2009: 82). It has the following structure:

²¹ Berwick’s view is similar to that of Bickerton (1990, 1998), who proposes that modern human syntax emerged in a single step from a proto-language involving string-concatenation.

²² Anticipating Piattelli-Palmarini’s point about there being no room for proto-language under minimalist assumptions, Jackendoff (2007a: 74) states that a single word stage (involving the symbolic use of a single vocalization, without grammatical organization) in the evolution of language is “logically impossible in the syntactocentric theory, since even single-word utterances have to arise from syntactic structure”.

- (9) *Argument for the saltational view of the evolution of syntax:*
1. Natural language grammars have several properties:²³
 - they are recursive (sentences and phrases are unbounded in size and made up of elements that can recur repeatedly);
 - they generate phrases with a particular kind of hierarchical organization;
 - they display non-local dependencies which are subject to both hierarchical and locality restrictions.
 2. These properties follow from the basic organization of the faculty of language.
 3. The faculty of language arose in humans within the last 200,000 years, perhaps as recently as 50,000 years ago.²⁴
 4. This is very rapid in evolutionary terms (“the blink of an evolutionary eye”; Hornstein 2009: 5).²⁵
 5. The faculty of language is the product of (at most) one (or two) evolutionary innovations, which when combined with the cognitive resources available before the changes that led to language, delivers the faculty of language.

This argument has been heavily criticized in the language evolution literature (see, for example, Kinsella 2009; Jackendoff 2010: 68–70; Hurford 2012: 585–595). As noted above, some researchers criticize the conclusion in part 5 of this argument on plausibility grounds (i.e. incremental accounts of the evolution of syntax are more plausible than saltational ones). For example, Hurford (2012: 587) writes: “From an evolutionary point of view it is sensible to hypothesize that humans have progressively evolved greater combinatorial powers. This is more plausible than a tale of an evolutionary jump, such as Berwick envisages, to the infinite products of ‘Merge in all its generative glory’”.

Other researchers criticize the empirical support for part 3 of the argument above. Hornstein’s (2009) claim about the timing of language evolution — i.e. that the faculty of language arose in humans within the last 200,000 years — is informed by the discussion in Diamond (1992; see Hornstein & Boeckx 2009: 82). Bickerton (1990) also proposes that language evolved as recent as 50,000 years ago. A defense of the claim that the faculty of language arose fairly recently can be found in Boeckx (2012). Boeckx claims that “the language faculty arose in *Homo sapiens*, and fairly recently, i.e. within the last 200,000 years” (p. 494). Evidence comes from cultural artifacts in the archaeological record; e.g., the emergence of new multicomponent tools. As Boeckx (2012: 495) puts it, expressing what I think is a view shared by many people working on the evolution of lang-

²³ See Berwick (1997, 1998, 2011) and above for a similar list.

²⁴ As Noam Chomsky (p.c.) puts it: “All we know with any confidence about evolution of the language capacity (languages, of course, don’t evolve) is that it hasn’t changed for about 50K years, and that about 50–100K years before that (plus or minus, it doesn’t matter) there is no evidence that it existed. That sets some significant conditions on a serious approach to evolution of language”.

²⁵ But see fn. 10.

uage, “it is hard to imagine the emergence of these artifacts and signs of modern human behavior in the absence of the language faculty”.

But the archaeological findings (e.g., personal ornaments or tools that are comprised of more than one component) that have been used to support claims about the evolutionary timing of the emergence of syntax are consistent with a theory of the evolution of syntax in which proto-language or full-blown human syntax was in place long before the cultural artifacts were made. It has not been demonstrated that syntax (or language generally) is either a necessary or a sufficient condition for the construction of the cultural artifacts in the archaeological record. Botha (2009, 2012) shows that inferences drawn about language evolution from archaeological findings (e.g., the shell beads excavated at Blombos Cave; Henshilwood *et al.* 2004) are not well-founded.

Is minimalism compatible with the incremental view on the evolution of syntax? Yes. The evolution of syntax must have involved at least two steps on minimalist assumptions. Progovac (2009a, 2010b) presents an incremental approach to the evolution of syntax, while adopting the basic insights of minimalism and its predecessors. She argues for the following stages in the evolution of syntax:

(10) *Incremental view of syntactic evolution on minimalist assumptions :*

1. *parataxis* (non-hierarchical; only prosody serves as an indicator that words have been combined)
2. *proto-coordination* (rise of an all-purpose segmental indicator that words have been combined, the first functional category)
3. *hierarchical functional stage* (all-purpose proto-conjunctions give rise to specialized functional categories and functional projections; Move and recursive structure become available as a consequence of these developments)

(from Progovac 2009a, 2010b)

Grammars developed within the minimalist program, even those of the most radical sort, contain at least two components: words (understood as bundles of syntactic features) and the recursive hierarchical operation Merge. Consequently, the evolution of words and the evolution of Merge must both be part of any minimalist account of the evolution of syntax.²⁶ Berwick (1998: 338) makes this clear: “Merge cannot tell us everything we need to know. *It does not say how words came to be*, and will have little to say about the word features particular to each language” (emphasis added).

The claim that the evolution of syntax involved at least the evolution of words and the evolution of a recursive operation giving rise to hierarchically structured expressions is similar to Jackendoff’s (2011) perspective on language evolution (see section 2). For Jackendoff (see, for example, Jackendoff 2011: 587), knowledge of syntax includes an inventory of principles of phrase structure (principles of constituency and principles of linear order), understood as units or complexes of units of hierarchical phrase structure stored in memory. On this

²⁶ On the assumption that words are, by definition, syntactic entities.

view, as discussed in section 2, the evolution of syntax must have involved at least the evolution of these units. These units are combined with words to build larger structures. Jackendoff (2011: 599, summarizing Pinker & Jackendoff 2005): “what makes language LANGUAGE is that recursion combines WORDS (and/or morphemes, depending on one’s view of the lexicon), where words are long-term memory linkings of structured sound, syntactic features, and structure meaning. That is FLN [faculty of language in the narrow sense—BC] includes the capacity to learn WORDS in profusion and to apply recursion to THEM”. To reiterate, the syntactic component of the human language faculty includes at least two components: words and a recursive operation. Both must be accounted for by any model of the evolution of syntax. Minimalists have given the evolution of words less attention than the evolution of the recursive operation Merge.

Chomsky’s (2005, 2010) exaptationist view of the evolution of language is that the root of combinatoriality in syntax (Merge) is to be found in thought rather than communication. That is, combinatoriality in externalized, communicative linguistic behavior served a different function in early hominins (thought) and one stage of language evolution involved recruitment for interaction of that system (see Fitch 2011: 4 for a compact summary of Chomsky’s perspective). This recruitment of the hierarchical combinatorial operation Merge for interaction generally (and communication in particular) was a crucial step in the evolution of language subsequent to the evolution of Merge itself. Chomsky, Berwick, and others call this step in the evolution of language *externalization*: “When the beneficial mutation [giving rise to Merge—BC] has spread through the group, there would be an advantage to externalization, so the capacity would be linked as a secondary process to the sensorimotor system for externalization and interaction, including communication as a special case” (Berwick & Chomsky 2011: 36).

As noted above, a key step in the evolution of syntax (along with the emergence of Merge and externalization) was the evolution of units with syntactic valence (words). In recent work, Boeckx (2011, 2012) argues that Merge — for him, concatenation — is “as primitive as one can get” (Boeckx 2012: 498) and that lexicalization instead was the key step in the evolution of syntax, making recursive Merge possible (Boeckx 2011: 53; see also Ott 2009). Lexicalization, on Boeckx’s view, is the cognitive capacity to combine virtually any concept with any other concepts.²⁷ What lexicalization does is endow a concept with a property called an *edge feature*, a property that makes an item active syntactically. Chomsky (2008: 139): “A property of an LI is called a *feature*, so an LI has a feature that permits it to be merged. Call this the *edge feature* (EF) of the LI. If an LI lacks EF, it can only be a full expression in itself; an interjection”. An Edge feature allows a concept to engage in Merge (Boeckx 2011: 54). These mergeable concepts are formally encoded as linguistic words.

²⁷ Boeckx appears to be using the term *lexicalization* differently from the ways in which that term has been used elsewhere in the linguistics literature. The term *lexicalization* is sometimes used to refer to a synchronic process by which conceptual structures are formally encoded. In the historical linguistics literature, *lexicalization* has been broadly defined as a diachronic process involving additions to the lexicon. See Brinton & Traugott (2005) for discussion. Jackendoff (2011: 608) critiques recent minimalist views on concepts and the conceptual-intentional interface.

There might have been a proto-language stage prior to lexicalization in which syntactic relations were dependent on conceptual content, as in Jackendoff's model (e.g., Agent First and Focus Last). Further, at a later stage, after the origin of the lexicalizing function, autonomous syntactic principles (such as parametric differences between languages involving linear order) might have developed as a consequence of the externalization of language (i.e. the recruitment of the sensorimotor systems to externalize the structures produced by the syntactic engine; Boeckx 2012: 500).

To recapitulate, the evolution of syntax on minimalist assumptions must have involved at least the three steps in (11):

- (11) a. evolution of Merge
 b. evolution of lexical items (lexicalization)
 c. externalization linking the syntactic component of grammar to the sensorimotor systems²⁸

Can any of these three steps be split up into further steps, while preserving minimalist assumptions? It is important to keep in mind that Merge is typically understood as a grouping operation that combines two elements to form a labeled set. Repeated application of Merge produces a nested hierarchical phrase structure. This is to be distinguished from string-concatenation. Repeated application of string-concatenation yields a flat structure (see Samuels 2012: 310 and Samuels & Boeckx 2009 for discussion). As noted above, if the emergence of Merge was an important innovation in the evolution of syntax, earlier combinatorial stages are not necessarily ruled out. Stages prior to the emergence of Merge might have involved no concatenation (the one-word stage) and/or string-concatenation (the two-word stage), in which syntactic relations are dependent on conceptual content (for example, Agent First and Focus Last). Crucially, these earlier stages in the evolution of syntax do not involve a recursive combinatorial operation which gives rise to labeled hierarchical phrase structures.

Hauser *et al.* (2002) distinguish between the faculty of language in a broad sense (FLB) and the faculty of language in a narrow sense (FLN). FLB consists of all the mechanisms involved in language. FLN is that (perhaps empty) subset of FLB unique to humans and unique to language. Hauser *et al.* hypothesize that FLN is the abstract linguistic computational system, perhaps consisting only of Merge.²⁹ FLB includes the computational system of the human language faculty

²⁸ Jackendoff takes issue with the role that externalization has played in Chomsky's (2010) speculations about language evolution:

[Chomsky] sees 'externalization' as a second step in the evolution of language. But for him, externalization includes all of phonology and all of morphology, plus most of the aspects of syntax that differentiate one language from the next: word order, agreement, overt case marking, the distinction between WH-movement and WH-in-situ, and so on — in short, most of the things that most linguists think of as 'language'.

(Jackendoff 2011: 616)

²⁹ Pinker & Jackendoff (2005) critique the hypothesis that FLN consists only of a recursive operation. For example, they argue that "words appear to be tailored to language — namely [...] they consist in part (sometimes in large part) of grammatical information, and [...] they are bidirectional, shared, organized, and generic in reference" (Pinker & Jackendoff 2005: 217).

combined with other organism-internal systems that are both necessary and sufficient for language (such as the sensory-motor system).

Longa *et al.* (2011: 602) argue that Merge was “the result of an intricate evolutionary pathway”, involving both FLB and FLN components. For example, they propose that the recursive property of Merge might not be “a bona fide characteristic of FLN”. Recursion could be evolutionarily ancient, whereas other properties of Merge (e.g., asymmetric labeling) might have emerged more recently in human evolution (see Hornstein 2009 for a related view). This proposal concerning Merge is consistent with proposals in Pinker & Jackendoff (2005) and Jackendoff (2011) that recursion (an operation characterized by the property that it can take the output of a previous application of the operation as part of the input for the next application) is of “considerably earlier ancestry than the human lineage” (Jackendoff 2011: 593).

Merge itself has been argued to be a compound operation composed of a concatenation operation and a labeling operation (see fn. 15). If this is correct, the labeling operation developed later in the evolution of syntax than the concatenation operation (which arguably underwrites the vocal sequences observed in a range of non-human primates).

In conclusion, syntactocentric architectures like the one presupposed by most work within the Minimalist Program are compatible with an incremental view of the evolution of syntax. The evolution of syntax on minimalist assumptions must have involved several distinct stages, including the evolution of Merge, the evolution of words, and externalization. One or more of these stages (for example, the emergence of Merge) might have involved further stages, once FLB and FLN are distinguished.

4. Conclusion

Jackendoff (2010) claims that the parallel architecture and syntactocentric architectures are committed to different models of the evolution of the human language faculty. As discussed in the introduction, he argues that there is a dependency between theories of language and theories of language evolution: “Your theory of language evolution depends on your theory of language”. Jackendoff’s (2010) focus was the evolution of the human language faculty generally, rather than the evolution of any particular subcomponent of that faculty (for example, phonology or syntax). In this article, I limited my attention to the evolution of syntax. I argued that there is not a dependency relationship between theories of syntax and theories of syntactic evolution. The parallel architecture is compatible with a view that the biological evolution of syntax involved just one stage (the recruitment of skeletal headed hierarchical phrase structure from elsewhere in cognition). The syntactocentric architecture assumed in most minimalist work is compatible with a view of the evolution of syntax that involves at least three stages, where, perhaps, some of those stages (e.g., the emergence of Merge) involved further evolutionary stages.

Thus, the simple take-home point of this article is that your favored theory of syntax does not determine your theory of syntactic evolution.

It is, of course, possible to turn this argument around. Just as your theory of syntax influences your theory of syntactic evolution, your theory of syntactic evolution influences your syntactic theory. The relationship between theories of syntactic evolution and theories of syntax is many-to-many. Most syntacticians would agree with the following claim:³⁰

Language is a system that is grounded in biology. As a biological endowment in our species, it must have evolved over a particular time scale, and in particular steps, as with our other biological endowments.

(Kinsella 2009: 91)

If you start with the incremental view that syntax evolved over a long time scale and in multiple steps, then you are likely to be led to the view that syntax is a complex system along the lines suggested by Pinker & Bloom (1990) and Jackendoff's parallel architecture. If you start with the saltational view, then you are likely to be led to the view that syntax is a simple system and adopt a minimalist methodology (Kinsella 2009: 91, fn. 15).

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³⁰ Both of the approaches to syntax that I compared in this article assume that the object of study is the linguistic competence of individual speakers. For both Jackendoff and Chomsky, among many others, the properties of linguistic competence do not depend on relations to the external environment. There are other possibilities, of course. The object of study may be neither purely a matter of individual psychology nor exclusively a social phenomenon. Ludlow (2011: chap. 5) argues that syntacticians need not make an exclusive choice between an internal and external perspective on language.

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