

Introduction

1. Merge
 - (a) A lexical item (LI) is a syntactic object (SO)
 - (b) *Merge*: an operation that takes n SOs already formed, and constructs from them a new SO. (with n usually taken to be 2) [based on Chomsky 2005:6]
2. Claims of this paper:
 - (a) Structure Building (SB) is specific to humans but not to (narrow) syntax or even language (hence not part of the narrow faculty of language (FLN))- contra [HCF 2002])
 - (b) SB does NOT by itself alone combine two syntactic objects into a new syntactic object
 - (c) SB accounts for unbounded recursion but unbounded recursion is not its only diagnostics
 - (d) A major use of SB is alleviating the limitations of short term memory in production/analysis by providing a systematic procedure to do "chunking" in the sense of [Miller 1956]. Hence, alleviated short term memory effects are also a diagnostics for structure building.
3. FLN is not empty: consists of the grammatical component that defines
 - (a) grammatical features and their possible values
 - (b) grammatical items ('morphemes') in terms of these grammatical features, and
 - (c) (non-recursive) principles/rules to combine grammatical items

Part A: specific to humans but not to syntax or even language

4. Chomsky acknowledges or even suggests himself that *Merge* is used for outside the language faculty:
 - Generally** [Chomsky 2010a:53], [Chomsky 2010draft:4]
 - Natural numbers** [Chomsky 2004] [Chomsky 2005:6]; see also [Chomsky 2010a:53])
 - Vision** [Jackendoff & Pinker 2005: 217-218]; [Chomsky 2010a:53]
 - Music** [Fitch 2010:121]; [Katz & Pesetsky 2011]; [Chomsky 2011: 22'53"-23':26"] (perhaps)
 - Morphology / Lexicon** [Chomsky2010draft:4]
 - Planning** [Chomsky2010draft:4]

5. but he always considers these as derivative of / 'parasitic on' / 'an offshoot of' the language faculty ('There is no other possible explanation' [Chomsky 2011: 22'53"-23':26"])
6. Other domains Chomsky does not mention
 - Discourse** [Levinson & Evans 2010] and references there; [Koschmann 2010] and See below
 - Artificial languages** Logic, Mathematics, Programming languages, Number notation systems¹
 - Thinking** Cf. correction of the production of a sentence
 - Morphology** Compounding, derivation. But perhaps this is syntax and see above
 - Phonology** Phonotactic rules. See below
 - Phonology** Metrical structure (though perhaps metrical structure piggy-backs on syntax)
 - Orthography** Graphotactic rules. See below
7. If recursion outside of language is 'parasitic on language' (using *Merge*) then why don't we have
 - (a) Case assignment to musical notes 'parasitic on language'?
 - (b) Agreement in person and number between digits in an integer 'parasitic on language'?
 - (c) Etc.
8. I conclude: *Merge* must be an independent component interacting with other components, among them the grammatical component.
9. Chomsky: arithmetics, music must all be offshoots of language otherwise "There is no other possible explanation for its existence", "otherwise, again, it would be very hard to explain".
10. I agree that they must be due to the same mechanism (which is the case if (8) is assumed) , but not that this mechanism is part of FLN (which is not the case if (8) is assumed).

Part B

11. Merge does NOT by itself combine two syntactic objects into a new syntactic object: a combinatorial principle/rule is required as well, cf.
 - (a) *This annoys me very

¹We mean here the unconscious capacity of humans to produce and analyze an indefinite number of expressions from such artificial languages. Our scientific understanding of the concept of 'recursion' is irrelevant here.

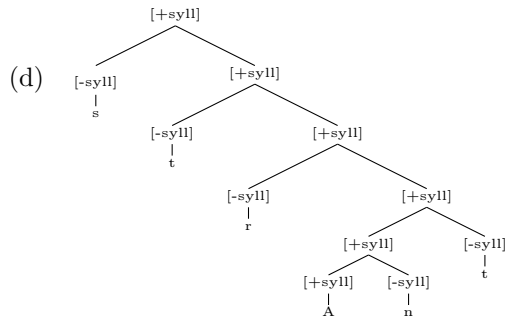
- (b) *The the the
 - (c) *John John John
 - (d) *Annoy annoy annoy
12. [Chomsky 2005:6] does mention that
- (a) 'for an LI to enter into a computation,[...], it must have some property permitting this operation'.
 - (b) 'an LI has a feature that permits it to be merged' (the 'edge feature' (EF))
 - (c) 'The fact that *Merge* iterates without limit is a property at least of LIs - and optimally, only of LIs, as I will assume. EF articulates the fact that *Merge* is unbounded, that language is a recursive infinite system of a particular kind.'
13. What is implicit here is that *Merge* requires a combinatorial principle (say, the 'Edge Feature Principle'), and this combinatorial principle requires an LI to have an edge feature for *Merge* to be applicable)
14. Signature of Structure Building (SB):
- (a) SB: $[OC] \rightarrow OPC \rightarrow OC$ where
 - (b) OC is an object of component C
 - (c) $[X]$ is a sequence of objects of type X
 - (d) OPC is a combinatorial operation for objects of component C
 - (e) $OPC: [OC] \rightarrow \{OC\}$ where $\{X\}$ is a sequence, a set, or a multiset of objects of type X depending on your favorite theory or on component C
15. Examples of combinatorial operations for syntax
- (a) Universal principles such as
 - i. 'Edge Feature Principle',
 - ii. syntactic selection principles (strict subcategorization), e.g. [Stabler 2011]
word1::=X Y word2::X \rightarrow word1::Y word2::X
 - iii. modification principles, e.g.
 - A. $[X1_{MOD=[Y]}, X2_{CAT=Y}] \rightarrow \{X1_{MOD=[]} X2\}$
 - B. *very* with property MOD=[A] can modify a syntactic object of syntactic category A but not of syntactic category V
 - (b) language-specific or even construction-specific combinatorial rules
 - (c) or whatever your favorite combinatorial principles/rules are
16. Since SB is not a operation of syntax, it can't do anything specific to syntax to determine the properties of the newly created SO. Hence the properties of the newly created object must be derived from the input element properties (= Inclusiveness)
17. For the same reason, the relevant operation to determine the properties of the newly created SO must be a very general one (e.g copying, unification, re-entrancy (token-identity)). Only one element must be selected as input since combining the properties of two or more elements will (almost) always lead to incompatibility or be undefined (we almost derive Headedness).

Part C

18. Unbounded recursion in natural language is real and must be accounted for. *Merge* indeed can in special cases account for unbounded recursion, but unbounded recursion is just a side effect that can occur if the combinatorial principle/rule happens to allow this.
19. But recursion is severely limited in many cases. Two examples from syntax:
- (a) Complementation
 - i. $V \rightarrow V \text{ XP}$ (if V syntactically selects for XP)
 - ii. Each lexical item allows only a finite (in fact very small (max 3 perhaps 4 including subjects)) number of complements (\rightarrow recursion limited)
 - iii. Which (by the way) follows from the theory proposed here in which the grammatical component has no recursive mechanisms (\rightarrow finite) + short term memory size (\rightarrow small)
 - iv. There is no logical necessity for this:
 - A. in all programming languages procedures/functions can take an indefinite number of arguments
 - B. a specific predicate taking an indefinite number of arguments is also conceivable
 - v. but it does not occur in natural language
 - (b) number expressions
 - i. numbers are the prime example of values without an upper bound
 - ii. is claimed by Chomsky to originate from recursion in language
 - iii. But: every natural language has number expressions for only a **finite** set of numbers
 - iv. Follows from a semantic condition on rules for number expressions (which itself may follow from the Packing Strategy, [Hurford 2007], though I have my doubts)
 - v. '#Number expressions is always finite, even though it can be extended indefinitely (but always finite) by inventing a new 'word''

Rule	Semantics LHS	Condition
Number \rightarrow Digit	= [[Digit]]	True
Number \rightarrow Phrase (Number)	= [[Phrase]]+[[Number]]	[[Number]] < [[Phrase]]
Phrase \rightarrow (Number) M	= [[Number]] * [[M]]	[Number] < [[M]]

20. It is therefore not unreasonable to assume SB also operates in domains even if they are finite in nature, e.g. in phonotactics:
- (a) Sonority Sequencing Principle restricts recursion
 - (b) Combine a phoneme P1 with phoneme P2 provided that P2 is less sonorant than P1 (P1 will be the head)
 - (c) If you start out with a syllabic phoneme this will result in a syllable:



(e) Exceptions are possible but always listed as exceptions (cf. Dutch *psycholoog*, *wesp*), and causing pronunciation problems

Part D

21. A major use of SB in production/analysis is alleviating the limitations of short term memory in production/analysis by providing a systematic procedure to do "chunking" in the sense of [Miller 1956].
22. Working Memory (WM), which includes Short Term Memory (STM)
23. STM can contain only a small number of item (7+/- 2 [Miller 1956])
24. Elements in WM can only be accessed via a slot in STM
25. if a combinatorial rule is not applicable, it leads to overflow of STM for long sequences:

STM	m	n	g	l	s	a	a	o	i
WM									

26. combinatorial rules applicable:

STM	[+syll]	[+syll]	[+syll]	[+syll]					
WM	$\widehat{\text{man}}$	$\widehat{\text{ga}}$	$\widehat{\text{li}}$	$\widehat{\text{so}}$					

27. If, for an object sequence, a combinatorial rule exists and is applicable, SB can be applied. A combinatorial rule can be
 - (a) automatic : fast, no external memory needed, few errors
 - (b) not-automatic: slow, requires additional memory (pen and paper; keyboard and screen), and error-prone.
28. Examples
 - (a) Phonology (automatic): Cf. /mnglsaaoi/ v. /mangaliso/ 9 phonemes v. 4 syllables
 - (b) Orthography (automatic): Cf. mnglsaaoi v. mangaliso

- (c) Syllable sequences: no combinatorial rule. SB cannot apply
 - i. Long sequence of syllables processed with difficulty or not at all and only if you learn them by heart
 - ii. Llanfairpwllgwyngyllgogerychwyrndrobwyll-llantysiliogogoch
 - iii. A sequence of syllables can however be replaced by a single occurrence of a grammatical item ('morpheme') that it is related to (arbitrarily)-if you know the language
 - iv. → each morpheme consists only of a small number of syllables
 - (d) Decimal number notation: (not automatic): 3458472748903
 - (e) Roman number notation (not automatic): MCMLXXXIII
 - (f) Programming languages (not automatic)
 - (g) Morphology (automatic)
 - (h) Syntax (automatic), cf. (28(h)i) v. (28(h)ii):
 - i. Get by of tired the sitting beginning was very on sister bank her Alice to
 - ii. Alice was beginning to get very tired of sitting by her sister on the bank
 - (i) C-I component (automatic)
 - (j) Discourse (automatic): discourse coherence rules
 - (k) Music (automatic)
29. From an evolutionary perspective, with SB not only syntax as we know it now became possible, but also complex thoughts, sequences of phonemes (phonology), sequences of morphemes (morphology), sequences of sentences (discourse), music (sequences of tones), etc. etc.

Conclusions

30. I submit that the claims of (2) have been convincingly demonstrated

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Appendix A: Quotes

Domain	Source	Quote	BUT
Generally	[Chomsky 2010a:53]	"one may raise the factual question of whether the basic properties of language, notably recursive generation, are unique to the language faculty or are found elsewhere. [] We know that it is not"	
Generally	[Chomsky 2010draft:4]	"Nonetheless, it is interesting to ask whether this operation is language-specific. We know that it is not."	Chomsky considers all as derivative of / parasitic on language
Natural Numbers	[Chomsky 2004**; see also: [Chomsky 2005:6] and [Chomsky 2010a:53]]; and [Chomsky 2011: 22'53"-23':26"] below]	"the most restrictive case of Merge applies to a single object, forming a singleton set. Restriction to this case yields the successor function, from which the rest of the theory of natural numbers can be developed in familiar ways."	'one possibility is [that] the natural numbers result from a simple constraint on the language faculty, which would make recursion in arithmetic "parasitic on the language faculty".'
Vision	[Chomsky 2010a:53] (implicitly replying to [Jackendoff & Pinker 2005 217-218]?)	"Suppose the single item in the lexicon is a complex object, say some visual array. Then Merge will yield a discrete infinity of visual patterns"	"this is simply a special case of arithmetic" and "tells us nothing new about recursion beyond language"
Music	[Fitch 2010:121]	music 'has a form of syntax (a set of rules for combining these [notes, JO] into larger hierarchical structures of essentially unbounded complexity'	
Music	[Chomsky 2011: 22'53"-23':26"]	"A language is plainly a computational system, and as far as is known, unique in nature in this respect. It is hard to find another system of digital infinity that has computational properties. In fact, there may not be any, but this is one. Actually, arithmetic is another, but it almost certainly is an offshoot of language. There is no other possible explanation for its existence. And people talk about music but in so far as it is true for music"	"it probably is also an offshoot of language, otherwise, again, it would be very hard to explain."
Morphology / Lexicon	[Chomsky2010draft:4]	"if we add a recursive operation[] to form an infinite lexicon, on the model of some actual (if rather trivial) lexical rules of natural language"	then "this is" also "simply a special case of arithmetic"
Planning	[Chomsky2010draft:4]	"Similar questions might be asked about the planning systems investigated by George Miller and associates 45 years ago If these and other cases fall under the same general rubric,"	" then unbounded Merge is not only a genetically determined property of language, but also unique to it."