Errors and Buffers

Essays in the Economics of Syntactic Rearrangement

by

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ABSTRACT

This dissertation draws upon modern Chomskyan theory to address issues surrounding the development of a unified, minimalist account of language as a mental and biological object, both in terms of its generation and historic change. Towards that end, I investigate, apply, and advance the labeling approach to generative syntax. Labeling is a hypothetical process, operating within the confines of phase theory, which is thought to prepare constructed syntactic objects for interpretation at relevant mental interfaces. I argue a number of points applicable to both synchronic and diachronic linguistics: 1) Labeling failures happen as a matter of course during a derivation, forcing re-evaluation of labeled syntactic structures which ultimately leads to a successful derivation. 2) Labeling and its errors do not happen in real-time, but are bounded by phases. This has consequences for how researchers ought to look at notions and limitations of phasal memory. 3) Labeling not only drives an individual's mature syntax, but has an effect on how children acquire their syntax, causing them in some cases to alter structures and create new categories. This is responsible for many cases of language change, and I support this argument by investigating data from the history of Chinese and Macedonian that are sensitive to labeling-based phenomena. 4) Research into labeling can help us speculate about the evolution of language generally. Although recursion is sometimes thought to be a defining feature of Universal Grammar, labeling in fact is a much more likely candidate in this regard.

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CHAPTER 1

INTRODUCTION

This dissertation argues that certain particular mechanisms in syntactic linguistic architecture must behave in ways that exchange and process informational units in accordance with the best 'benefit' of those same processes and units. In other words, the mechanisms of syntax form a sort of classically liberal 'economy'. Informally, a liberal (monetary) economy is a kind of balanced system, where both seller and purchaser benefit from an exchange, and crucially, the position of seller and purchaser is reversible, and exchange is in no case obligatory should either the seller or purchaser not meet the demands set forth by the other. One well-known text describes the study of economics as such: "Economics is the study of how men and society end up *choosing*…to employ *scarce* productive resources…to produce various commodities and distribute them for consumption" (Samuelson, p. 4, his italics). The core building blocks of a cognitive/informational/syntactic system are in this definition: some mechanism must choose what informational units to process from a store space with limited (e.g. scarce) items, build those informational units into larger complexes (e.g. a commodity), and distribute those complex units in specific ways such that they can be understood by other areas of the cognitive system (e.g. be consumed).

Many modern theories of syntax are guided by the ideas of Minimalism (Chomsky, 1995, et seq.), which does touch upon certain concepts of economy. Minimalism essentially states that language is a 'perfect' system, having evolved to satisfy certain conditions imposed upon it by non-linguistic Conceptual-Intentional and Sensorimotor mental systems. While I do adopt this approach, my continual appeal to

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economics is done to argue that the various modules of syntax responsible for the generation of syntactic structure are not necessarily a series of one-way exchanges (e.g. lexical items are pulled from the lexicon, combined and checked by some mechanism, and subsequently handed over to interface systems, etc.). Instead, in many cases the 'buyers' and 'sellers' of syntactic information must be able to reverse roles, to negotiate an exchange that leads to some kind of mutual benefit, however that may be defined.

There are many ways in which the notion of an economics of Minimalism could be approached. In the chapters that follow, I happen to have chosen to focus on the issue of what I call *syntactic rearrangement*. I construe this term broadly to include two kinds of rearrangement: the first is real-time rearrangement, movement that occurs naturally during the course of a syntactic derivation. The second is grammaticalization, the reanalysis of structure by an individual with long-lasting effects on that individual's grammar. I have chosen the phenomenon on syntactic rearrangement specifically because during the course of syntactic generation it is never an 'easy sell' – rearrangement is always the result of some kind of initial syntactic failure mitigated by a fix that acts as a kind of 'negotiation'.

Towards this end, I investigate, apply, and advance the "Problems of Projection" (POP) or labeling approach to generative syntax (Chomsky 2013; 2015). POP, I will argue, is the best approach to building a negotiative theory of economic Minimalism. At this point, however, I will focus a bit on the standard account of POP and labeling, and move on to a detailed economics-based account later (starting with Chapter 3).

The POP operation LABEL is a hypothetical process, operating within the confines of phase theory (Chomsky, 2000, et seq.), thought to prepare constructed syntactic

objects for interpretation at relevant mental interfaces. One main claim of this dissertation is that the operation LABEL is largely responsible for both real-time rearrangements (movement during the course of the derivation) and permanent rearrangements (grammaticalization) – LABEL is a dynamic operation that affects the generation of syntactic structure in speakers with *developed* grammars and speakers with *developing* grammars differently. It helps drive the economic system alluded to earlier.

Along with LABEL, the modern minimalist approach to generative grammar assumes the presence of a more basic operation, MERGE, which is responsible for combining syntactic objects into sets. It is logically necessary that MERGE be of two kinds. The first, External MERGE, creates binary sets out of unique syntactic objects. The second, Internal MERGE, creates binary sets out of objects whereby one object has been previously merged as part of the other:

(1a) MERGE (X, Y), where X is *not* part of Y and vice versa, → { X, Y } (External MERGE)

(1b) MERGE (X, Y), where X *is* part of Y or vice versa (e.g. Y = { Z, X } or X = { Z, Y }) → { X, Y } (e.g., either { { Z, Y }, Y } or { X, { Z, X } }) (Internal MERGE)

Minimalist accounts of generative grammar assume that when syntactic objects undergo Internal MERGE, the lower (i.e. more hierarchically embedded) object 'deletes' or is otherwise not phonetically articulated. Thus, Internal MERGE is sometimes called 'movement', given that the lower object appears to move to a higher position, when the underlying and surface representations are viewed in tandem.

There are multiple kinds of Internal MERGE or movement, some of which are displayed in (2a)-(2c), where the italicized element represents what has been moved and *t* (trace) represents the moved element's point of origin:

(2a) *The children* may have all *t* seen Alice.

(2b) *Who* did Alice see *t*?

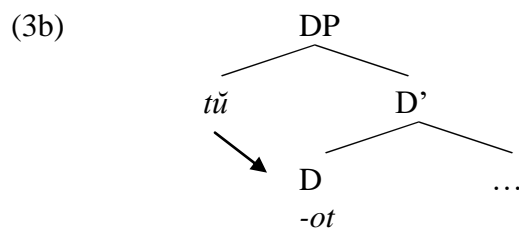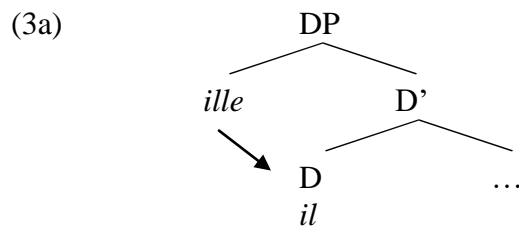(2c) *Bob*, Alice saw *t*. *Charles*, she didn't see *t*.

Example (2a) displays Internal MERGE of *the children* from the VP-internal subject position to the surface subject position (SpecTP). Example (2b) shows movement of a *wh*-phrase from a VP-internal object position to a surface non-argument position (SpecCP). And finally, example (2c) shows topicalization of an object to a surface non-argument position (SpecTopP, or a related position in the extended CP). The three types of Internal MERGE shown in (2a)-(2c) can be characterized with respect to their optionality. Subject movement as in (2a) is always necessary – English requires the subject position to be filled overtly in non-imperative main clauses. The *wh*-movement in (2b) is partially optional – the *wh*-phrase may remain *in situ* in echo questions (cf. Alice saw WHO!?). Conversely, the movement in (2c) is totally optional and comparatively uncommon.

Internal MERGE, as opposed to External MERGE, is by definition a kind of syntactic rearrangement, and so will be the kind of MERGE investigated below. More importantly, the kinds of movement displayed in (2a) and (2b) are motivated by something *other* than conscious manipulation (truer for (2a) than (2b)), and so are of special interest here. But what motivates this kind of movement? The answer, I will argue, consists of the factors that contribution to labeling – LABEL spurs Internal MERGE, given that Internal MERGE

satisfies conditions imposed by LABEL. There is an economic exchange between the two, in other words.

The second kind of syntactic rearrangement investigated in the pages that follow is grammaticalization, a phenomenon whereby a language acquirer (i.e., a child) receives ambiguous input and reanalyzes that input in a way that is structurally different from adult speakers of the language being acquired. Thus, it too is a kind of syntactic rearrangement. There are two types of grammaticalization of concern here, both of which extend from van Gelderen (2004): grammaticalization that results in a change from a full phrase to a head (Spec to head, or the Head Preference Principle) and grammaticalization that results in a change from a 'lower' head to a 'higher' head (Late MERGE). Examples of each follow.

The Head Preference Principle can be seen in e.g. the historical change of demonstratives. Demonstratives, occupying the position SpecDP, may grammaticalize into definite articles (D heads) over time. This is what happened with full phrase demonstratives like the Latin *ille* and Old Slavonic *tŭ*, which became Italian *il* and Macedonian *-ot*, respectively (among others).

(3a)

```
              DP
            /    \
         ille     D'
            \    /  \
             → D      …
               il
```

(3b)

```
              DP
            /    \
          tŭ      D'
            \    /  \
             → D      …
               -ot
```

Late MERGE, on the other hand, can be seen in the historical change of certain verbs to modals. Verbs naturally occupy V, while modals occupy M, part of the higher Tense, Mood, and (outer) Aspect complex above the VP layer. Thus, the change from Old English *willan* 'to wish' or Archaic Chinese *yao* 'to wish' to future mood markers can be thought of as a shift from a lower head to a higher one.

Both the Head Preference Principle and Late MERGE are formulated under the assumption that the syntax 'prefers' simplicity over complexity: heads are simpler than full phrases on the one hand, and the presence of higher functional heads helps disambiguate and 'lubricate' the derivation on the other hand. Van Gelderen (2013) updates the Head Preference Principle by putting it into the labeling framework of Chomsky (2013; 2015). Here, she argues that full phrases are re-analyzed as heads in order to deal with potentially-unlabelable structures of the type { XP, YP }. In the pages below, I build on her work in two ways: a) I argue that Late MERGE is also the result of labeling issues, and b) I situate both the Head Preference Principle and Late MERGE within the specific operation LABEL as a way to hopefully more-closely approach explanatory adequacy with regards to these phenomena.

In this brief introduction, I've introduced the hypothesis that both Internal MERGE and grammaticalization, being kinds of syntactic rearrangement, occur under the control of the operation LABEL, which itself operates in a kind of economic system. The dissertation proceeds as follows: Chapter 2 situates labeling/POP-theory within the larger context of generative grammar, specifically the Minimalist program and phase theory, and discusses issues of innateness, Universal Grammar, factors of growth and development, MERGE, and problems raised within the POP-theoretic context. Chapter 3

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looks at the ideas of Chapter 2 through an economics lens, and touches upon why those ideas are necessary for Minimalism to grow towards explanatory adequacy. Chapter 4 discusses LABEL more in-depth, hypothesizing its position within a phase and how it operates as such. Crucially, LABEL allows for the presence of a 'buffer zone' whereby syntactic rearrangement can take place – Internal MERGE on the one hand for those with developed grammars (i.e., adults), and Internal MERGE or permanent reanalysis/grammaticalization for those with developing grammars (i.e. children). Ideas gleened from economics come crucially into play here. Chapter 5 provides a historical account of reanalysis within the economic/POP-theoretic context, namely the Late MERGE of an Archaic Chinese verb (*yao*) to a modern Mandarin tense/mood particle. Chapter 6 concludes the dissertation.

CHAPTER 2

FROM MIND TO MERGE TO LABEL

In the previous chapter, I briefly introduced the notion of an economic system and how it may be applied to Minimalist syntactic architecture. I will return again to this topic starting in Chapter 3. I also introduced MERGE and LABEL as two operations already well-defined within modern generative grammar, particularly the "Problems of Projection" (POP) account of Chomsky (2013; 2015). These two operations are thought to be responsible, respectively, for the combination of syntactic objects and the preparation of those objects for interpretation at the Sensorimotor (SM) and Conceptual-Intentional (C-I) interfaces. Thus, they play important roles in the notion of syntactic rearrangement, where (Internal) MERGE is the engine of such rearrangement, and LABEL is its motivation.

In this chapter, I provide an overview of the theoretical bases for the development of these operations within generative grammar and POP specifically, including the *internalist* or *mentalist* guiding philosophical frameworks that are presupposed in the formal study of language within this tradition. I also discuss the growth of the Minimalist program, phase theory, and some problems that are left to be resolved in the POP approach. Since grammaticalization is not typically discussed within the framework of generative grammar (with important exceptions, e.g. van Gelderen, 2004; and others), I discuss that approach and how it can be integrated into POP in later chapters (starting with Chapter 4). As mentioned above, I return to the previously-discussed economics approach below in Chapter 3.

2.1 Appearance and Reality: What You See is Not Entirely What You Have

Syntax, as a branch of linguistics and cognitive science, is the scientific study of human knowledge of natural language sentence structure. This definition has three subparts: the notions of *language*, *sentence structure*, and *knowledge*, each of which I will elaborate upon below.

A language may be defined broadly as a potentially infinite set of information-bearing strings that can be generated from a finite set of base elements[1] by means of a recursive combinatory mechanism[2] (Chomsky, 1975, p. 5; Ginsburg, 1966, p. 6; Gross and Lentin, 1970, p. 2). For example, imagine a language with only three elements: *a*, *b*, and *c*. We may (arbitrarily) concatenate a series of these elements – for example, we may say that '*b a c a*' is one string (call it *A*), and '*a c*' is another string (call it *B*) within our made-up language. Those defined strings could then be further concatenated such that *AB* = '*b a c a a c*' and *BA* = '*a c b a c a*' (Gross and Lentin, 1970, p. 3; Chomsky, 1955, p. 60-61). This extremely simplified artificial example is meant to show an important feature of languages: they build larger structures from smaller ones.

Natural human languages, on the other hand, are much more complicated. It is rather difficult, if not impossible, to formally define one language as opposed to another, although we seem to have an intuitive notion of what it means to speak English or Chinese or French. But one question we can ask is how languages like these differ from the artificial *a*, *b*, *c* language constructed above. For one, in the artificial language example there are no rules stating how elements are combined, or whether there are any restrictions on the combination of elements. It is simply stipulated a priori that '*b a c a*'

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[1] Sometimes called 'formatives', 'primitives', 'lexical items', 'syntactic objects', an 'alphabet', etc.
[2] Namely, MERGE.

and '*a c*', as well as *AB* and *BA* are possible strings. In fact, it may be the case that *any* combination of *a*, *b*, and *c* are possible in this constructed language, if we stipulate it as so.

Conversely, linguists in the tradition of generative grammar assume that there are "principles and processes by which sentences are constructed [in natural languages]" (Chomsky, 1957, p. 11) as a whole, to the extent that the sentence structures of natural languages do not arbitrarily vary without limit (pace Joos, 1957, p. v; Boas, 1911, p. 81[3]). In other words, in the constructed language above, the designers or users may set the combinatory rules however they see fit for some express purpose – in natural languages, the users are not necessarily the ones setting the rules. Syntacticians, then, have as their goal "the construction of a grammar that can be viewed as a device of some sort for producing the sentences of [any] language under analysis" (Chomsky, 1957, p. 11). *Grammar* in this sense simply refers to a series of rules that determine what counts as a possible sentence in a language, and what counts as an impossible sentence in a language.

A linguist may use a series of methodologies to attempt to produce a grammar of a language, with considerable difficulty. Meanwhile, any ordinary speaker of a language has within his or her purview the ability to generate and understand, quite effortlessly, any number of grammatical sentences in his or her native language(s). For this reason, humans may be said to have a *generative grammar*, which defines sentence structure by

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[3] Joos describes American Linguistics at the time as assuming no "preexistent scheme of what a language must be" (p. v) due to its development as a consequence of the study of Native American and First Nations languages. Boas, for his part, adopted the view that a strict association between race, culture, and language was fundamentally misguided, and sought to quarantine the three from each other and presume nothing in studying the latter. Thus, any assumptions of biological commonalities in linguistic ability were naturally nowhere to be found in these investigations.

"generat[ing] all and only the strings of [a language] in a determinate way" (Chomsky, 1975, p. 71).

To illustrate, a generative grammar may be thought of as a black box with a string of old-fashioned ticker tape printing out from one end. Linguists, crucially, cannot peer inside the black box to see how it works, nor can they see any obvious input mechanism hooked to the black box. They can only examine the 'ticker tape' (i.e., the sentences that people speak), which appears to be potentially endless.

To make matters more difficult, the theory of syntax has assumed that any particular surface output string (sentence) produced by a generative grammar is in reality the final step in a series of strings produced at various linguistic 'levels' which are linked in some manner during the course of a derivation (Chomsky, 1955, p. 61). For example, as pointed out in example (2b) of Chapter 1, given a sentence like w*ho did Alice see*?, the word *who* can be thought of as signaling the fact that a question is being asked and as an interrogative pronoun that serves as the object of *see*. Thus the underlying or 'real' structure would be something like *who did Alice see who?*, with *who* being interpreted in both positions, but having only one position in the surface structure. In the black box example above, this would mean that the ticker tape would have been written, changed, and rewritten all before it even left the black box. This is prima facie unintuitive, and quite unlike the artificial *a*, *b*, *c* language, where elements are simply stuck together and lack any obscuring opacity.

Although the exact theoretical methods used to describe this 'what you see is not entirely what you have' phenomenon have changed significantly in the last sixty years, the essential spirit of this assumption remains – namely, that what appears to be a static

and linear string is in fact a complex multiply-derived (cyclic and hierarchical) structure[4].

This then presents an important empirical problem: being that there exists a difference between the appearance and reality of syntactic structure, how do we investigate the nature of the generative grammar with which all humans appear to be endowed, especially when we can't peer inside the black box?

2.2 The Preliminary Philosophy

Such a question is not new to philosophy or science, and has received varying support by specialists over the course of history (cf. Bradley, 1893; Russell, 1914). The study of syntax has taken a well-worn route by assuming a mentalist idealization of the generative grammar as described, or a "mental reality underlying actual behavior" (Chomsky, 1965, p. 4; cf. Katz, 1964).

This brings us to a larger issue, the notion of *knowledge*, which is itself idealized. By knowledge I mean a technical term, what might also be called '(linguistic) competence' (e.g. Chomsky, 1965, p. 4; Chomsky, 1968, p. 4) or 'capacity' (e.g. Chomsky, 1980, p. 4-5), a particular aspect or state of the mind/brain[5] that, with respect to language, "underlies behavior but … is not realized in any direct or simple way in behavior" (Chomsky, 1968, p. 4), of which an individual's generative grammar is a subpart. This knowledge is largely "private and individual" (Russell, 1948, p. xii), and although triggered by experience, unlike some other knowledge systems it is not

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[4] This thesis as expressed in the theory of generative grammar is actually a return to Enlightenment-era thought, first discussed at least as early as Arnauld and Lancelot's *Grammaire générale et raisonnée de Port-Royal* (the *Port-Royal Grammar*) in 1660.

[5] From Chomsky (2000b, p. 2): "Biolinguistic inquiry seeks unification with other approaches to the properties of the brain, in the hope that some day the slash '/' in the phrase 'mind/brain' will gain more substantive content". As it stands, the slash indicates the controversy in cognitive science between how to characterize the higher-order properties of mind as emerging from the "physical meat" of the brain (Jackendoff, 2002, p. 21).

dependent upon any validity in the belief about that experience – that is to say, it is not

falsifiable by new knowledge (Russell, 1948, p. xii). Such linguistic ability "is not only

innovative and potentially infinite in scope, but also free from the control of detectable

stimuli, either external or internal" (Chomsky, 1968, p. 11), a marked and important

departure from the assumptions of behaviorist and structuralist models (as in Bloomfield,

1933; Quine, 1960; Sapir, 1921; Skinner, 1957; Whitney, 1896; and many others[6]).

This knowledge, although at the root of linguistic behavior, is not the same as the

behavior itself (Searle, 1982). For example, the mere expression of some grammatical

sentence in a language does not necessitate the presence of linguistic knowledge or a

generative grammar of that language – it could be a coincidence, an act of translation, etc.

Furthermore, this knowledge should not be confused with consciousness itself (Searle,

1993, p. 62), nor should it be characterized as accessible to consciousness (Chomsky,

1968, p. 22; 1970; 1978)[7]. On the other hand, this kind of knowledge also cannot be said

to be "unconscious" or "subconscious" (German: *Unbewußte*) in the sense of Schelling

(1800) or Freud (1895) – instead, it might be characterized as an aspect of the "functional

mind" ("f-mind", a term I will borrow), an "in-between domain of description" below the

quasi-scientific romantic and psychoanalytic realm of desires and phobias but above the

physical level of "neurons firing" (Jackendoff, 2002, p. 21).

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[6] Sapir (1939), while arguing that "[t]he process of speech is, in sober fact, an utterly different sort of thing
from the process of learning to walk [i.e., it is cultural]" (p.1), does concede later that there is a "lack of
correspondence between race and language" and "[a]s with race, so with culture…language and culture are
not instrinsically associated" (p. 227-228; cf. note 2 above). Sapir was not the only structuralist to betray
doubts about the behaviorist/cultural paradigm - Bloomfield (1948) and Lashley (1951) both offer
poignant, if not somewhat veiled, critiques.
[7] See Searle (1992, Ch. 9) for a cogent and thorough argument on the necessity of cognitive scientists
(including Chomsky) to formulate some of the 'accessibility to consciousness' arguments more formally.
See McGinn (1991) on the lack of accessibility of the "content" of the mind to consciousness generally.

Wherever the f-mind may be, it occupies some area of the brain, and hence is subject to the rules of human biology. The complexity of this domain of knowledge is furthermore on par with other systems of the body, such as the circulatory or immune system (Piattelli-Palmarini, 1989; Piattelli-Palmarini and Uriagareka, 2004) – therefore, linguistic competence can be thought of as a 'module', in the sense that it is a "unit that is highly integrated internally and relatively insensitive to context externally" (Fodor and Piattelli-Palmarini, 2010, p. 46), or 'organ' of the mind/brain, where it interfaces with other systems as part of an "organic whole" (Lenneberg, 1967, p. 3). Thus, the study of language cannot be conflated with the study of the mind/brain itself (as in Quine, 1975, p. 94), but rather one part of it, which is itself almost certainly a network of highly specified localizations (Lenneberg, 1967, p. 214; Mesgarani, et al., 2014).

Many philosophers and scientists, from at least Socrates onward, have noted that there often exists a gap between one's productive knowledge (in the specialized sense discussed above, located in the f-mind) and the amount of data that could have contributed to that knowledge[8] (e.g. Russell, 1948, p. v; von Humboldt, 1836, p. 7; and many others). Language is a prime example, where the ability of the learner to traverse that gap and develop a generative grammar remains a "complete mystery" (Chomsky, 1964, p. 17). In this case cognitive scientists and philosophers have given a name to the problem: *the poverty of the stimulus* (POS) (e.g., Chomsky, 2012, p. 40-41). Among biological phenomena, however, the POS of language and an individual's generative

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[8] In Plato's *Meno*, the discussion between Socrates and the dialogue's eponymous antagonist concerns the possibility of innate mental qualities, namely virtue (and mathematics). Socrates thought that such qualities were inborn, and Meno, a Sophist and student of Gorgias, thought that such qualities were taught and learned. The *Meno* therefore stands as one of Western philosophy's first inquiries into the 'nature vs. nurture' problem, and due to its being immortalized by Socrates's most famous student, is therefore sometimes called "Plato's Problem".

grammar alone remains controversial – it is hardly debated, for instance, that the growth and development of a human hand proceeds from 'minimal' input (caloric intake, consumption of water, exchange of gases), and it is taken for granted that such development is largely the consequence of very specific aspects of human DNA (e.g., Chomsky, 2006, p. xi). Within linguistics, however, there is assumed a sort of "scientific common sense" (Russell, 1948, p. xi), stipulating *that* the growth and development of linguistic competence must be predicated along biological foundations (including DNA), but not knowing *how* exactly this happens. We employ the traditional trajectory of science and philosophy, moving from the bottom up (Chomsky, 2007; McGilvray, 2009, p. 36), knowing that "it is impossible first to clear up one problem and then proceed to another, for the intervening haze envelops all alike" (Russell, 1948, p. vi), and yet still assuming the Galilean intuition that nature is perfect, and that language itself may in some sense be "optimal" (Chomsky, 2001, p. 1). As a matter of theoretical necessity, we therefore give a name to the still-unknown biological component that bridges the gap described by the POS: *universal grammar* (UG), "an account of the initial state of the language faculty before any experience" (Chomsky, 1988, p. 61), or a "set of plans for the grammatical machinery that powers all human languages" (Pinker, 2007, p. 30), and attempt to proceed in the development of our cognitive models.

2.3 UG and the Three Factors of Language Design

Generative grammarians have assumed from the beginning that behaviorist, structuralist, statistical, and information-theoretic accounts of language are woefully

inadequate (e.g., Chomsky, 1957; Chomsky, 1959; Chomsky and Miller, 1958) and are either a) unable or unwilling to account for the mentalistic aspects of linguistic knowledge/grammar (grammar as a part of f-mind) or b) unable to account for language acquisition given the arguments put forth by POS observations. The postulation of UG does not solve the problems of a) or b), but it allows for the development of a framework through which the questions can be productively investigated. UG should, however, be seen as part of a larger context of impactful factors of language design.

In fact, all scientific inquiry into the nature of growth and development (including that of the language 'organ') assumes the influence of at least three such factors (Chomsky, 2005[9]). The first is external data or experience (Chomsky, 2005, p. 6). In the example of growing a hand (Section 2.2), I mentioned that the 'data' or 'experience' for such development would be the things it takes to keep a human body alive (food, water, oxygen, etc.) inputted during a particular period of an individual's life – namely, the period in which growth of a hand occurs (from pre-natal to post-puberty, roughly). This is a somewhat trivial observation until we compare how language must develop. In the case of language the data or experience (in addition to what it takes to keep the human body alive) would mean the external input a child receives from a speaker (or signer) who has a fully-developed grammar, such as a caretaker or parent, again during a specific period of the child's life. The hand and the language 'organ' proceed along similar paths – given the right conditions, they simply grow; take away the conditions, and they fail (e.g. Curtiss, 1977).

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[9] Chomsky (2005) presents these three factors in some detail. My presentation differs from Chomsky (2005) particularly in the order of assignment of the factors – I assign "experience" or "data" to factor 1, whereas he assigns it to factor 2 (p. 6). Factor 3 remains the same in both accounts. My alteration allows for the correlation between the three factors and the three goals of scientific inquiry discussed below.

The first factor suffers from at least three major issues: primarily, a child has to be able to tell what counts as relevant input data, a problem not unknown in psychology and philosophy (e.g. James, 1890, p. 488; Locke, 1689). In the case of language, the child must be able to separate linguistic input from a myriad of non-linguistic (but possibly communication-relevant) sounds and gestures. Secondly, a child has to be able to somehow analyze the linguistic data it receives into individual meaningful or grammatically-relevant units. This is particularly impressive, given the rapidity of speech and sign and the lack of significant 'breaks' between morphemes or lexemes. Thirdly, as mentioned above, the data itself is 'deficient' in the sense that the final state of an acquirer's grammar is more potentially complex (i.e., can generate more possible tokens) than the data he or she received during the acquisition period.

The second factor, genetic endowment (Chomsky, 2005, p. 6), helps mitigate the problems that come along with the first factor. Returning to the hand example, how might we turn food, water, and air into a human hand? Naturally, what is required is an organism with human DNA. The same question can be asked with respect to language: how do we grow a fully-functioning generative grammar out of an input plagued with "numerous false starts, deviations from rules, [and] changes of plan in mid-course" (Chomsky, 1965, p. 4)? Again, the answer (broadly speaking) is DNA (with some further refinements to be made, naturally).

In order to better understand what the genetic component responsible for language and its acquisition may consist of, researchers sometimes assume that the second factor is divided into two types, a faculty of language broad (FLB) and a faculty of language narrow (FLN) (Hauser, Chomsky, and Fitch, 2002). The former may be an instance of

'general cognitive abilities', descended from problem-solving techniques or the advanced communications systems displayed in many species from hominids to birds (Fitch, 2010; Hauser, 1996). This corresponds to the observation that mammals, in general, grow arms not too unlike that of humans, and many other non-mammilian species have similar appendages.

The FLN, however, is likely species specific, equitable to universal grammar, and for Hauser, Chomsky, and Fitch (2002), perhaps minimally identifiable as *recursion*. Recursion is a noticeable property of language, namely, its ability to be bracketed as a series of nested units, and according to Chomsky (e.g., 2001, p. 3), is a necessary component of the structure-building operation MERGE.

Chomsky (2005, p. 6) describes the third factor as "[p]rinciples not specific to the faculty of language". This would technically include, according to the article cited, the 'general cognitive abilities' I assigned to factor 2. But in publications since Chomsky (2005), the third factor has been amended slightly to refer almost exclusively to affecting factors inherent to the physical structure of the universe itself, "organ- and possibly organism-independent" (Chomsky, 2006, p. xi), which in fact hearken back to a comment made by Chomsky almost forty years earlier – that language may be a product partially of "neural organization…deeply grounded in physical law" (Chomsky, 1965, p. 59). I will adopt this more stringent version of the third factor, keeping any of the genetic components of language, whether FLB (general cognitive abilities affecting language) or FLN (universal grammar, recursion, MERGE), firmly in factor 2, while still conceding that the genetic components *themselves* may be affected by third factor laws.

This kind of third factor-style thinking traces its roots back at least to early work by Thompson (1917), who sought to raise the study of biological morphology to "the rank of science, in the high and strict sense", which meant finding the mathematical factors involved in growth and development (p. 1). Thompson acknowledges the reluctance of natural philosophers and scientists to engage in this task, which would seem a step backward into Cartesian automata[10]:

As Thompson explains, to treat the living body as a mechanism (i.e., subject to mechanistic laws) was repugnant, and seemed even ludicrous, to mathematician and Christian apologist Blaise Pascal – furthermore:

> Goethe, lover of nature as he was, ruled mathematics out of place in natural history. Even now the zoologist has scarce begun to dream of defining in mathematical language even the simplest organic forms. When he meets with a simple geometrical construction, for instance in the honeycomb, he would fain refer it to psychical instinct, or to skill and ingenuity, rather than to the operation of physical forces or mathematical law… (1917, p. 2)

Thompson's "psychical instinct", or the "skill and ingenuity" that perhaps arises from it, would both of course be the bee's own version of factor two. That Thompson finds "physical forces or mathematical law" a much more powerful, plausible, and simpler explanation for honeycomb construction is telling – psychical instinct carries with it an expensive evolutionary burden.

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[10] The concept of which was largely done away with by Isaac Newton, which in effect destroyed the entire Cartesian philosophy (including the view that humans are *not* automata) for many years. See McGilvray (2009, pp. 36-48) for a summary.

The Russian scientist Leo Berg (1922) applies a third factor line of reasoning to evolution in general, arguing that there are natural, physical limits to the shape and form of organisms, contrary to the common Darwinian assumption of the time:

> Had infinite variations prevailed in nature, and had every organ varied in all directions, deformed beings and monstrosities would have become the rule, while normal beings well adapted to their surroundings would form the exception…[i]t would be impossible to conceive how such complex organs as the eye, the ear or the pituitary body could properly exercise their functions, if they were the seat of an infinite number of variations. (p. 27)

Similar ideas were also explored by Alan Turing (1952), who noted that there must be a chemical (i.e., mathematical) basis for the morphogenesis of such phenotypic expressions as those found in a tiger's stripes or a cow's spots.

It is interesting to note that the three factors of language design (encountered and employed by a language acquirer) correspond in spirit to the three levels of scientific inquiry (encountered and employed by a linguist) as outlined in some detail in Chomsky (1965) and (2005). Just as the child receives data, which it must utilize to grow its language organ, so the linguist may encounter data (factor one). By painstakingly cataloging, segmenting, and coding data, etc., the linguist may hope to reach "descriptive adequacy", the level at which he or she can say they possess enough data to adequately describe any particular language, or perhaps any particular phenomenon within a language. Incidentally, descriptive adequacy was the goal of the structuralists up until the early 1950s, which had "enormously broadened the scope of information available to us and [had] extended immeasurable the reliability of such data", but suffered such that its

"techniques [were] at best limited to the phenomena of surface structure and [could not], therefore, reveal the mechanisms that underlie the creative aspect of language use and the expression of semantic content" (Chomsky, 1968, p. 19). Note as well that a child never truly reaches descriptive adequacy in the sense that it 'possesses' or has somehow internalized actual tokens of all the possible strings for its language – it instead grows a device (a generative grammar) that allows it to produce any and all such sentences. Similarly, neither does a linguist have in his or her possession such a data set, which is infinite by definition. This brings to bear another question as to what kind of unconscious assumptions and leaps of knowledge linguists may bring with them when analyzing a data set, or put another way, how innate linguistic knowledge might impede scientific analysis by providing a priori solutions to problems and restricting the kinds of questions one might ask. I will not pursue the topic here, but if Chomsky is correct, such a problem has proved nearly insurmountable in language studies and the history of science generally[11].

The second factor, the genetic basis for language, corresponds in some sense to the notion of explanatory adequacy, the second part of three levels of scientific inquiry. If the poverty of the stimulus argument holds, then a language acquirer *must* be bootstrapping his or her acquisition process with something not available from input. This points to universal grammar, a missing link of sorts that explains how the final state of an acquirer's grammar differs so radically from both his or her initial state and the fractured data he or she receives. UG must have some direct bearing on (or in) an

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[11] A common refrain in Chomsky's public lectures, for example, is that science cannot proceed if one already assumes that an answer is obvious (see e.g. Chomsky's lecture on 12 November 2012 at Princeton, "After 60+ Years of Generative Grammar: A Personal Perspective", https://youtu.be/Rgd8BnZ2-iw).

acquirer's f-mind, so in a sense the child 'knows' how to use UG to create his or her own grammar. The linguist, working with conventional knowledge, does not. UG is of course a theoretical postulation meant to simply give a name to whatever mysterious properties are involved. If these properties are elucidated satisfactorily, however, the linguist may be said to have reached explanatory adequacy.

Explanation, however, runs the risk of being ad hoc. For instance, linguists may develop a model of a generative grammar that accounts for *how* language works (explanatory adequacy) but that ultimately fails to distinguish itself from other possible grammatical models that have the same result. If explanatory adequacy deals with the question of *how*, then the next logical question is *why*: why should one model of generative grammar work instead of any other? Or from the acquirer's perspective, why does acquisition of language or language itself work one way as opposed to another? An answer to this question would take us beyond explanatory adequacy (Chomsky, 2004).

This is where the third factor has bearing – if the class of possible grammars developed by a linguist, or the class of grammars that UG can create for an acquirer, is somehow naturally constrained, then the options to choose from are a priori limited. What might count as being 'naturally constrained' in this case? For Thompson, Berg, and Turing, the answer lay in possible geometric (i.e., mathematical), biological, or chemical structures, namely how the elements of those structures are defined universally in terms of how they may fit together. For a computational system like a generative grammar, an obvious place to look for 'natural constraints' is in computational efficiency (e.g., economy). This has multiple benefits: if computational efficiency is borne out of physical properties (say for example, how electro-chemical information moves from neuron to

neuron), and those properties have existed before language emerged in our species, then those are properties that don't have to be evolved. All properties of universal grammar are subject to evolution, and therefore their likelihood of evolving exists in a negative relationship to their complexity. And last, but certainly not least, a complex UG would in and of itself be computationally inefficient.

A third factor approach therefore should in fact be applicable to all three factors in some sense: factor one should be as efficient as possible, in the sense that minimal input (data) yields maximal results (a generative grammar), which appears to be the case as articulated by the POS[12]. Factor two should be computationally efficient, which if reducible to MERGE (itself computationally efficient), fits our criteria, and factor three is efficient by definition.

2.4 Projection and Labeling – Then and Now

I turn now to the notion of *projection*, something which has been important in generative grammar since the field's beginnings in the 1950s. Generative grammar has always assumed that the initial generation of a structure, sometimes called D(eep) Structure, differs in particular ways from the final structure, or S(urface) Structure. This is what I called above the 'what you see is not entirely what you have' phenomenon. But the relationships between elements at D-Structure differ from the relationships between elements at S-Structure in particular ways, and thus syntactic objects (and the relationships they form) can be said to 'project' from level to level predictably (Chomsky, 1955). For example, if the thematic relationship between a noun and a verb is defined as 'Agent' at D-Structure, that relationship will be the same at S-Structure – this

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[12] For an economic correlate arguing that economic growth occurs when real cost decreases while value remains the same or increases, see Chapter 3.

is called the Projection Principle (e.g. Chomsky and Lasnik, 1995, p. 54). The status of 'Agent' does not disappear as the relevant elements cycle through various levels, and in fact new local relationships may be defined via movement (for example, 'Subject') – this is called the Extended Projection Principle (e.g. Chomsky and Lasnik, 1995, p. 55).

Labeling, which tries to address the question of how the human linguistic system 'knows' what kinds of syntactic objects make up a particular derivation, is a notion that goes hand-in-hand with projection, and at this point in the theory of generative grammar (e.g. Chomsky 2013; 2015), the two are nearly synonymous. Traditionally, the projection of elements throughout a derivation is largely dependent on how those items are or can be labeled (that is to say, what kinds of elements they are or can become). In Phrase Structure Grammar (PSG), for example, projection from earlier levels to later levels (what eventually became D- and S-Structure) was handled by a series of context-free rewrite rules. Pre-labeled constituents acted as *initial phrase markers*, meant to enter into a derivation and be subsequently acted upon (either via rewrite rules or transformations) as a derivation proceeds. Such rewrite rules appeared in the form (1), where the ellipses signify the context-free nature of the rules:

(1)   …X… → …Y…

The category that begins any derivation, S (for 'sentence'), is stipulated, and so a sentence such as *the man ate an apple* proceeds via rewrite rules as follows (some steps are omitted):

(2a)   S → NP VP

(2b)   NP → *the man*

(2c)   VP → *ate* NP_2

(2d) $NP_2 \rightarrow$ *an apple*

Arguably, the other categories in the derivation besides S, namely NP and VP, are stipulated as well – there is no algorithm to define their presence other than the ad hoc assumptions of e.g. (2a). However, Chomsky (1955) does define an (otherwise theoretically unspecified) 'relationship' that exists between these syntactic levels or steps, namely, phrase markers of the kind NP, VP, etc. and their corresponding output strings (*the man*, *ate an apple*, etc.). Chomsky calls this relationship ρ (the Greek letter 'rho'), and so statements of the kind

(3) $\rho\,(X, X')$

define the relationship that exists between the syntactic objects X and X'[13], where these variables indicate the same objects at different points in the derivation. For example, the relationship between NP and *the man* in a derivational rewrite sequence would be defined by the statement

(4) $\rho\,(NP,$ *the man*$)$

where ρ takes NP as its input and returns the string value *the man*. Since derivations in PSG stipulate the labels of categories like NP and VP a priori, the function ρ acts as a sort of 'reverse labeling algorithm', taking the category label which is already 'known' by the grammar and determines what it consists of. If we assume that syntax proceeds instead in the opposite direction, bottom up, starting with lexical items/syntactic objects and trying to determine how they are to be labeled (the modern approach), we would get ρ applying directly to strings like *ate apples* (putting aside any tense component) and returning the label VP.

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[13] Read as 'X-prime' not 'X-bar'.

(5) $\rho\,(ate\ apples,\ \text{VP})$

In this way, the relationship ρ, with some minor adjustments, is essentially equivalent to the modern notion of a labeling algorithm. The labeling algorithm furthermore replaces the rewrite command '→ ', since it is the label itself which determines the level of each syntactic object or set of syntactic objects formed by MERGE (see Section 2.5). Thus, 'rewriting' is not necessary, strings that are to be labeled are simply labeled.

The period in-between PSG and the advent of modern Minimalism (of which labeling has become a focus) was dominated by X-bar (X') theory. X-bar theory is a codified model of syntactic structure that combines combination, projection/labeling, and (unlike its predecessor) transformation/movement[14].

X-bar theory assumed two things. The first is that the presence of any particular lexical item X (a head) implied the presence of a corresponding phrase XP. This is the projection/labeling aspect of the theory – projection/labeling is built up from simpler aspects of the structure and defined as such via the qualities of those simpler aspects. The second assumption was that any particular XP contains areas for other XPs (some YP or ZP, each with its own internal structure) to be combined and contained *within it*. The basic configuration is as below:

(6)

```
              XP
           /      \
         YP         X'
                  /    \
                 X       ZP
```

---
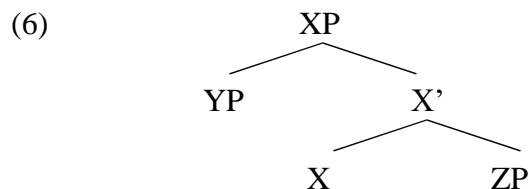
[14] In PSG, phrase structure was handled by a 'phrase structure component', which transformations were handled by a 'transformational component'. X-bar theory still had a 'transformational component', namely Move α, but the abandonment of rewrite rules in favor of the clear hierarchical embedding of X-bar theory allowed transformations to be more clearly shown.

Thus, X-bar theory provides a model that addresses how elements are combined (i.e., X and ZP are combined to form a new structure) and how those elements are labeled (the combination of X and ZP is labeled X', X' and YP are labeled XP).

One important question to ask may be the following: if X-bar theory consists of a way to model both the combination and projection of syntactic objects, both of which are needed and ultimately replaced with *two* things (namely MERGE and LABEL), why modify X-bar theory at all? The answer to this is related to how X-bar theory stipulates the existence of phrases – it claims they are 'automatic' as the result of projection from a head. X-bar theory also stipulates how syntactic objects may be combined – e.g., X cannot be a sister to X' as defined a priori. It remains a mystery as to where these initial restrictions come from, leading to the logical (but ultimately untenable) conclusion that they are consequences of UG. In other words, taken at face value, X-bar theory seems to imply that syntactic trees, as they are, somehow pre-exist in the brain. The problem of how our species evolved these strange stipulated elements remains unresolved.

The Minimalist program, therefore, assumes that X-bar theory is too complex. The natural solution, according to Chomsky, is to decouple the combinatory and projection aspects of X-bar theory. Combination becomes MERGE, which I've already discussed as the 'engine' of syntax, responsible for combining syntactic objects into sets. The operation MERGE radically over-generates, a consequence of dispensing with certain a priori conditions of X-bar theory (X + ZP = X', YP + X' = XP).

If MERGE simply combines syntactic objects into sets, then there is no 'automatic projection' as in X-bar theory. Thus, something else must be responsible for projection – for Chomsky, this is where a labeling operation comes into play. Thus, labeling is applied

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algorithmically, not automatically, following from questions of interpretation, not questions of combination.

How labeling works, then, depends on how MERGE works. If MERGE applies freely, forming binary set-theoretic sets out of syntactic objects, the following sets should be logically possible (discarding the now untenable notion of 'bar-level', and noting that sets don't stipulate an order):

(7a)   { H, H } – MERGE combines two heads.

(7b)   { XP, YP } – MERGE combines two phrases (replacing the X-bar theoretic concept of some YP as specifier with X' as its sister).

(7c)   { H, XP } – MERGE combines a head and a phrase (equivalent to the X-bar relationship of complement).

MERGE should also be of two *kinds*, again, as a matter of logical possibility (see Chapter 1):

(8a)   External MERGE (EM): MERGE combines two unique objects α and β, where either α or β inclusively is a head or a phrase.

(8b)   Internal Merge (IM): MERGE combines two objects α and β, where either α or β inclusively is a head or a phrase, and either α or β exclusively is an element of the other.

Chomsky proposes the following for labeling: some operation LABEL enters the course of generation at certain points after MERGE has applied. LABEL deals with each type of structure differently. For Type 3, the set { H, XP }, LABEL selects H as the label (presumably based on some principle of minimal search) and derivation proceeds as normal. For Type 2, { XP, YP }, there is no head/phrase asymmetry. The absence of this

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asymmetry means that LABEL must select the label slightly differently. Chomsky

proposes two possibilities. The first is to remove one member of the set, i.e., to Internally

MERGE it in a higher position ('?' is a placeholder for a label waiting to be assigned):

(9a)   { α { XP, YP } } → { XP { α { X̶P̶, YP } } }

```
              ?
         ┌────┴────┐
        XP         ?
        ▲     ┌────┴────┐
        │     α         ?
        │           ┌───┴───┐
        │          X̶P̶      YP
        └───────────┘
```
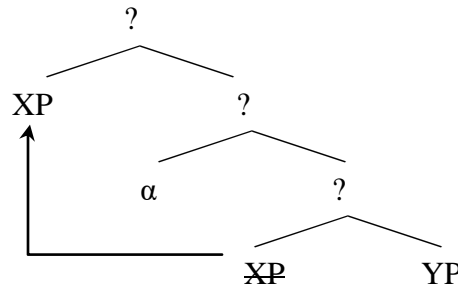
After this movement, the XP copy (marked as 'X̶P̶') is no longer visible to LABEL, and

{ X̶P̶, YP } is labeled as YP as a de facto solution. The second strategy LABEL may utilize

in { XP, YP } structures is as follows: assume that α above is a head with some

uninterpretable feature uF. Labeling proceeds as expected:

```
              ?
        ┌─────┴─────┐
       XP          αP
              ┌─────┴─────┐
              α          YP
             [uF]     ┌───┴───┐
                     X̶P̶      YP
```
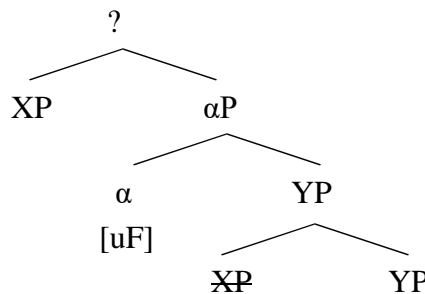
{ XP, αP } is a phrase-phrase structure, and if XP has a corresponding interpretable

feature iF, LABEL may label the structure using the agreeing features.

```
                    < iF, uF >
                   /         \
                 XP           αP
                [iF]         /    \
                           α        YP
                          [uF]     /    \
                                 X̶P̶      YP
```
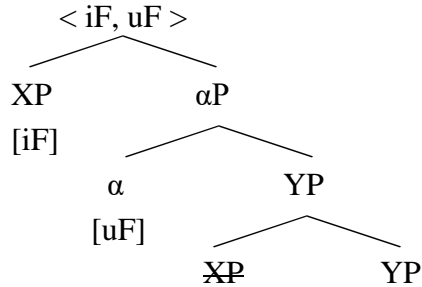
The third type of structure, { H, H }, is not discussed by Chomsky at any length, but

presumably (if it exists at all) works in a similar way as { XP, YP }.

Because of labeling, then, we can provide a decent account not only of how

structures are prepared for interpretation at the brain's semantic (Conceptual-Intentional)

interface, but of why Internal MERGE exists (to allow structures to label by removing an

element and placing it elsewhere) and why agreement exists (to label an element and

'freeze' it in place, i.e., to stop further instances of Internal MERGE). Some of the

consequences of these phenomena are explored in detail in Chapter 3 below.

2.5 Problems with Labeling

As it stands, the labeling approach is supposed to simplify the basic aspects of

syntactic theory. However, labeling is a relatively new approach, and in many cases

requires drastic and radical reimagining of syntactic phenomena that were handled,

descriptively, quite well under X-bar theory.

For example, one obvious benefit of the POP account is that it provides a

reasonable solution to the EPP problem mentioned briefly above – namely, the fact that

in English subjects move from a lower position to a higher position. Take (12) below, a

restating of (1a) from Chapter 1:

(12) The children have seen Alice.

According to the Projection Principle, thematic relationships of argument structure are defined locally – i.e., the derivation of (12) begins with *the children* directly 'next to' *see Alice* (before tense comes into play). Thus, *see* defines the θ-role for *the children* as 'Experiencer'. *Have* is added by MERGE before any labeling takes place:

(13) { have { the children$_{Experiencer}$ { see Alice } } }

Once LABEL attempts to operate, it notices that *the children* and *see Alice* are in an unlabelable structure: { XP, YP }, and XP (*the children*) must move to the next possible position (to the left of *have*). The Projection Principle states that *the children* doesn't lose its assigned θ-role, and the Extended Projection Principle notes that in fact a new local relationship is defined: subject. The POP account states that this happens because *the children* can (for whatever reason) spur agreement with *have see Alice* (manifesting as *have seen Alice*), and thus labeling is possible (I dispense with the actual labels below):

(14) { the children$_{Experiencer, subject}$ { have { ~~the children~~$_{Experiencer}$ { seen Alice } } } }

But this account must be developed further to deal with other kinds of word orders. Take Arabic, for example, the standard order of which is VSO:

(15)　Daxal-at　　　　　annisaa'u　　　makaatibahunna

　　　Entered-sing.fem.　the women　　their offices

　　　The women entered their offices. (Alsaeedi, 2016)

One account of (15) is that the subject *annisaa'u* remains in situ in the external argument position, while the verb *daxalat* moves to T. Indeed, the verb and the subject appear to be agreeing only partially – in terms of gender but not number: the *-at* on the end of *daxal* indicates a singular feminine form, while *annisaa'u* is feminine plural. Conversely, the more marked Arabic word order, SVO, shows full agreement:

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(16)   Annisaa'u   daxal-na   makaatibahunna

        The women   entered-pl.fem.   their offices

        The women entered their offices. (Alsaeedi, 2016)

Example (16) corresponds in spirit to the POP account of the English (12), but what of (15)? How does the labeling algorithm deal with the { XP, YP } structure of *annisaa'u makaatibahunna*? And to extend that case, why isn't *Have the children seen Alice* (meaning 'The children have seen Alice') a possible structure in English? More problems abound in a dialectical form of Arabic spoken in Western Saudi Arabia (e.g., the city of Mecca). This dialect shows full agreement in both word orders:

(17)   Alawalaad   raah-uu   almadrasah

        The boys   went-pl.masc. school

        The boys went to school. (Alsaeedi, 2016)

(18)   Raah-uu   alawalaad   almadrasah

        Went-pl.masc. the boys   school

        The boys went to school. (Alsaeedi, 2016)

(17) is not problematic, but what spurs the agreement in (18)? There are two accounts: either agreement can look 'downward' in this case and agree fully with *alawalaad* in situ, or *alawalaad* and *raahuu* agree locally in the typical manner, and *raahuu* moves further to some higher position. The first account, again, doesn't tell us why *Have the children seen Alice* is ungrammatical in English, i.e., why the English T cannot agree downward so that *the children* labels in situ with *Alice*. The second account, as well, presents a problem: if *Alawalaad* and *raahuu* agree at the T level, the T *raahuu*

should be 'frozen', with no reason to move to some higher head. Clearly, further work needs to be done to address these and other issues in the POP framework.

2.6 Conclusion

In this chapter, I've discussed some of the history behind generative grammar and the mentalist or internalist assumptions it makes, including the theory of universal grammar and the three factors of language design. I've also discussed the notion of projection and labeling, nearly synonymous theory-internal notions that have helped design the architecture of generative grammar. Perhaps most importantly, I've discussed the recent centrality of labeling in the POP-theoretic accounts of Chomsky (2013; 2015). Below in Chapter 4, I extend Chomsky's design to argue that the operation LABEL accounts not only for real-time syntactic rearrangements, but permanent ones as well.

CHAPTER 3

THE ECONOMICS LENS

I turn now to a discussion of Minimalist syntax from an economics perspective. In Chapter 1 of this dissertation, I briefly mentioned that a theory of liberal economics (in the tradition of Adam Smith and others) can be used to detail certain processes endemic to a Minimalist theory of syntax, i.e., a theory of syntax that assumes the process(es) of syntactic generation evolved as part of the natural world in order to satisfy certain conditions imposed upon it by non-syntactic parts of the mind/brain. In a liberal (e.g. free market or *laissez-faire*[15]) economy, market forces dictate how goods and money are exchanged, and a certain equilibrium (some state of mutual benefit) is ideally attained by the actors in that economy. Likewise, in the syntactic domain, where information[16] is the commodity being exchanged, 'mutual benefit' can be thought of as the 'motivating factor' for the perfect or 'just enough' system envisioned by the Minimalist program.

So how does an economic theory of Minimalism differ from the spirit that is already imbued within that program? Quite simply, the prevailing view of Minimalist syntax is that of a mechanism or series of mechanisms that 'hand off' information from one module to the next.

For example, during the initial moments of the derivation of a sentence, some mechanism may be responsible for searching for and fetching lexical items to be used to build that very sentence. For sake of argument, call this mechanism FETCH. What does

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[15] The use of this term as equivalent to classical liberalism is controversial, as noted by F.A. Hayek and others. I merely use it here as an informal expository device.

[16] I mean 'information' in the technical sense, such as pure data, including the logical concept of identity (see Plato's *Theaetetus* [185a]). This is more encompassing than the common notion of information as something that bears semantic significance at the level of conscious human thought and discourse.

FETCH do with its just-acquired array of lexical items? Standard Minimalist approaches may assume that FETCH hands over the array to MERGE, which is now responsible for it. Under this account, FETCH has a certain activating effect on MERGE. In common parlance, FETCH tells MERGE that it's time to go to work, and MERGE has no recourse in the matter. This may very well be what happens. But on the other hand, it may not.

It could be, for instance, that our hypothetical FETCH is not strictly specialized, and grabs not only lexical items proper but images or concepts and generalized categories such as N or V. This may result in MERGE or some other operation working with what it has (perhaps eventually outputting a 'tip-of-the-tongue' or aphasiatic phenomenon), while continuing to signal to FETCH to attempt to grab the correct lexical item. Or perhaps FETCH works twice, initially grabbing a lexical 'matrix' address of sorts until AGREE signals back to it whether it needs 'go' or 'went', and FETCH is activated again (something like this account seems to be the case in, e.g., distributed morphology). Even under the strictest account of an operation like FETCH, where only lexical items are targeted, MERGE or some other operation must tell FETCH when to stop (a very basic but not non-trivial problem).

In essence, my argument is that like a liberal economy, the relationship between *any* two (or perhaps more) syntactic operations is very likely to be dynamically intertwined, and not a series of isolated steps, where all previous responsibility is forgone upon the passing of information.

So what appears to *not* be asked in many accounts of modern Minimalism is what effect subsequent operations have on previous operations. Any proposal that does so results in the dreaded and apparently unassailable label of 'countercyclicity'. Ironically,

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perhaps, generative grammar was borne much out of Chomsky's criticism for Turing machine-style Markovian step-by-step processes; the very idea of a transformation meant that some part of a sentence had to 'look back' at another part of the sentence in order to figure out what to move and where. So while any charge of countercyclicity may be valid (especially in Chapter 4), as pointed out to me by Andrew Carnie (p.c.), I am going to set aside concerns over it for now. In the rest of the current chapter, I am going to explore Minimalism using an economics lens (to borrow a term often used by rhetorical scholars), mostly from Smith's *The Wealth of Nations*, in a very informal matter. I return to a more formal application of some of these ideas in Chapters 4, 5, and 6.

3.1 Modularity and the Division of Labor

Adam Smith opens his seminal tract on economy with a discussion of the division of labor – something that is necessary to (but not sufficient for) a liberal economy:

> The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgment with which it is any where directed, or applied, seem to have been the effects of the division of labour…This separation too is generally carried furthest in those countries which enjoy the highest degree of industry and improvement; what is the work of one man in a rude state of society, being generally that of several in an improved one. (1776, p. 9-11)

Smith is arguing that a society in which the workforce consists of a number of specialists is necessarily more productive than a workforce of generalists.

Take the modern example of automotive construction. If some small group of people had the need for automobiles, they could in theory rely on one member of that society, say a very talented engineer, who could build for them the automobiles they need

from scratch. Such craftsmanship is rare, but possible. A larger society may in fact have a

larger number of expert engineers, who could again fill the automobile needs of that

society, but the pace of doing so would be slow and the work tedious.

However, a number of perhaps less-skilled workers who specialize in particular

aspects of automotive construction (e.g. the fashioning of wheel bearings, sewing of

upholstery, installation of windows, and so on) would more quickly and effectively build

the necessary automobiles. And as an added benefit, very few of those workers would

need to have knowledge of how to build an entire automobile. Thus, "what is the work of

one man in a rude state of society" is "that of several in an improved one".

The modularity of mind, a concept advocated by philosophers like Chomsky and

Fodor, bears no coincidental resemblance to the notion of division of labor. As discussed

previously in Chapter 2, the characterization of certain operations in generative grammar

have become more specific and more modular over time. Under Minimalist assumptions,

this has been prevalent with MERGE and especially so with the advent of LABEL.

Smith continues:

This great increase of the quantity of work, which, in consequence of the division

of labour…is owing to three different circumstances; first, to the increase of

dexterity in every particular workman; secondly, to the saving of the time which

is commonly lost in passing from one species of work to another; and lastly, to the

invention of a great number of machines which facilitate and abridge labour, and

enable one man to do the work of many. (1776, p. 13)

Thus, taking into account Smith's first consequence, an operation like MERGE is

very fast and very cheap because it is highly specialized. And furthermore, any of its apparent complexity (e.g. Internal MERGE) falls naturally as a consequence of how the operation is defined (see Chapters 1 and 2). Interestingly, in general it would appear that the more divided labor is or the more specific operations are the better. But at some point a balance occurs, as Internal MERGE demonstrates. For example, if MERGE were confined to External MERGE, and Internal MERGE were a separate operation, each operation would have to include instructions to bar it from performing the other's operation, which it could otherwise easily do. Such an approach would be hardly economical – the added cost would outweigh the potential benefits. Similarly, it may make sense for a factory supervisor to have one assembly worker do two tasks which are both naturally in that worker's purview than to hire twice the number of workers. An economics of *anything*, that is to say, does not exclusively rely on the division and specialization of labor to the detriment of everything else, but seeks the most effective way to a balanced and mutually beneficial system.

As for the second consequence, the saving of time between the switching of tasks, we may see clearly the necessary decoupling of MERGE and LABEL as per the POP approach. Under the older X-bar theoretical assumptions, MERGE and LABEL (projection) were combined. Since bar levels were thought to be projected as an immediate consequence of MERGE, something like the following would have had to have occurred (note that in this case, MERGE and LABEL are not separate but rather two facets of the same X-bar theoretical operation):

Step 1: MERGE A and B to form the tree A, B.

Step 2: LABEL the tree A, B as A'.

Step 3: MERGE A' and C to form the tree C, A'.

Step 4: LABEL the tree C, A' as A'' (AP).

And so on and so forth. In this case, since MERGE and LABEL are not at all within the same purview (not even as close as External MERGE and Internal MERGE would be if separate), for the syntactic machinery to switch operations iteratively would result in a vastly unnecessary expenditure of work (see Chapter 4 for a detailed account of how MERGE and LABEL work together more economically).

There are of course criticisms of the division of labor approach to capitalist production, perhaps articulated most famously through Marx's idea of *Entfremdung* ('estrangement' or 'alienation') or through Thoreau's quip that "[Man] has no time to be anything but a machine" (or perhaps an extension of a machine, to invoke the third part of Smith's quote above) (1854, p. 2). But Smith, in discussing the concept of division of labor, is of course not proposing anything, but is rather observing what is in all practicality a naturally arising phenomenon. It is in this sense unsurprising that a *laissez-faire* economy would be a higher-order mimicry of the more basic interactive tendencies of complex systems phenomena[17].

3.2 Third Factor Self-Interest

Recall from Chapter 2 the notion of 'third factor'. Within observable nature, the proliferation of data (factor 1) and intricacies of human nature and genetics (factor 2) make complex systems such as language very difficult to comprehend scientifically. Similarly, it would be very difficult to build a perfect snowflake from scratch using

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[17] This is perhaps beyond the boundaries of the current study, but it may be worth nothing that non-*laissez-faire* economies require homunculus-style interference from some not-so-invisible hand. A step-by-step account of sentence generation in which modules have no active abilities to 'communicate' would require a similar kind of cognitive oversight.

individual hydrogen and oxygen atoms. But just as a snowflake may form easily from certain conditions imposed upon hydrogen and oxygen atoms by the natural physical laws of the universe, so too may something like language be grounded in natural law (factor 3).

Indeed, Smith makes similar observations, supporting the idea that liberal economies form as a matter of the natural world. Regarding a factor 2 of sorts, Smith writes:

> [The division of labor] is the necessary, though very slow and gradual, consequence of a certain propensity in human nature which has in view no such extensive utility; the propensity to truck, barter, and exchange one thing for another. (1776, p. 19)

The phrase "which has in view no such extensive utility" is key – Smith is arguing that it is impossible to tell from the simple human propensity to barter that a complex economy rooted in division of labor may arise, just as it may be impossible to tell from the character and nature of MERGE that the human who employs it may one day have a lovers' quarrel or engage in political debate. This is a common character of complex systems – they appear to be more than the sum of their parts.

Smith continues, appealing to the species-specificity of barter:

> [Bartering] is common to all men, and to be found in no other race of animals, which seem to know neither of this nor any other species of contracts…Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog. Nobody ever saw one animal by its gestures and natural cries signify to another, this is mine, that yours; I am willing to give this for that. (1776, p. 19)

But what is the origin of bartering? Smith argues that it is self-interest or self-preservation, a kind of third factor phenomenon[18]. Pure human self-preservation is tempered by rhetorical necessity (bartering being "the necessary consequence of the faculties of reason and speech" (1776, p. 19)), due to the fact that "man has almost constant occasion for the help of his brethren" and would "in vain…expect it from their benevolence only" (1776, p. 20), for:

> It is not from the benevolence of butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity [i.e. concern for others] but to their self-love, and never talk to them of our own necessities but of their advantages[19]. (1776, p. 20)

This general rule may apply to how a complex cognitive system exchanges information, and if so, self-preservation could more readily and easily be thought of as a third factor phenomenon. So what evidence is there for self-preservation in syntax? Chomsky often asserts that syntax abides by its own rules that are, at least at one level, difficult to see and understand by an observer. The prime example is *that*-trace effect (here exemplified in question form by *if*). Take the following:

(1a) He asked if the four mechanics fixed the twenty cars today.

(1b) How many cars did he ask if the four mechanics fixed *t* today?

(1c) *How many mechanics did he ask if *t* fixed the twenty cars today?

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[18] At least, a kind of 'weak' third factor (see Chapter 2). If barter is akin to the faculty of language – narrow, then self-interest may be akin to the faculty of language – broad. In other words, not exactly species specific, but not purely grounded in physical law.

[19] This 'biorhetorical' reality, i.e., that communicative exchange is rooted in human self-interest, has been noted by many laypeople who study human behavior, perhaps most famously Dale Carnegie. It appears to be, however, totally absent in the academic field of rhetoric.

The situation for each of these sentences may be thought of as follows. (1a) is a declarative sentence (with a subordinate clause) that notes the action of some individual (*he*), say the owner of an auto shop. At the beginning of the work day, the owner assigned ten cars to be fixed by the four mechanics on duty. At the end of the day, he asks the floor supervisor if the four mechanics did indeed fix the ten cars. However, things get more complicated when the floor supervisor recounts the (rather uninteresting) story to his wife after he gets home. In scenario (1b), the wife is surprised that the owner asked four mechanics to fix such an unusually and unexpectedly large number of cars, so she asks her husband to clarify. Syntactically, we assume that (1b) is built upon a kind of underlying version of (1a). So in order to ask this question, the object of the subordinate clause (marked by *t* in its original position in (1b)) must be moved to the front of the sentence with the corresponding question word (*how many*). The result is a grammatical sentence fitting the scenario, namely (1b). But in scenario (1c), perhaps the wife knew in advance that twenty cars would be needing repair that day, and is amazed at the low number of mechanics who were assigned to the task. So she incredulously asks about the owner's original question in sheer disbelief that he would actually expect four mechanics to fix twenty cars. In theory, the question formation should proceed similarly: the subject of the subordinate clause (again marked by *t*) is moved to the beginning of the sentence with the corresponding question word (again, *how many*). But, for whatever reason, (1c) is ungrammatical. It is, as Chomsky is fond of saying, a "perfectly fine thought", but if expressed, must be done so by some circumlocution, namely by removing the offending *if*:

> (2) How many mechanics did he expect to fix the twenty cars?

Chomsky (2013) discusses in length a potential explanation for this phenomenon with respect to (what I have been calling) the operation LABEL[20]. LABEL rejects (1c) because (for a complex reason) it doesn't fit the standards set forth by the operation itself. These standards are either inherent to language (factor 2) or based on something else (factor 3), but what appears to be probably true is that the tendency to stick to these standards (self-preserve) *at the expense of semantically significant communicative effectiveness* is a third factor phenomenon at its base. Just as the butcher must be appealed to via his own self-interest, not with regards to his supposed duty to feed his fellow man, so too does LABEL (and other operations, I assume) only accept some syntactic structure if it conforms to its own standards, not out of some 'duty' to facilitate humanly meaningful sentences.

The idea of self-preservation among syntactic modules specifically or even larger mind/brain modules generally is likely to be much more detailed (and hopefully more formalizable) than I have briefly outlined here. But in this section I have attempted to show another parallel with a liberal economic system. It doesn't need to be said that syntactic phenomena are not cognizant. But they do consist of a number of operations that in some sense make certain 'choices' over others. Those choices that *are* made result in grammaticality and never result in ungrammaticality. This success is characterized by the tautological reality that the end result is a homogenized system of sorts, comparable to the end result of a fair and equal exchange of goods on an open market. The basis of this, at least so far, appears to be rooted in the fact that each operation or actor involved

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[20] There appears to be some confusion as to whether or not Chomsky views the labeling process as an actual operation. I assume it is. See Chapter 2.

in e.g. a syntactic or economic system is both highly specialized and self-interested. Successful exchange is not made in spite of this reality, but rather because of it.

3.3 Grammaticalization as Economic Exchange

Turning now to Chapter 5 of *Wealth of Nations*, Smith commences discussion of what he calls real and nominal price. Put simply, nominal price is the price of a commodity commanded on the market[21]. In the United States, for example, the price of real estate has fluctuated enormously over the past ten years. This is due to a number of complex factors, from supply and demand to the intersection of the real estate industry with the mortgage industry and the federal government. However, over the last decade, the *actual value* of real estate has remained relatively the same: a plot of land has more or less the same capacity for building structures in 2016 as it did in 2006, and a house built then provided more or less the same kind of modern civilized comforts as a house built today does. Furthermore, the amount of actual energy expended by humans to build a house has not changed recently (putting aside any innovations in technology). Hence, most companies involved in real estate have suffered, especially since the real price and value of real estate has remained the same.

On the other hand, the oil industry has countered the notion of "peak oil" with recent innovations in fracking. The July 2016 issue of *Fortune* magazine, in fact, recommends investing in oil exploration and production companies because such companies have greatly reduced their costs through technical innovation, so a decrease in the nominal price of oil affects them less, and such a decrease is likely to drive gasoline usage higher.

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[21] I am here conflating nominal price with market price, but I believe the comparison still holds. See Smith (1776) Ch. 7.

The actual or real price of a commodity therefore is determined by effort expended or labor. Smith explains:

> Every man is rich or poor according to the degree in which he can afford to enjoy the necessaries, conveniences, and amusements of human life. But after the division of labour has once thoroughly taken place, it is but a very small part of these with which a man's own labour can supply him. The far greater part of them he must derive from the labour of other people, and he must be rich or poor according to the quantity of labour he can command, or which he can afford to purchase. The value of any commodity, therefore, to the person who possesses it, and who means not to use and consume it himself but to exchange it for other commodities, is equal to the quantity of labour which it enables him to purchase or command. Labour, therefore, is the real measure of the exchangeable value of all commodities. (1776, p. 36)

In the real-world examples above, some party purchasing real estate may benefit because the nominal price of real estate has decreased (through somewhat artificial means, e.g., interference from other factors), while a home builder may see lower profits because real cost (and corresponding labor) has remained stable. In the oil example, however, exploration and production companies have benefited by lowering costs through technology, and consumers have benefitted through corresponding drops in nominal price, while the actual value of oil remains the same (i.e., still has the same if not better ability to power internal-combustion engines). Therefore, the oil example is a better example of a mutually-beneficial liberal economy: if a product can be made more

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efficiently and therefore sold and bought less expensively, *while retaining the same or better value*, the economy in question can grow.

This principle applies to a particular linguistic phenomenon – grammaticalization. Grammaticalization, introduced briefly in Chapter 1 and explored again in Chapters 4, 5, and 6, is phenomenon whereby the morphosyntax of a language is permanently altered. By almost all accounts, it is an inter-generational process that results in semantic units being reinterpreted as grammatical units. I will review again the examples I mentioned in Chapter 1 (and explore in some depth especially in Chapters 5 and 6) and show how each one is an example of an economy.

3.4 From 'Wish' to Future

The grammaticalizing change of verbs denoting DESIRE to markers of future modality is well-known and well-studied. In Old English, for example, the word *willan* expresses a desire or wish. The Modern English successor of *willan* is *will*.

(5) I will see the king.

It is relatively clear to see that the use of *will* in (5) can denote a kind of desire, wish, or hope (cf. *I will see the king if he lets me*), but this reading is not necessary (cf. *I will see the king and be executed*). Nor is it even necessary to have an agent capable of expressing desire, wishing, or hope:

(6) It will rain tomorrow.

So although the DESIRE reading is perhaps murkily present in Modern English *will*, the most salient reading is of course future modality – *will* expresses the likelihood of an event, not the inner workings of a speaker's mind.

It is largely argued that the future modal reading of *will* comes from the DESIRE reading of *willan*, or rather, that the DESIRE semantics of *willan* contain within them a heavy implication of some future event. Through the process of grammaticalization, the DESIRE reading fades, leaving the FUTURE reading as salient:

(7)   Old English   Modern English

       willan   *will*

       [+DESIRE]   [DESIRE]

       [+FUTURE]   [+FUTURE]

From a microeconomic point of view, examining the word and its surrounding syntax, what does *willan*/*will* and the syntactic system stand to 'benefit' through grammaticalization? Clearly, (7) shows some kind of semantic loss – assigning a positive numerical value for each + trait gives a semantic 'weight' of 2 for *willan* and 1 for *will*, so the semantic loss must be countered by some benefit in order for the grammaticalization to make economic sense.

As I mentioned above, grammaticalization results in a permanent morphosyntactic change. Morphologically, the change from *willan* > *will* results in the loss of the verbal -*en* ending (as *will* is no longer a verb in Modern English). Thus *will*, being monomorphemic, is 'cheaper' than *willan*. Furthermore, the second verb associated with *willan* no longer has to appear as a specially-marked non-finite verb in a subordinate clause and can now appear as a finite verb in a main clause. We may speculate that a finite verb is 'cheaper' than a non-finite verb (again, in terms of morpheme count). Syntactically, the grammaticalization of *willan* > *will* results in an M + V structure (a single clause) as opposed to the original biclausal $V_1 + V_2$ (with a possible intervening

C). M + V are probably part of the same phase (see Chapter 5), while $V_1 + V_2$ are at least

two different phases (three if an intervening C is assumed). Lastly, the syntactic change

from biclausal to monoclausal eliminates the first person redundancy of *PRO* as well as

any necessary raising-to-object ECM movement, etc.

There are certainly practical drawbacks in terms of the possible loss of

expressiveness that *will* has compared to *willan*. But that is a larger pragmatic issue

(although certainly of some consequence). In this case I am only making an argument for

the potential benefits of the grammaticalization of *willan* > *will* from a microeconomic

perspective. And from this perspective, the grammaticalization of *willan* > *will* bears a

resemblance to the lowering of real (and nominal) cost.

From a macroeconomic point of view, the grammaticalization of *willan* > *will* has

a gain that is quite obvious: the creation of *will* as a definitive future modal occupying the

category M. In fact, from a properly abstract point of view, the grammaticalization of *will*

results in no loss at all – through the benefit of hindsight, we know that *want* has taken

the place of *willan*. So, while the real and nominal cost decrease by grammaticalizing

willan > *will* (due to the less amount of operating 'labor' used to create *will* and the M+V

structure), the value of *will* increases over *willan*, especially with the advent of *want* in

Modern English. Since all 'parties' benefit through the exchange, the economy of the

system grows.

3.5 Conclusion

In this chapter, I have argued that certain aspects of linguistic generation act as a

kind of economics, which I defined as a system of exchange that seeks mutual benefit. To

recap, large economies are noted for their division of labor, which allows for better

products to be produced at a faster rate. I compared this to the notion of species specific modularity in language generation, which has apparently evolved in such a manner as to allow for the virtually effortless generation of syntactic structures. As a consequence of division of labor, cooperation between economic units is required, such that one actor relies on the specialization of another to form a mutually beneficial economy. However, actors in an economy are fundamentally self-interested, thus they are motivated to exchange goods. Similarly, syntactic units and operations are 'motivated' by self-interest in the sense that information is exchanged only in a way that satisfies the rules of the system – they follow these rules sometimes at the expense of certain larger human values (e.g. communication). Lastly, I discussed the notions of real and nominal price, where real price is equivalent to labor and nominal price equivalent to an exchange price. The ideal economic situation occurs when a product's real and nominal prices decrease while the value of the commodity remains the same or increases. In the case of the grammaticalization of *willan > will*, the real and nominal 'costs' have decreased while the value of *will* has increased.

While in this chapter I've taken a very large-scale metaphorical approach to arguing how linguistic (especially syntactic) systems behave like an economy, in the next chapter I present a more formal argument as to how the nuts and bolts of economic exchange within that system work.

CHAPTER 4

THE ERRORS AND BUFFERS APPROACH

4.1 A Brief Recap and New Hypothesis

In Chapter 3, I argued that syntactic mechanisms or operations can be informally

characterized as a kind of liberal economy. By this I do not only mean to say that syntax

is economic in the sense of Chomsky (1995) or van Gelderen (2004), but rather that

syntax bears a number of similarities to actual human economies as described by e.g.

Adam Smith (1776). That is, syntax can be characterized as consisting of a number of

operations that negotiatively exchange information in way that is 'mutually-beneficial' to

the entire system. These operations can furthermore be said to bear resemblance to the

liberal economic notions of division of labor, self-interest, and real/nominal price. The

purpose of Chapter 3 was to conceptually show that syntactic modules do not exist in a

one-way relationship to each other, but work together back and forth. In this chapter, I

present a formalism that theorizes how that back and forth might operate.

Earlier in Chapter 2, I discussed some of the history of generative grammar,

including the mentalist and internalist assumptions that guide its philosophical and

scientific inquiry. I also discussed labeling and projection. I reiterate the following for

expository purposes:

1. Phrase Structure Grammar (PSG) in early theoretical syntax assumes a top-down

   approach to syntactic derivation, with labels (S, NP, VP, etc.) assigned a priori.

   The Deep Structure contains initial phrase markers and the Surface Structure

   contains the final output string. Projection occurs as the derivation cycles through

   the changes from Deep Structure to Surface Structure.

2. X-bar theory, which succeeded PSG, assumes a bottom-up approach to syntactic derivation, with labels assigned in accordance with the categorical heads that form their base. What X-bar theory adds are a priori assumptions as to the combinatorics involved, i.e., heads combine with phrases to form bar-levels. Heads, and their corresponding labels, project upward to form maximal projections with other phrases embedded within them – so X combines with a complement ZP to form X', and X' combines with a specifier YP to form XP.

3. MERGE-based Minimalist syntax, i.e. the most recent "Problems of Projection" or POP approach, dispenses with pre-labeled structures, bar levels and the untenable notion 'specifier'. In its place is a single combinatory operation which puts syntactic objects into unordered sets. Labeling is done elsewhere and as a separate operation (LABEL).

As I will show in this chapter, a particularly key economic relationship in syntactic generation is the one that exists between LABEL and MERGE. The underlying hypothesis regarding this economic relationship is threefold. First, Internal MERGE and structural grammaticalization (syntactic rearrangement) are both motivated by what I call 'labeling errors'. In this case, the term 'error' does not mean to imply that there is something wrong with the system – quite the opposite[22]. It only means that the operation LABEL may receive as input some merged structure but fail to return a labeled structure, forcing LABEL to 'renegotiate' the structure with MERGE. The result of this renegotiation is either movement or grammaticalization. Second, these labeling errors are a normal consequence

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[22] To invoke the (somewhat tongue-in-cheek) terminology of computer program design, errors are a feature, not a bug. From an evolutionary perspective, however, this harkens to Galileo's intuition that nature is perfect. See Chapter 2.

of the labeling algorithm (LA), and are derivationally real-time processes characteristic of syntactic economics. Third, these labeling errors occur in intra-phasal 'buffer zones', after the activation of a phase head, but before the post-phasal operation TRANSFER.

This chapter proceeds as follows: in Section 4.2 below I discuss the concept of phases and phasal architecture while keeping in the background the economics perspective of Chapter 3. In Section 4.3, I introduce the concept of 'buffers' as a companion to 'errors', extending the phasal architecture of 4.2. In Section 4.4 I analyze the memory quality of phases. In Section 4.5, I show how errors and buffers apply not only to real-time structure change (Internal MERGE), but diachronic structural change as well.

4.2 The Marketplace of Phases

In modern Minimalism, the cyclical 'level'-based derivations of PSG and its descendants, along with Deep Structure and Surface Structure, have been abandoned in favor of single-level multiple-cycle derivations called *phases*. Phases are finite derivational 'spaces' that allow for the generation of sentences to proceed in manageable chunks. The syntactic range of each phase is determined by its respective head: transitive v* and C, and possibly D (see Chomsky, 2000 and later). According to Chomsky (2013), phases begin through External MERGE alone, selecting and combining items retrieved from the lexicon. Upon the merging of a phase head, other operations occur, namely LABEL and Internal MERGE. TRANSFER, an operation which 'hands-over' labeled constituents to the Conceptual-Intentional and Sensorimotor interfaces, completes the phase. Under this analysis, the derivation of a sentence has a cyclical effect: operations occur in one phase, the output of that phase (the complement of the phase head) is sent to

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relevant interfaces and subsequently 'forgotten' by the derivation, and the next phase starts over.

Phase theory has been integral to minimalist syntax since Chomsky (2000). Earlier, in a PSG (or X-bar theoretic) approach to derivation, an entire Deep Structure is formed first to which transformations apply later. Multiple transformations may apply before the final Surface Structure is reached, e.g., a standard *wh*-question in English requires both subject-auxiliary inversion and movement of the *wh*-word to the front of the sentence. These approaches, therefore, have both a phrase structure component (which form kernel sentences) and a transformational component (called 'Move α' in X-bar theory) as part of their generative machinery.

Phases, on the other hand, when combined with Internal MERGE, allow for the elimination of the transformational component completely (as well as Deep Structure). This is because 'transformations' (i.e., Internal MERGE) don't have to wait until an entire Deep Structure is generated before they can apply – movement and combination can apply essentially in tandem (cyclically), especially since they are two aspects of the same operation (MERGE).

More recently, in Chomsky (2013; 2015), phases have been combined with a labeling algorithm, which as I mentioned above, replaces the previous notion of projection. If phases are the spaces in which expressions are built to be interpreted by mental interfaces, labeling is a way to assure that those expressions are 'readable' by the interfaces.

For example, there is a sardonic adage in the food service industry that serves as a warning to customers – you can only choose two: 'good', 'fast', and 'cheap'. If your food

is good and fast, it won't be cheap; if it's fast and cheap, it won't be good, and so on. MERGE appears to be fast and cheap, hence it is not good (or in our case, perhaps 'smart'). If MERGE is indeed free, that is (to borrow from Italian), *gratuito* (in the sense that it comes for free via evolution) and *libero* (in the sense that it applies freely), it should operate in a way that (over-)generates any number of strings, only dumbly. Take two of the more well-known sentences from Chomsky (1957):

(1) Colorless green ideas sleep furiously.

(2) *Furiously sleep ideas green colorless.

Theoretically, MERGE could generate each string by applying freely. Sentence (1) is nonsensical, but contains grammatical constituents which are 'readable' to the Conceptual-Intentional interface. An interpretation arises, although it is perhaps fantastical. Sentence (2), on the other hand, although it can be generated, has no constituents and gives rise to no interpretation, however fantastic. Curiously, the generative capability of humans must account for both (1) and (2). If, for example, we rely purely on semantic functional application for generation and interpretation, then (2) does not arise, or rather, we'd have to speculate another operation that allows for the creation of non-semantic strings.

Phases and labeling, when combined, are an efficient way to build and 'check' a derivation economically – phases in which each constituent is labeled correctly get a pass, strings of words which are not labeled correctly, not labeled at all, or not labelable, either crash or are consciously overridden (as (2) must be) to result in an ungrammatical output. Phases then are a sort of marketplace where information is exchanged and terms are negotiated to build grammatical sequences.

Take the following as a thought experiment to understand phases and labeling. Imagine that there are a test-taker and a test-administer in a room together. It is the job of the test-administer to check the results of the test-taker and either pass or fail him (assume that there are no in-between results). The test-taker, on the other hand, has no knowledge of the subject being tested, and is forced to essentially guess answers at random. Luckily, he gets an unlimited number of guesses. So, to proceed, he takes a copy of a multiple-choice test with some number of questions (say, 25) and guesses answers (say, 'a' through 'e') randomly: 'a' for question 1, 'b' for question 2, 'c' for question 3, and so on. After he's finished, he takes his completed test to the administer, who checks the test for errors, and fails him if he finds any (the likely result). Upon failure, the test-taker gets a fresh copy of the test and tries again.

A more efficient approach, for the test-taker, would be the following: guess an answer on the first question (begin with 'a'), and take the test to the administer to receive either a 'yes' or a 'no' verdict. If 'no', guess 'b', and so on until the correct answer is found. Once that occurs, move on to question 2, etc. The former approach, wherein the test-taker guesses every question before it is evaluated, is similar to earlier approaches to syntactic derivation – and once Internal MERGE is factored in, the combinatorial possibilities become problematically astronomical. The latter approach, wherein each question is evaluated per se, is similar to a phase-based approach, and results in the correct 'answers' much quicker.

In theory, LABEL (the administer) could simply 'tell' MERGE (the test-taker) what it wants, or point out all the incorrect answers on a handed-in test (in a line-item veto fashion), but this is likely giving too much credo to the LABEL operation. LABEL is not

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intended to be a homunculus. In the spirit of proper division of labor (Chapter 3), it may be assumed that like MERGE, LABEL is fast and cheap, but not good/smart. Just as MERGE does not know what's going to be labeled, LABEL does not know what's going to be merged. But like the test administer, it does know what's proper when it sees it.

What, then, are the phases, and what happens within them? According to e.g. Chomsky (2000), the phases are CP, v*P (transitive verb phrase) and possibly DP. I will put aside the arguments as to why these three are phases, and simply assume them to be (for information in this regard, see e.g. Citko, 2014). What becomes important, for the purposes here, is the order of operations that occur within a phase. I offer the following as a possibility for the construction of a grammatical phase:

Step 1: MERGE items from lexicon

Assume that all syntactic actions that lead to the construction of interface-interpretable expressions (e.g. phrases and sentences) occur within phases. That is, if the syntactic mechanisms are operating in a constructive manner, then they must be doing so within a phase. Therefore, MERGE only operates within a phase, never without.

Assume as well that MERGE has continuous access to the lexicon during the construction of the phase up until the point that a phase head is merged. This crucially eliminates the need to build an array of to-be-later-merged lexical items, and thus eliminates a redundant operation, namely FETCH from Chapter 3. If MERGE doesn't know or care about what structures are possibly labelable, and LABEL doesn't know what it's going to get in terms of merged structure, there's no reason to postulate that there is some other operation FETCH which *does* know what MERGE needs.

As for the lexicon, it consists of mental objects which represent assembled features. The set of all lexical features for a given language is F. F itself is a group of features that are selected from a larger set $\mathbf{F}$ provided by UG (i.e., $F \subset \mathbf{F}$), presumably during language acquisition. So, for an adult speaker at least, MERGE operates within the confines of a phase directly on lexical items in the lexicon, not F or $\mathbf{F}$. At this point, only External MERGE is active.

Step 2: MERGE a phase head (C, v*, D)

After MERGE operates on some number of lexical items, Step 2 occurs, signaling a stop. MERGE yields to LABEL, which then proceeds.

Step 3: LABEL phase-internal constituents

LABEL examines the structure given to it by MERGE and proceeds according to the rules outlined above (e.g. { H, XP } is given the label H, etc.).

Step 4: TRANSFER labeled constituents to interfaces

At this point, assuming all has gone well, a successful phase is generated.

Take the following example derivation: assume that MERGE is going to operate on the following syntactic objects, {…, Z, A, B, C, D, E }, with A the phase head. Figure 1 below shows how this derivation might look – there are three columns, one to show the operation (either MERGE, LABEL, or TRANSFER), one to show the output of that operation (in terms of sets if the operation is MERGE, and square brackets if the operation is LABEL), and a final column to display the status of the phase itself. The status OPEN means that the phase is proceeding normally. Note that in the ninth row, only the complement of the phase head is transferred, and that the eleventh and twelfth rows represent a new phase beginning.

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Operation	Output	Phase Status
-	-	OPEN
MERGE (D, E)	{ D, E }	OPEN
MERGE (C, { D, E })	{ C, { D, E } }	OPEN
MERGE (B, { C, { D, E } })	{ B, { C, { D, E } } }	OPEN
MERGE (A, { B, { C, { D, E } } })	{ A, { B, { C, { D, E } } } }	OPEN
LABEL { A, { B, { C, { D, E } } } }	{ A, { B, { C, $[_{L1}$ D, E] } } }	OPEN
LABEL { A, { B, { C, $[_{L1}$ D, E] } } }	{ A, { B, $[_{L2}$ C, $[_{L1}$ D, E]] } }	OPEN
LABEL { A, { B, $[_{L2}$ C, $[_{L1}$ D, E]] } }	{ A, $[_{L3}$ B, $[_{L2}$ C, $[_{L1}$ D, E]]] }	OPEN
LABEL { A, $[_{L3}$ B, $[_{L2}$ C, $[_{L1}$ D, E]]] }	$[_{L4}$ A, $[_{L3}$ B, $[_{L2}$ C, $[_{L1}$ D, E]]]]	OPEN
TRANSFER L3-L1	-	CLOSE
-	-	OPEN
MERGE (Z, $[_{L4}$ A, …])	{ Z, $[_{L4}$ A, …] }	OPEN (etc.)

Figure 1

Figure 1 shows only examples of External MERGE and subsequent labeling. But such a derivation is effectively impossible, given that Internal MERGE is ubiquitous in any phase. Where does Internal MERGE come from? The answer has to do with labeling.

4.3 The Phase Statuses ERROR *and* BUFFER

The economics of syntax dictate that two operations such as MERGE and LABEL exist as part of a negotiative exchange-based relationship. Continuing the economic metaphor, MERGE makes an 'offer' of some exchange (i.e., it is willing to give its information to LABEL) which is either 'accepted' or 'rejected'. Figure 1 shows what happens if it is accepted, but what if it is rejected?

Since LABEL is the operation doing the accepting or rejecting, it may be thought of as a dynamic operation. It may be also thought of as a dynamic filter, not only deciding what can or can't be sifted through to TRANSFER, but actively negotiating a change in structure to improve the possibility of success. LABEL, like any operation, has an input (raw merged sets) and an output (labeled sets, or crucially, unlabelable sets). Along with these outputs, I argue that LABEL has return values or statuses akin to a computer-user

interface. If the output is labeled it proceeds normally, but if the output is unlabelable it returns `ERROR`.

Figure 2 below reimagines the derivation with this new complexity. This time, assume a set of syntactic objects, { C, T, EA, v*P }, with C the phase head, v*P the final product of a previous phase, EA an external object, and T the tense node (I put aside questions as to whether C and T are Merged first, but assume that they do in fact share features).

Operation	Output	Phase Status
-	-	OPEN
MERGE (EA, v*P)	{ EA, v*P }	OPEN
MERGE (T, { EA, v*P })	{ T, { EA, v*P } }	OPEN
MERGE (C, { T, { EA, v*P } })	{ C, { T, { EA, v*P } } }	OPEN
LABEL { C, { T, { EA, v*P } } }	?	ERROR

Figure 2

Let us look at this derivation in depth. After the phase begins, External MERGE combines the external argument EA with the v*P (i.e., subject and predicate). The tense node T and complementizer node C are merged respectively. The C node, being the phase head, activates the process of other operations, namely LABEL. LABEL operates on the entire merged set { C, { T, { EA, v*P } } }, attempting first to label the most embedded. { EA, v*P }, however, does not label as these syntactic objects share no relevant labelable features. Thus, the output is undefined, returning a message or status of ERROR.

So what happens at this point? It can be assumed that the derivation does not crash – since subject/predicate combinations are essentially ubiquitous (in some form) in linguistic expressions. Therefore, I mean to say that ERROR and CRASH are different phenomena. To be clear, the system I advocate is one in which MERGE, being both fast and cheap, radically overgenerates. It is likely that most merged structures result in

CRASH. Figure 2 displays a derivation (subject/predicate) which is known to work (i.e., it results in a grammatical sentence), but there is no reason not to think that MERGE might have tried something different first, resulting in a legitimate instance of CRASH:

Operation	Output	Phase Status
-	-	OPEN
MERGE (T, C)	{ T, C }	OPEN
LABEL { T, C }	?	ERROR *CRASH*

Figure 3

It should be noted that crashes can occur during the course of a derivation when there are no recoverable options, as Figure 3 shows, or could occur outside of the derivation during interpretation:

Operation	Output	Phase Status
-	-	OPEN
MERGE (T, CP)	{ T, CP }	OPEN
LABEL { T, CP }	[$_{TP}$ T, CP]	OPEN
TRANSFER [$_{TP}$ T, CP]	-	CLOSE
INTERPRET.SEM [$_{TP}$ T, CP]	?	*CRASH*

Figure 4

In Figure 4, LABEL proceeds as expected because MERGE has provided it with a head and a phrase. LABEL thus chooses the head, and the structure is transferred successfully. But when the semantic or Conceptual-Intentional interface receives the input [$_{TP}$ T, CP], no output can be derived, as [$_{TP}$ T, CP] makes no sense. On the other hand, and perhaps interestingly, a phonological output should in fact be possible, something like *have for him to win*, where *have* is an auxiliary.

In short, errors as defined above are fixable or recoverable, crashes are not. Logically speaking (proceeding from Figure 2), the derivation has two options in order to recover from an instance of ERROR. The first option is to proceed anyway, despite any errors. This kind of error management is common in web browsers – browsers are

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designed to partially render Web pages even if there are errors in the underlying HTML code. Something like this for syntax might be plausible, given that we can in fact generate and interpret many deviant sentences (as the island violations discussed in Chapter 3 show). However, this approach would be problematic in a particular way. For grammatical sentences (as in Figure 2), the derivational mechanism would have to 'decide' in row 5 whether to continue anyway (perhaps labeling { DP, v*P } as 'null' or similar) or attempt to fix the error (which I argue actually happens below). The 'continue anyway' approach could result in a phonological string such as *Will he win the race* ([CP [T will [? [DP he] [v*P win the race]]]]], with '?' the label of DP-v*P) as a declarative, which perhaps would be ruled out at the Conceptual-Intentional interface.

As mentioned, the other option for the derivation is to try to fix the error. I argue that this is indeed what happens, and to continue the comparisons to computing, I argue that something like the following happens. Many computer users of the 1980s and early 1990s were beguiled by the following (unfortunately rather cryptic) error message when using Microsoft DOS:
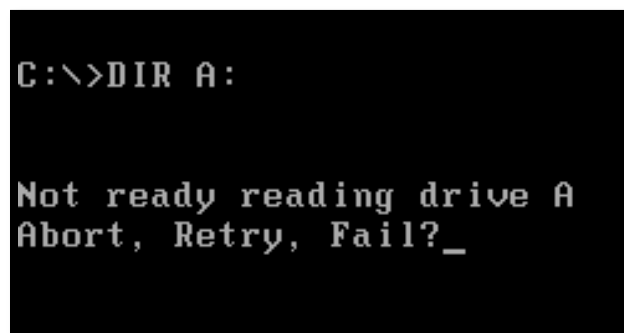

Figure 5

In this particular case, a user is attempting to access drive A: without a floppy disk in the actual drive. Since there is nothing to access, the computer returns the above error

message. This error message stops whatever processes is happening (in this case, the attempt to access A:) and waits for further user input to either correct the error or shut down the process altogether. If the user presses 'a' on the keyboard, the process aborts and returns the user to the command prompt. If the user presses 'r' on the keyboard, the program will retry the previous command. If it had been the case that the user had inserted a floppy disk into A: before pushing 'r', the program will successfully access A:, otherwise the error will appear again[23]. The 'space' wherein the program ceases its attempts to continue after encountering an error and waits for more input from the user might be considered a 'buffer' of sorts – computer programs are designed to anticipate common errors in very specific ways, rather than just give up and crash.

I propose that phases work similarly. When MERGE encounters a phase head, it yields operational priority to LABEL, and ceases access to the lexicon. This occurs while the phase status is OPEN. When LABEL encounters a problem, the phase status switches from OPEN to ERROR. At this point, the derivation's phase status either switches to CRASH, in which case the process ends, or BUFFER, where it will await further input (perhaps both happen, if one wishes to take a quantum approach).

If the phase status is at BUFFER, then the only operation available to make any kind of changes or give any new input is MERGE. The only question is whether or not this second round of MERGE still has access to the lexicon. Assume that it doesn't. If this is the case, then the only kind of MERGE available would be Internal MERGE since the operation would acting upon already-merged sets. A single instance of Internal MERGE may count

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[23] The 'fail' command is somewhat specialized, and effectively identical to 'abort' for common users of DOS during that era (hence the lack of user-friendliness of this famous error message). The differences between it and 'abort' are not important for the metaphor I'm putting forth.

as new input, and LABEL is free to try again. If successful, the phase carries on as normal.
Figure 6 below accounts for this – recall that Chomsky (2013) allows for labeling of EA-
TP as <φ, φ> via the sharing of those features (agreement):

Operation	Output	Phase Status
-	-	OPEN
MERGE (EA, v*P)	{ EA, v*P }	OPEN
MERGE (T, { EA, v*P })	{ T, { EA, v*P } }	OPEN
MERGE (C, { T, { EA, v*P } })	{ C, { T, { EA, v*P } } }	OPEN
LABEL { C, { T, { EA, v*P } } }	?	ERROR
MERGE { C, (EA), { T, { ~~EA~~, v*P } } }	{ C, { EA }, { T, { ~~EA~~, v*P } } }	BUFFER
LABEL { C, { EA }, { T, { ~~EA~~, v*P } } }	[$_{CP}$ C, [$_{<φ, φ>}$ [EA], [$_{TP}$ T, [$_{v*P}$ ~~EA~~, v*P]]]]	OPEN
TRANSFER [$_{CP}$ C, [$_{<φ, φ>}$ [EA], [$_{TP}$ T, [$_{v*P}$ ~~EA~~, v*P]]]]	-	CLOSE

Figure 6

4.4 (Non-)Markovian Memory and Alternative Architecture

Following Chomsky and others, I have so far argued that the operations that make
up the derivation of a sentence occur in phases. In the model I've presented (and as far as
I can tell, all Minimalist models), phases are clearly memory spaces, since they contain a
(temporary) storage of information. But it would appear that phases are accessible only to
the f-mind (see Chapter 2), and that only the outputs of phases are accessible to
consciousness. Thus, from a human's temporally-oriented point of view, it is difficult, if
not impossible, to imagine how a phase might be conceived of in terms of memory.

Most models of memory indeed appear to be inadequate. Long and short term
memory have prima facie no relation to phases. The closest model of memory to phases
may be Baddeley's working memory. Working memory is a temporary store of a set
information that is forgettable. But working memory models rely on visual-spatial and,
crucially, phonological information. For example, a phone number might enter working

memory through constant mental repetition of that number until it is written down or dialed. Obviously, since working memory presupposes access to phonological information, and phases proceed phonological information, phases are not the same as working memory.

The key to understanding the particular quality of phasal memory may lie in entertaining an alternative series of processes, and understanding how that alternative fails. Buffers, as outlined, allow the errors encountered by a derivation to remain inside the phase. Without buffers, the evaluative criteria would have to lie elsewhere. One might argue for a possibility whereby the interfaces themselves act as an evaluator. It may be the case that they do – the example of a properly-labeled but interface incoherent structure, [TP T [CP]], was discussed above. This might work for easily labelable structures, but structures that involve Internal MERGE must be different. If the Conceptual-Intentional interface evaluated and rejected e.g. { C, { T, { EA, v*P } } }, then the phase itself would be over, since TRANSFER has already occurred. Thus, the baseline whereby further possible structures are evaluated with respect to the original merged structure is lost. If the phase and only the phase is a memory space for generating sentences, then phase-internal buffers allow the derivation to 'keep track' of what it tried before. If phases are not the only memory space for derivation, or are to be expanded to include post-TRANSFER interface evaluation, then the very notion of phases requires reevaluation (a possibility not to be totally rejected, but further unexplored here). Importantly, with the advent of the BUFFER status, phases can be said to exhibit both Markovian and non-Markovian properties, both of which are crucial to a unified theory of generative grammar. Markovian processes are generative mechanisms that look at a

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current state and determine the probability of the next state without looking at any other previous states.

Games such as hopscotch and checkers (also called draughts) exhibit Markovian properties. In checkers for example, the squares to which a player is allowed to move his or her piece are determined solely by that piece's current position. In the game shown below (Figure 7), the indicated black piece at (6, 8) can move only to either (5, 7) or (7, 7):
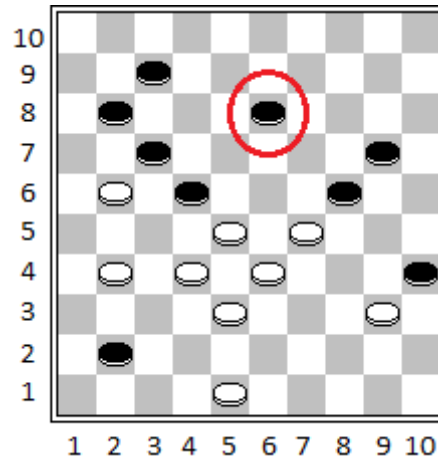
Figure 7

The legality of these moves, or rather, the probability that (5, 7) or (7, 7) is selected, is not determined by that piece's previous moves. In other words, checkers does not have some rule stating that if the piece had previously occupied (5, 9) that only (7, 7) could be selected. The only thing that matters is the piece's current square.

The fact that it is impossible to tell exactly where the piece at (6, 8) originated from (the possibilities are (4, 10), (6, 10), or (8, 10)) shows an important quality of Markovian processes: memorylessness. The player can 'forget' all previous moves up to that point, since he or she only needs to focus on the active squares. Similarly, phases are

theorized to have this property as a way to reduce the computational burden on the generative system. Recall from Chapter 2 that in earlier versions of generative grammar, a dual cycle exists whereby entire Deep Structures are created first, upon which transformations apply to create Surface Structures. Phases allow for a single cycle derivation – after each phase is created, it can be immediately 'forgotten' by the computational system.

Thus, it would be expected that phases *themselves* exhibit Markovian properties. This seems to be the case. Any given phase (namely, v*P and CP) appears to determine what the next phase will be[24]. For example, if a v*P phase is generated and sent to the interfaces, the computational system knows that the next phase *must* be CP. From that point, the computational system uses the CP state to determine the next phase (another v*P)[25]. If this were *not* the case, the computational system could look backward and use the earlier v*P to determine the next phase, creating an erroneous { CP, CP, v*P }. Thus, structures like { CP, CP, v*P } are ruled out automatically.

Conversely, intra-phasal generative capabilities must be non-Markovian. As I mentioned earlier as well (Chapter 2), movement or Internal MERGE was an early motivation by Chomsky (1955; 1957) to reject Markovian models of language generation (such as Turing machines). This is because the derivation has to 'remember' what has been merged before in order to move a component. Buffers, then, allow for non-Markovian sequences within the phase, while also allowing for Markovian sequences between phases. By using a buffer, the derivation can keep track of what has happened,

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[24] DP, if a phase, does not fit this model.
[25] The transitional probability between states in this case is 1.

utilize Internal MERGE appropriately, and separate errors (which are temporary and can be resolved) from crashes (which are critical and end the derivation).

4.5 The Grammaticalization Component

Let us return to Figure 6. Here, the ERROR status is resolved through an instance of Internal MERGE during BUFFER which results in a labelable structure, <φ, φ>. The movement is possible because the internal capabilities of phases are non-Markovian and can thus 'remember' what aspect(s) of the derivation didn't work and thus alter the derivation accordingly. The label <φ, φ> is possible through agreement of φ-features on DP and TP, thus ending BUFFER and allowing the phase to continue normally. This approach applies to a developed grammar, i.e., the steady-state native generative grammar of an adult speaker of a language. But what happens if a developing grammar, i.e., the grammar(s) of a child between initial state (UG) and steady-state, encounters errors? Hypothetically speaking, encountering an error could be devastatingly problematic. If a developing grammar had, say, access to Internal MERGE but not to AGREE (being necessary to 'freeze' cyclical instances of Internal MERGE), there'd be no way to Spell Out certain structures – BUFFER would repeat indefinitely because there'd be no way to label <φ, φ>.

I argue that children do in fact have strategies to deal with errors – in a developing grammar, access to the lexicon and its features must be more robust, allowing the altering of the structure of the developing grammar itself. The result of this alteration is the outwardly-visible phenomenon of grammaticalization.

The typical approaches of grammaticalization have developed along paths separate from Minimalism. The latter has typically been dominated by formal/theoretical

researchers, and while the former has been typically dominated by functionalist linguists. But over the last several decades, starting with Lightfoot (1979), many researchers working within generative grammar have successfully adopted their theoretical methods to language change generally and further to the phenomena of grammaticalization, and vice versa (more recent works include e.g. van Gelderen, 2004; 2011; Roberts, 2007; Roberts and Rossou, 2003; among others).

One important account for grammaticalization in the generative literature comes from van Gelderen (2004). She introduces the Head Preference Principle (HPP, p. 18), which states (within an X-bar-theoretic context) that full phrases (i.e., specifiers of any given phrase XP) over time turn into heads. This is due to principles of economy, assuming that syntax 'prefers' simple structures over complex ones for their own sake[26]. For example, demonstratives, which are often thought to occupy the position SpecDP, may grammaticalize into definite articles (D heads) over time. This is probably what happened with full phrase demonstratives like the Latin *ille* and Old Slavonic *tŭ*, which became Italian *il* and Macedonian *-ot*, respectively (among others).

```
              DP
           /      \
        ille       D'
                 /    \
                D      …
                il
```

---
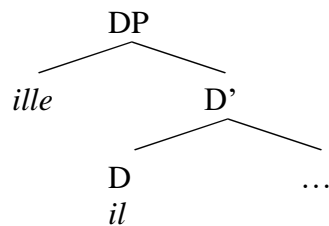
[26] This notion of economy differs slightly from the economic viewpoint I've espoused so far. In short, as long as the syntactic system is working, it is behaving as an economy. Grammaticalization offers a 'cheaper' solution, which the system will take if it has the chance. Thus, grammaticalized structures are more economical.

```
            DP
          /    \
        tŭ      D'
              /    \
             D      …
            -ot
```
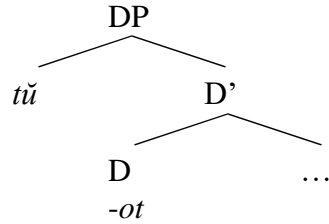
Van Gelderen (2013) updates the HPP by putting it into the labeling framework of Chomsky (2013). Here, she argues that full phrases are re-analyzed as heads in order to deal with difficult structures of the type { XP, YP }. For example, in a labeling approach which forsakes trees and bar-levels, a demonstrative-noun structure is probably merged as something like { DemP, NP }, where DemP is a full-phrase demonstrative. This is ordinarily fine, as DemP and NP may agree in some relevant feature (i.e. number), and { DemP, NP } becomes labelable, similar to <φ, φ> labeling { DP, TP }. But if a child's grammar lacks this strategy, i.e. it does not 'know' about agreement, it may be most beneficial for the generative system to simply assume that DemP is not a full phrase at all, but is rather a head (D). This way, the re-analyzed { D, NP } structure labels easily (as D)[27].

So, to recap, I earlier claimed that a typical derivation will likely encounter an error at some point, thereby triggering the BUFFER status that allows for a repair of the structure. Doing so, LABEL yields back to MERGE, which no longer has access to the lexicon, and is restricted to Internal MERGE only. For the child's grammar, the BUFFER status again proves useful – when LABEL yields back to MERGE, MERGE is *not* restricted to being Internal only, but can also be External. The lexicon provides MERGE with a novel

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[27] A 'chicken and the egg' problem exists here. Under my 'chicken' account, DemP must be reduced to D to account for labeling problems. Under an alternative 'egg' account, DemP reduces to D for some other reason (functionalists might argue overuse), naturally giving rise to DP. Since both accounts result in successful labeling, I assume the account that has the least intervening factors.

but similar reconstituted item from the feature set *F* to attempt to pass the labeling

criteria. If successful, that item has the potential to solidify within the child's grammar.

Thus, we are left not only with an account of why the child's grammar would reassess

and change the lexicon (labeling difficulty), but how that action dovetails with the

generative/syntactic mechanism in real-time. Furthermore, we have an account of why

the adult's grammar does *not* re-access the lexicon and grammaticalize items. Since the

lexicon is clearly accessible to adults, the postulation of a space (BUFFER) which allows

the lexicon to be accessed *in a particular way* helps demarcate adult and child grammar. I

conclude with two operational declensions for merging { DemP, NP }, Figure 8 for the

adult, and Figure 9 for the child. Since the status of D as a phase head is debatable

(Chomsky, in press), assume F_{Nmax} to be the maximal functional head of the N 'spine', a

phase head[28]. The ellipses (…) in row 1 indicate that the phase is not opening from

scratch, as it would be after v*P, but that has been MERGE has been operating for some

time to create NP (I put aside the problem of how NP itself is labeled).

Operation	Output	Phase Status	Lexicon Status
…	…	OPEN	OPEN
MERGE (DemP, NP)	{ DemP, NP }	OPEN	OPEN
MERGE (F_{Nmax}, { DemP, NP })	{ F_{Nmax}, { DemP, NP } }	OPEN	CLOSE
LABEL { F_{Nmax}, { DemP, NP } }	$[_{FNmaxP} F_{Nmax} [_{<\varphi, \varphi>} DemP, NP]]$	OPEN	CLOSE
TRANSFER $[_{FNmaxP} F_{Nmax} [_{<\varphi, \varphi>} DemP, NP]]$	-	CLOSE	CLOSE

Figure 8

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[28] Whether or not F_{Nmax} is D has some consequence for a Spec-head analysis à la (3) of this chapter and (3a) and (3b) of Chapter 1. That analysis would assume a linear sequence Dem – D – NP, where only Dem or D can be filled. A non-Specifier approach (e.g. labeling) would assume D (= F_{Nmax}) – Dem – NP, since the merging of a phase head *last* would be needed to activate LABEL. Interestingly, the string *the that one* seems less ungrammatical than *that the one*, and may provide some clue as to the actual sequence.

Operation	Output	Phase Status	Lexicon Status
…	…	OPEN	OPEN
MERGE (DemP, NP)	{ DemP, NP }	OPEN	OPEN
MERGE (F$_{Nmax}$, { DemP, NP })	{ F$_{Nmax}$, { DemP, NP } }	OPEN	OPEN
LABEL { F$_{Nmax}$, { DemP, NP } }	?	ERROR	CLOSE
MERGE { F$_{Nmax}$, (D, NP) }	{ F$_{Nmax}$, { D, NP } }	BUFFER	OPEN
LABEL { F$_{Nmax}$, { D, NP } }	[$_{FNmaxP}$ F$_{Nmax}$ [$_D$ D, NP]]	OPEN	CLOSE
TRANSFER [$_{FNmaxP}$ F$_{Nmax}$ [$_D$ D, NP]]	-	CLOSE	CLOSE

Figure 9

CHAPTER 5

LABELING { H, H }

5.1 Introduction

So far, I've argued that the syntactic operations MERGE and LABEL exist in a

(laissez-faire/classically liberal) economic relationship: both operations are modular and

function-specific, and both 'negotiate' with each other pursuant to their own 'self-

interests'. This so-called negotiation typically comes in the form of Internal MERGE, a

reshuffling of previously-merged sets that satisfies the conditions demanded by MERGE.

Occasionally, for children, a 'cheaper' (e.g. more economical) solution

(grammaticalization) can be found to labeling conditions.

The marketplace of this economic exchange is the phase with its special statuses

ERROR and BUFFER. In the previous chapter I argued how these two statuses collude to

produce grammatical strings. I also briefly mentioned a solution to { XP, YP } that a

grammaticalizing child might employ, namely, change XP to X. In this chapter,

borrowing heavily from LaBarge (2016), I show a similar solution to the problem { H, H

} looking at the history of Chinese.

Over the course of more than two thousand years, new uses of the Chinese word

要 *yāo*/*yào*[29] have emerged as the result of grammaticalization. Early uses of the word

were as a full verb with multiple meanings involving semantic notions of COMPULSION

and VOLITION, while more recent uses include that of an auxiliary modal indicating

future time. (1) and (2) show examples along this cline, while (3) shows that the full verb

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[29] I use *pinyin* as to transliterate the word 要 out of convenience, but naturally the Modern Mandarin
pronunciation is not the same as the classical pronunciation. See e.g. Ulving (1997). I use the first tone *yāo*
for the classical full verb, the fourth tone *yào* for the grammaticalized form and modern full verb.

usage is being 'renewed' or 'reinforced' by a new lexical item. This is evidence for the

presence of cyclical change (as in van Gelderen, 2009; 2011):

Archaic Chinese (ca. 350 B.C.E)

(1)   非 … 要   譽…

　　　fēi　　*yāo*　　*yù*

　　　not want fame

　　　'[A man may] not want/seek fame…' (孟子 *Mèngzǐ*, 公孫丑上 Gōngsūn Chǒu

　　　Part 1, Ch. 6).

 Modern Mandarin

(2)   明天,   我   要   去   中國

　　　míngtiān　　*wǒ*　　*yào*　　*qù*　　*Zhōngguó*

　　　tomorrow   I   will   go   China

　　　'Tomorrow, I will go to China'.

(3)   我   想要   去   中國

　　　wǒ　　*xiǎngyào*　　*qù*　　*Zhōngguó*

　　　I would like go China

　　　'I would like/want to go to China'.

The grammaticalization of 要 *yào* appears to be similar to the historical path of the

English word *will*, which has itself been studied in considerable depth (Visser, 1969;

Aijmer, 1985; among many others). The English examples below show a similar cline of

grammaticalization and cyclical change:

Old English (ca. 700-1000 C.E)

(4)   *Will-e   ic   asecgan…*

         Want-1S   I   say-INF

         'I want to say…' (*Beowulf*, line 344).

Modern English

(5)   a. *I will say…*

         b. **I will to say…*

(6)   a. *I want to say…*

         b. *I wanna say…*

In (4), *will* shows agreement with its subject *ic* (first-person singular) and takes

the non-finite complement clause *āsecgān*, evidence that it is a true matrix full verb

(Aijmer, 1985, p. 12). In (5a), *will* has no affixes and no agreement with its subject, and

also does not force a non-finite subordinate reading of the verb *say*, as in the

ungrammatical (5b). Hence, it is a modal auxiliary instead of a verb. A new verb (*want*)

has come to take the place of the old *will* (6a), but it too is beginning to grammaticalize

(6b). Given this evidence, both English and Chinese are displaying instances of the future

cycle (van Gelderen, 2011).

But unlike *will* in Modern English, 要 *yào* in Modern Mandarin can be used either

as a full verb or as a modal auxiliary (Li and Thompson, 1981, p. 174). Although a

widely-observed phenomenon in other languages (Traugott, 1989, p. 33), this has led to

controversy among grammarians and linguists regarding the actual syntactic status of 要

yào, some of whom consider it to be an adverb (Li and Thompson, 1981, p. 174-176). It

is the goal of this chapter to show that the modern variable uses of 要 *yào* and their

connection with the ancient uses are not at all idiosyncratic – like *will* and other verbs turned modals (Haegeman, 1983; Kratzer, 1977; Sarkar, 1998), there is an underlying account unifying each usage. And these usages do, in fact, have a principled account as predicted not only by the cycle framework of formal grammaticalization theory, but by the POP/errors and buffers account. The syntactic upshot, then, means that for Modern Mandarin 要 *yào*, the current future time modal reading places it in the head of the Mood Phrase, having grammaticalized to this position from the VP (in Archaic Chinese) via the Aspect Phrase (as a deontic in Ancient Chinese):

(7)
```
                       MP
             ┌─────────┴─────────┐
             M                  AspP
      要 yào = future    ┌────────┴────────┐
                        Asp               VP
                 要 yào = deontic    ┌─────┴─────┐
                                    V           …
                             要 yāo = full verb
```
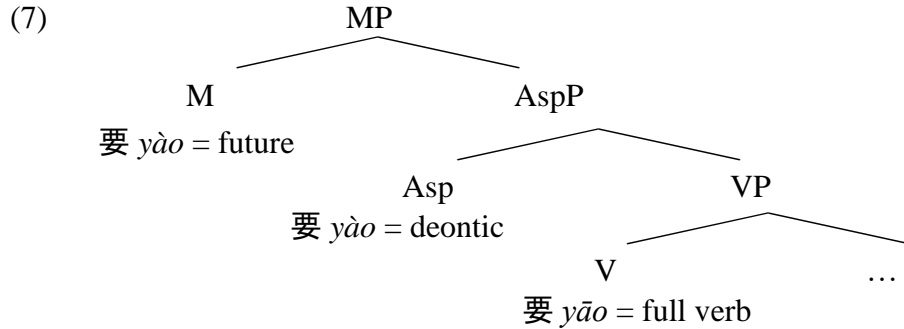
The forms of (7) still exist in Modern Mandarin, but in many cases new multisyllabic variants have appeared with a disambiguating role:

(8)
```
                       MP
             ┌─────────┴─────────┐
             M                  AspP
      要 yào = future      ┌──────┴──────┐
                         Asp            VP
                須要 xūyào = deontic  ┌────┴────┐
                                   V          …
                 想要 xiǎngyào or 要 yào = full verb ('want')
```
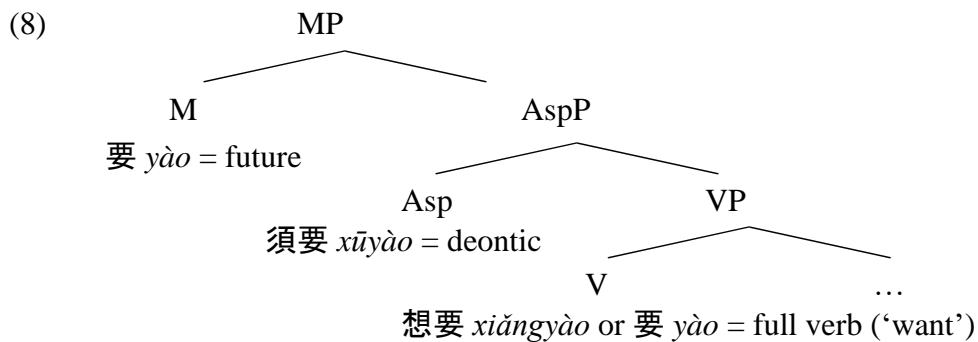
The paper proceeds following the diachrony of 要 *yāo/yào*: Section 2 briefly covers its verbal history throughout the Archaic period (texts range from ca. 475 B.C.E. –

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350 B.C.E), noting that the different meanings of the word during this time can be reduced to a common semantics, either VOLITION or COMPULSION. This, I argue, invites subsequent meaning change and modal usage as in Traugott (1989). Section 3 analyzes the period of 要 *yào*'s transition into deontic and future modal auxiliaries (in the sense of Palmer, 2001, p. 8-9), presenting evidence from texts in Ancient Chinese (ranging from ca. 100 C.E. – 200 C.E). I discuss the grammaticalizing concept of Late MERGE (van Gelderen, 2004, p. 28), and propose a way by which it may have led to the reanalysis of 要 *yào* into an auxiliary, namely an errors and buffers reanalysis of { H, H }.

5.2 要 Yāo *as a Full Verb in Archaic Chinese*

In this section, I analyze the syntactic and semantic status of 要 *yāo* (cf. fn. 29) in the Archaic period of Chinese. Texts from this time show that 要 *yāo* functions as a verb with a fully-developed argument structure, and has multiple but related meanings, including: 'meet', 'desire/seek', 'compel/force', 'subdue/agree', and 'submit' . I present examples of each below, noting that what unites them are underlying notions of COMPULSION and VOLITION, and that these meanings set the stage for the grammaticalization of the verbal usage into the modal auxiliary usage (Lightfoot, 1979; Bybee and Pagliuca, 1987, p. 109-111; cf. fn. 4).

Perhaps the earliest instance of 要 *yāo* comes from a line in the 詩經 *Shī Jīng* (sometimes called *The Book of Songs*, or *The Classic of Poetry* in English), which is among the oldest of Chinese texts. Here, 要 *yāo* requires an Object (我 *wǒ*, 'I/me'), but allows *pro*-drop in the subject position:

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Archaic Chinese (1046 B.C.E. - 771 B.C.E)

(9) 要   我   乎   上   宮,   送   我   乎   淇   之   上

yāo *wǒ* *yú* *shàng* *gōng* *sòng* *wǒ* *yú* *qí* *zhī* *shàng*

meet me PREP Shang Gong deliver me PREP Qi POSS top

矣

yǐ

PART

'[She will] meet me in Shanggong and accompany me to the mouth of the river

Qi' (詩經 Shī Jīng, 桑中 "Sāng Zhōng", stanza 1, line 3).

The meaning of 要 *yāo* in (9) is that of 'meet' with the intention of performing some

subsequent action, in this case, two lovers meeting and eloping or running away together.

This is expected, given that Bybee and Pagliuca (1987, p. 109) list verbs of movement

along with verbs of desire and obligation (what I have called COMPULSION and

VOLITION) as the most common potential source for future time markers. Perhaps by

extension, 要 *yāo* in this case may be thought of as belonging to all three categories. But

any notion of 'meeting' and subsequent movement (which may be bundled with

VOLITION), or any physical action at all for that matter, is subsumed by

COMPULSION in later uses several centuries later. (10) appears in the 論語 *Lúnyǔ*, or

Confucian *Analects*, a series of aphorisms attributed to China's great teacher and

collected by his disciples:

Archaic Chinese (ca. 475 B.C. – 221 B.C)

(10) 雖   曰   [*pro*] 不   要   君   吾   不   信   也

 suī   *yuē*   [*pro*]   *bù*   *yāo*   *jūn*   *wú*   *bù*   *xìn*   *yě*

though   said   [*pro*]   not   force   lord   I   not   believe   PART

'Although it may be said that [Zang Wu Zhong] did not force his lord, I don't

believe this' (論語 *Lúnyǔ*, 憲問 "Xiàn Wèn" chapter, paragraph 14).

The COMPULSION semantics here can be seen in larger context in which (10)

was written. Here, Confucius is chastising the actions of a certain minister Zang Wu

Zhong for asking his lord to do something on that minister's behalf. Zang Wu Zhong is

not physically forcing his lord to complete an action, but is rather 'putting him in an

awkward position', where the lord feels some pressure or compulsion to satisfy Zang Wu

Zhong's request, but under ordinary circumstances shouldn't have been asked at all.

The COMPULSION semantics continues with what might be considered 要 *yāo*'s

most recognizable meaning, 'to desire', 'to seek', or 'to want', which is probably directly

derivable from (10). Example (11) is an expanded version of (4), and is from the 孟子

Mèngzǐ, or *Mencius*, the eponymous text of another important philosopher in China's

Confucian tradition. In the larger context, Mencius notes that human behavior is

inherently good, as a man who sees a child about to fall into a well will, without thought

for himself or toward his possible fame for doing so, grab the child before it's too late:

Archaic Chinese (ca. 350 B.C.E)

(11) 非   所   以   [*pro*] 要   譽   於   鄉   黨

fēi   *suǒ* *yǐ*   [*pro*] *yāo* *yù*   *yú*   *xiǎng*   *dǎng*

not   PART PART [*pro*] want   fame PREP country   fellows

朋   友   也

péng *yǒu* *yě*

friend friend PART

'This [action to save a child from imminent danger] is not a means by which a man [would] seek fame from his fellow countrymen and friends' (孟子 *Mèngzǐ*, 公孫丑上 Gōngsūn Chǒu Part 1, Ch. 6).

The difference between (10) and (11) then, is that in (10), the subject is causing the object to experience compulsion (putting his lord in a position where he feels forced), whereas in (11), the subject himself is experiencing compulsion (i.e., the type of desire that comes from the thought of receiving fame or praise for one's actions).

(12) below appears to be derived from the 'meet' or 'seek' meanings above, and seems again to have an underlying semantics of COMPULSION. That is, 要 *yāo* here does not mean 'agreement' in the common English sense of two people having the same opinion on a particular matter in an equal relationship, but rather is closer to a plea agreement or plea bargain between two parties:

Archaic Chinese (ca. 389 B.C.E)

(12)

使	季	路	要	我	吾	無	盟	矣
shǐ	*Jì*	*Lù*	*yāo*	*wǒ*	*wú*	*wú*	*méng*	*yǐ*
send	Ji	Lu	accord	me	I	no	covenant	PART

"Send Ji Lu to accord [with] me, I have no covenant" (左傳 *Zuǒ Zhuàn*, Book 12, 哀公 Āi Gōng Year 14).

In this section, I've provided evidence that the Archaic Chinese verb 要 *yāo* has multiple meanings. Though mostly used contemporaneously, the oldest meaning is likely to be that of 'meet', which appears to have both COMPULSION and VOLITION semantics. As the underlying semantics changes from VOLITION to COMPULSION, other versions of 要 *yāo* appear, including 'force', 'desire', 'subdue', and 'submit'. Important is the fact that the early verbal uses of 要 *yāo* contain argument structure, and are all related despite their polysemy. VOLITION and COMPULSION semantics end up setting the stage for 要 *yāo*'s appearance as a modal auxiliary during the Ancient period.

5.3 要 Yào *as a Modal Auxiliary in Ancient Chinese*

5.3.1 Deontics and Futures

Section 2 argued that the early meanings of 要 *yāo* included semantic notions such as VOLITION and COMPULSION. In this section, I appeal to the notion of Late MERGE (van Gelderen, 2004) to explain why 要 *yāo* in turn grammaticalizes into an auxiliary position (first as a deontic and then as a future), becoming 要 *yào* and taking a VP as its complement. I begin by discussing the qualities of the various early modal

instantiations of 要 *yào* before I give possible accounts for the motivation behind its structural change.

The first auxiliary uses of 要 *yào* appear in the Ancient period, around the second century C.E. As expected (cf. Bybee and Pagliuca, 1985; Shepherd, 1982; Traugott, 1989), they begin as deontic modals, indicating "the necessity or possibility of acts performed by morally responsible agents" (Lyons, 1977, p. 823) and (crucially) lacking argumenthood. More specifically, the earliest classes of modal auxiliaries have a meaning akin to 'you are required to X', as explicated by Traugott (1989, p. 36) and Lyons (1982, p. 109). Haegeman (1983, p. 105) defines similar modals as being rooted in "external initiation", where "the decision [to act] is prompted by the situation and is a response to a request, offer, invitation, etc. from the interlocutor". Following Palmer (2001, p. 81), we may call the structure in (13) hortative or jussive (as special types of imperatives), or possibly even optative (Bybee, 1985, p. 171):

Ancient Chinese (111 C. E.)

(13) 要　　以　　俱　　　　死　　立　　信

　　　yào　*yǐ*　*jù*　　　　*sǐ*　*lì*　*xìn*

　　　must　PART　accompany　　death　stand　faith

'It is imperative that you [risk] death with us for the sake of good faith' (漢書 *Hàn Shū*, 張耳陳 餘傳 "Zhāng Ěr Chén Yú Zhuàn" Chapter, Section 36; translation by Dobson, 1974, p. 804).

Shortly after, around the third century C.E., another deontic modal usage appears, with a meaning of 'I require you to X', or in this case, 'I require myself to X' (Traugott,

1989, p. 36; Lyons, 1982, p. 109). Examples (14) and (15), then, may be labeled injunctive (cf. Beekes, 1995, p. 245) in that they represent a speaker imploring himself towards a particular action (cf. the 'internal initiation' of Haegeman, 1983, p. 105), and also correspond to Bybee's (1985, p. 171) category of volitional mood markers. These examples are still spurred by external pressure, but the ultimate decision to act comes from the speaker:

Ancient Chinese (ca. 200 – 300 C. E)

(14) 我   要   自   當   以   信   義   待   人

      wǒ   *yào*   *zì*   *dāng* *yǐ*   *xìn*   *yì*   *dāi*   *rén*

      I   must   self   act   PART   faith   righteousness treat   man

      'I must deal with this myself and treat others with good faith' (三國志 *Sān Guó*
      Zhì, 魏書 "Wèi Shū" Chapter, Section 28; translation by Dobson, 1974, p. 804).

(15) 吾   要   當   立   效   以   報   曹   公   乃   去

      wú   *yào*   *dāng* *lì*   *xiào* *yǐ*   *bào*   *Cáo*   *gōng* *nǎi*   *qù*

      I   must   do   stand   effect PART   requite Cao   lord   so   left

      'I had to do something of merit in order to requite the Lord of Cao and so I left'
      (三國志 *Sān Guó Zhì*, 蜀書 "Shǔ Shū" Chapter, Section 36; translation by
      Dobson, 1974, p. 804).

(16) below appears in the same text as (13) above, a century before (14) and (15), and may in fact be interpreted in a number of ways :

Ancient Chinese (111 C. E)

(16)   人　　生　　要　　死　　何　　為　　苦　　心

     rén　*shēng*　*yào*　*sǐ*　*hé*　*wéi*　*kǔ*　*xīn*

     man　born　will　die　why　PART　pain　heart

     'All men, being born, must/will die. Why should this pain my heart?' (漢書 Hàn

     Shū, 武五子傳 "Wǔ Wǔ Zǐ Zhuàn" Chapter, Section 31).

     (16) is ambiguous, particularly given the context in which it appears. Here, a

protagonist is facing execution, which spurs him to write a poem lamenting his fate.

Since his execution is obligatory (i.e., deemed by law), 要 *yào* could be seen as deontic,

in which case the translation might be rendered as 'A man [in such a situation, facing

imminent execution], being born, must die. Why should this pain my heart?' Being

honor- or duty-bound, he may be seeking solace in the fact that he can accept his fate as

determined by the law. Likewise, 要 *yào* may be epistemic, referring to a "piece of

knowledge or information" (Kratzer, 1977, p. 338). In this sense, the protagonist knows,

from experience or rational conclusion, that "all men, being born, must die…"

     The data presented so far are summarized in Table 1 below. 要 *Yāo/yào* has

changed from a semantics of VOLITION to a semantics of COMPULSION (meaning

that the deontic quality of 要 *yāo/yào* started early, even in the fully verbal uses). The

COMPULSION semantics is fully entrenched by the time the modal usage arises, which

also establishes 要 *yào* as an auxiliary (lacking argument structure). This change from

verb to modal auxiliary, which is the only real instance of grammaticalization presented

so far, is delineated via shading. The final column displays the approximate date of emergence for each particular form:

Form	Meaning	Class	Semantics	Arguments?	Emergence
要 *yāo* 'meet'		full verb	VOLITION	Yes	ca. 1046 BCE
要 *yāo* 'desire', etc.		full verb	COMPULSION	Yes	ca. 475 BCE
要 *yào* '[you] must'		deontic (hortative)	COMPULSION	No	ca. 111 CE
要 *yào* '[I] must'		deontic (injunctive)	COMPULSION	No	ca. 200 CE

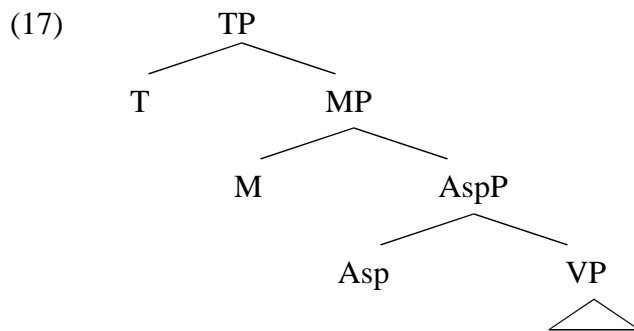*5.3.2 Forming Auxiliary Modals from Full Verbs*

      I have argued so far that the Archaic Chinese full verb 要 *yāo* grammaticalized into a modal auxiliary during the Ancient period several centuries later. I have also argued that in this sense, 要 *yāo* has followed a path similar to that of certain full verbs in (Old) English, such as will in example (1). This phenomenon, of full verbs becoming modal auxiliaries, has been investigated in depth by a number of previous researchers (Aijmer, 1985; Bybee and Pagliuca, 1987; van Gelderen, 1993; Haegeman, 1983; Lightfoot, 1979; Traugott, 1989; Visser, 1969; among many others). One question, of course, is how the leap from full verb to auxiliary modal is made. Below, I investigate the cartography of the auxiliary layer and propose a method by which 要 *yāo/yào* enters this layer.

 5.3.2.1 AspP and MP

      I argue that the auxiliary layer should be split into three phrases TP, MP, and AspP. Evidence "comes from the possibility of adverbials in the specifiers of [those positions]" (van Gelderen, 2004, p. 159), and is argued in-depth by Cinque (1999). Other

authors such as Boye (2012, p. 221) propose a universal ordering of CP – MP – TP and

he notes (p. 226) that Bybee has proposed a similar ordering: MP – TP – AspP.

Compelling evidence is provided by van Gelderen (2004), however, that the ordering of

these elements is in fact TP – MP – AspP (pp. 155-178), and with respect to modals,

argues that "deontics are lower in the tree, i.e. connected to Asp, and epistemics are

higher, i.e. in a category between T and Asp [namely M]", which "suggests that elements

'climb' higher up in the tree as they grammaticalize" (p. 157). A tree structure showing

this general ordering is given in (17) below:

(17)

```
              TP
          ┌────┴────┐
          T         MP
               ┌─────┴─────┐
               M          AspP
                      ┌─────┴─────┐
                     Asp          VP
                                 /──\
```

Since AspP is projected immediately above VP, we might assume that this is

where the deontics of (14)-(16) are housed. That Aspect might be connected to (deontic)

modals might at first seem curious, but van Gelderen makes two points. The first is that

> "deontics [in English] originate historically as perfect, i.e. stative, verbs (can
>
> means 'to know', motan [i.e., must] 'to have measured', and the non-preterite-
>
> present will is originally 'to want') and express that original unboundedness
>
> through being in Asp. So when modals occur in Asp, the main verb cannot be
>
> stative. With a stative verb, the unboundedness must be expressed by checking
>
> Asp or by have/be in Asp" (p. 163).

Her examples ((12) and (13), p. 162) appear below as (18) – in the first example, must/may appears in Asp and read in V, in the second example, be attempts to check features by moving to Asp, but is blocked by must/may in that position:

Modern English

(18) a. *He must/may read that letter*.

i.e. Someone forces/allows him to read that letter (deontic reading/eventive verb).

b. *#An orange must/may be healthy*.

i.e. Someone forces/allows an orange to be healthy (deontic reading/stative verb).

Aside from the historical connection between Aspect and deontic modals, as well as the inability for deontics to take stative verbs as complements, van Gelderen points out that deontic modals in English cannot take perfect or progressive auxiliaries as their complements (because they base-generate in the same position, Asp), while epistemic modals can, being base-generated in M (her examples, p. 161):

Modern English

(19) a. **I can have read that book*. (deontic and perfective)

b. **I can be swimming*. (deontic and progressive)

(20) a. *He must have read that letter*. (epistemic and perfective)

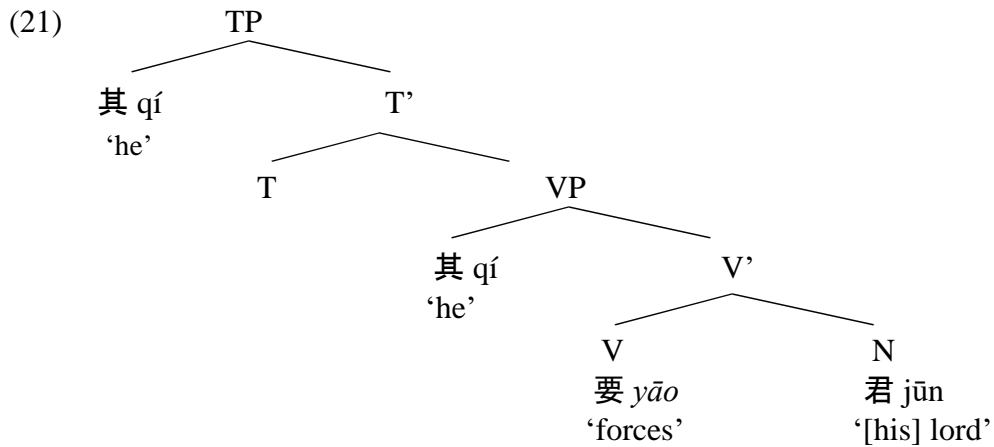b. *He must be looking for that letter*. (epistemic and progressive)

Like van Gelderen, I will assume the 要 *yào* of (13)-(15) is deontic and thus occupies the head of the AspP. Later instances of 要 *yào* (i.e. in Modern Chinese) are more clearly future, similar in some ways to epistemics, and so fit in M. This works

nicely because, to recap, we have a diachronic model for 要 *yāo/yào* moving 'up the tree'

one step at a time, from V to Asp to M.

5.4 Late MERGE and Labeling

Now that we have a model to describe the cartography of auxiliary positions

above V, and thus can provide stopping points for the upwards grammaticalization of

certain auxiliaries, we must ask how such movement could be motivated to begin with.

To help solve this problem, I utilize the concept of Late MERGE developed in van

Gelderen (2004, p. 18) combined with an errors and buffers approach.

Consider (21) below. This example repeats (10), but uses a third-person personal

pronoun instead of *pro* for clarity. The meaning is 'he forces [his] lord':

(21)

```
                         TP
                    ┌─────┴──────┐
                 其 qí          T'
                 'he'       ┌────┴─────┐
                            T          VP
                                   ┌───┴────┐
                                其 qí        V'
                                'he'     ┌───┴────┐
                                         V         N
                                      要 yāo     君 jūn
                                     'forces'   '[his] lord'
```

Since in the Spell-Out form of (21) the Subject has moved the Spec of TP, 要 *yāo* could

theoretically occupy either V or T (or M or Asp) and yield identical surface structures.

This fact must pose some parsing difficulties for the acquirer of a language, who receives

only the surface structure as evidence, and doesn't know if a) 要 *yāo* is generated in V

and stays there, b) 要 *yāo* is generated in V and moves to a higher head, or c) 要 *yāo* is

base-generated in a higher position. If the acquirer assumes the final hypothesis, then we have an instance of Late Merge, and 要 *yāo* successfully grammaticalizes.

But what might be the origin of the change that leads to this confusion? There are a number of possibilities. The first is with regards to c(omplement)-selection (à la Grimshaw, 1979). If the c-selection abilities of a given verb are expanded beyond (human or non-human) nouns to propositions as a whole, then the structure Subject-Verb1-(*PRO*)-Verb2 may arise, as in (1)'s '*Wille ic asecgan*'. In order for 要 *yāo* to begin to take propositional/verbal arguments, its c-selection would not have necessarily needed to change (from taking N to V), but simply become underspecified (taking either N or V), and 要 *yāo* would begin to appear in V1-V2 concatenated structures. Further, if 要 *yāo* lost its ability to mark subjects as well, then the language acquirer has evidence that 要 *yāo* should in fact be in the first auxiliary position (Asp) and V2 in the matrix verb position V1. Hence, S-V1-V2 becomes S-Asp-V1.

The 'promotion' of a full verb to an auxiliary could be the consequence of labeling difficulties, as outlined in Chomsky (2013, 2014) and in the chapters above. Late MERGE follows naturally from the labeling difficulties of the type {H, H}. If structures of the type S-V1-V2 emerge naturally from the underspecification of the c-selection features of 要 *yāo*, the higher verb (要 *yāo*) must 'move' in order to allow labeling to proceed. Since the next highest phrase is AspP, 要 *yāo* begins to occupy this position, and the auxiliary is formed.

A curious question, however, is how 要 *yāo* actually becomes an auxiliary. Under the labeling account, 要 *yāo* as a head moves out of { H, H }, but it would still be a verb.

For example, being that the labeling algorithm cannot label the structure { EA, v*P }, EA moves to a new position (left of T), but does not itself cease to be a DP. Perhaps heads are special, and 要 *yāo* somehow 'receives' auxiliary qualities by being in an auxiliary position.

I propose, as a solution to this problem, an errors and buffers account of what is outwardly viewed as Late MERGE. Recall that the phase status BUFFER allows MERGE a chance to rearrange a generated string in order to satisfy conditions imposed by LABEL. In the case of a child's grammar, the lexicon at this point remains open for reassessment. This is probably the case in the { H, H } structure discussed. The difference this structure presents, however, is the fact that both heads have the potential to be phase heads. In fact, if they are both phase heads, then their concatenation as V1-V2 poses no difficulty, as labeling would occur in the respective phases separately. But clearly, something else is happening.

Earlier, I suggested that V1-V2 concatenation in this Chinese case may be due to the expanding c-selection of V1. This may explain why the set { V1, V2 } is formable by MERGE but it does not directly explain the emergence of M-V as a grammaticalized alternative. I will explain how M-V might arise through an in-depth operational declension (really a reconstructed interpretive declension) with commentary:

Operation	Output	Phase Status
-	-	OPEN
MERGE (V1, V2)	{ V1, V2 }	OPEN

How exactly c-selection and θ-roles interact with MERGE and LABEL remain a mystery – if MERGE 'knows' in advance what kinds of verbs take what kinds of complements or arguments, this challenges the 'MERGE is dumb' hypothesis set forth

earlier. Let's set this problem aside. What's important is that { V1, V2 } is a possible

structure. This is true to the very least that children do receive this concatenated string as

input.

There is no evidence to the acquiring child that V2 is a phase – there are no

subordinate T markings, no overt v* in the dependent clause, and no overt controlled

PRO or even an ECM subject. The main clause has difficulties too – the expanding of c-

selection of V1 makes it unclear as to where there is a v* in the matrix clause as well.

There is a subject present, but the obscurity surrounding the nature of the "object" of V1

must be confusing to the child's mind. The child's developing grammar may think: if V2

is an object then it must be a noun, but it's not a noun (and there's no outward reason to

think it's anything other than a noun or a verb). If it's a verb, then where's its subject?

And furthermore, where did the subject of V1 come from – was it base generated like an

unergative (but V1 is not an unergative) or normal transitive (but then again the object

problem remains) or moved there like an unaccusative (again, the object problem)?

Let us figure that the child assumes no v* at all, especially if it has yet to work out

the differences between unaccusatives and unergatives in normal speech. The next steps

would be to merge a subject and end the clause:

Operation	Output	Phase Status
-	-	OPEN
MERGE (V1, V2)	{ V1, V2 }	OPEN
MERGE (S, { V1, V2 })	{ S, { V1, V2 } }	OPEN
MERGE (C, { S, { V1, V2 } })	{ C, { S, { V1, V2 } } }	OPEN

At this point, labeling commences, but as expected, cannot handle the { H, H }

structure. If the buffer zone allows the child to re-access the lexicon, the child can very

easily re-evaluate the nature of V1, and assume that it is an M instead.

However, even then we are left with a problem – { M, V2 } is still an { H, H } structure. So how does the child go on to generate the correct order? The precise moment of grammaticalization would be a perfect storm of sorts – the child would have to be confused over the exact nature of v* phases in interpreting strings but have knowledge of the VP-internal subject hypothesis in generating strings. The interpretation difficulties give rise to the child re-analyzing V1 (in this case要 *yāo*) as M, but it must be able to know that the actual generated order is (initially) { M, { S, { V } } }, and that V furthermore is a phase. This heavily implies that the interpretive understanding of phases differs considerably from the generation of phases, which is itself likely automatic.

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