Ling 417 Exam 1: Introduction Review

Joseph Galasso / CSUN Linguistics

www.csun.edu/~galasso

A Biological Basis for Language

1.1 Introduction (Chapter taken from *Minimum of English Grammar*, Cognella, Galasso)

https://titles.cognella.com/downloadable/download/sample/sample_id/457/

Language is quite possibly the most unique of all complex systems known to man, with little if any antecedence to its nature and origin traceable back to a Darwinistic world. It appears that mere communicative needs as would be determined by a Darwinian model could not have possibly provided any great selective pressure to produce such an elaborate system as language that relies heavily on properties of **abstraction**. What one gains from language rather is an inner symbolic thought process, autonomous and private onto itself, built upon a **mentalese** which is to a large degree not optimal for serving mere communicative needs. Complicating the picture even more so is the fact that language seems to sit in a kind of 'no-man's land', at a crossroads between being an innate, biologically determined system (on the one hand), and a learned, environmentally driven system (on the other). In other words, language is one and the same both **subjective** and **objective** in nature. Because of this, it seems any approximate understanding of language must be informed by a hybrid model of its **dualistic** nature. Such a model must straddle and bring together both Abstract/Mental and Physical/Material worlds. This coming together should by no means be interpreted as an attempt 'to make nice' with opposing philosophical camps, but rather, hybrid modeling of language and mind goes far in addressing the very complex and abstract nature of language, particularly in light of the current knowledge linguists have gained over what I think has been a very prosperous half century of linguistics.

What makes the above statements tricky, however, is that while there may be some level of (mental) learning going on for our first language, presumably based on the (material) frequency of input, (as with vocabulary learning), it has to be a 'strange' kind of learning unconnected to mere conscious observation and will. For instance, a child cannot willfully choose not to learn his/her native language. Nor can a child (subconsciously) fail to observe the hidden structures of language. So any talk of 'learning' must be accompanied by the fact that this type of learning, or whatever it is, is

silent, automatic and biologically determined. The environmental aspect of language is evidenced by the fact that some input–driven learning, subconscious though it may be, is what triggers the otherwise innate mechanisms behind the acquisition of language. In fact, the term **acquisition** comes with its own portmanteau of claims, chief among them being the claim that the child is born with an already predetermined template for language termed **Universal Grammar**, a (human only) species-specific **Language Faculty** that situates in a specific region of the human brain and gives rise to language acquisition. Some will argue that second language, a language 'learned' beyond the so called **Critical Period** (Lenneberg)—reached around puberty when the brain goes through phases of neurological restructuring—is not qualitatively/quantitatively the same as 'acquisition' as seen via first language, with some linguists suggesting that **learning** can never approximate the natural state of **acquisition**. (Two cases come to mind regarding the Critical Period: (i) The case of a 'Genie', (S. Curtiss), and (ii) the case of 'Christopher' (N. Smith, I-M. Tsimpli). I suppose the notion of trying to learn such a complex system that is meant to be biologically determined presents linguists with some fairly serious issues, many of which are not even close to being resolved, nor will they be any time soon.

While the traditional treatment of grammar usually concerns itself with the basics behind language structure, our treatment of grammar also attempts to frame the general discussion of **language uniqueness** so that, overall, we can gain valuable insight into how the Human Language Faculty works as a complex, rule-based system. In understanding our English grammar, we do so first by understanding the abstract nature of language and how the integral parts of language fit together, down from the smallest levels of the **phoneme**, **morpheme** and **word**, up to the largest levels of **sentence** and **syntactic processing**.

1.2 Innate Rules of Grammar: The Logical Problem of Language Acquisition

Perhaps the most crucial thrust of this text is the notion that language is **rule-based** (as opposed to being simply **memory-based**). In what has now become known as one of the most pivotal moments in contemporary linguistics, the theoretical and formal debates between **B.F. Skinner** and **Noam Chomsky** (as represented in Chomsky 1959) are to be considered not simply as a philosophical divide (say, between **Empirical** and **Rational** schools-of-thought (respectively)), but as a new pedagogical approach in coming to understand current experimental results showing how the brain partitions the incoming speech stream into (i) **stems** (which incorporate the associative-memory component of

the brain), versus (ii) **affixes** (which incorporate the rule-component of the brain). These distinctions in stem+morphosyntactic processing have been attested in specific language tasks whereby the use of various **brain imaging devices** (fMRI and/or ERP electroencephalography) have shown where **word** recognition and retrieval elicit activity in areas of the brain involved with associative-memory—e.g., [*stem*]→ [*book*]—and where **affix** formations elicit activity in areas of the brain which involve a computation—e.g., [[*stem*]*+affix*] → [[*book*]-*s*]. In other words, before Chomsky it was not at all clear whether or not there was even a distinction to be made in processing between how **words** are stored and how **affixes** are stored. This 'dual' distinction is now part-and-parcel of what makes-up the Chomskyan revolution—namely, that language is processed in two fundamentally different ways. All are still not on board however with such a clear dual distinction: (**Connectionism** and **Single Mechanism Models** vs. **Computational** and **Dual Mechanism Models**). (For recent debates, see Seidenberg, Elman vs. Marcus).

1.3 The Dual Mechanism Model

Out of a Chomskyan processing distinction came the **Dual Mechanism Model** (DMM). The DMM (or sometimes referred to as the **Words & Rules Theory** (Pinker)) claims there to be a stark contrast between stem formation and affix attachment. Where it was assumed by Skinner that both the stem [*book*] and stem/affix [*books*] would be undecomposed and memorized as chunks, the DMM would claim that there is a clear demarcation between stems and affixes—so that while stems [*book*] may take on 'Skinner-like' properties of associationism, affixes {s} take on 'Chomsky-like' properties of rule computation. The processing distinctions can be drawn as follows:

(1) Skinner: singular | plural → A 'Single' processing

[*book*] | [*books*]

[memory stem]: non-rule-based

(2) Chomsky: singular | plural → A 'Dual' processing

[*book*] | [[*book*] *s*]

[[stem] + affix]: rule-based

Wugs Test. It is this aspect of the debate which motivated the classic 'Wugs test' to be performed by Berko in which young children were observed to add the plural rule [N+{s} = plural] to nonce (non-existent) words such as *wug*. The fact that the children in the experiment produced *wug-s*—a word formation that could not have been simply memorized as a chunk from any preceding input, it being a nonce word not found in the input—proved that children had an abstract rule capacity for plural which could be applied, absent any priming effect which would otherwise enable the word formation of *wugs* to be retrieved via brute memory. The tacit computational rule [N+{s}= plural] as found analogously in the language (e.g., *car>car-s, book>book-s*, etc.) is the inductive manner in which children applied the process, a true rule application.

For Skinner, the plural {s} would be incorporated and memorized as an entirely new word: viz., a speaker would have a list of words of her language, part of which would contain both the words *book* and *books*, treated both as different items in the **lexicon**. For Chomsky, while the stem *book* would indeed be stored as part of the lexicon, the affix {-s} of *book-s* would come about via a mental processing of [stem+affix] concatenation, or [[book] + {s}]. It is this processing distinction that makes the classic debate so valuable. For instance, first generation Chomskyan studies in which children (for the first time) were observed showed evidence for what is called **over-regularziation** of Nouns (plural) and Verbs (past). For example, Chomsky might ask: 'how could it be possible for children to make attested errors such as e.g., *goed* (= went), *drawed* (= drew), *bringed* (= brought), *putted* (put), *tooths/teeths*, etc. if children have stored as chunks all items?' Recall, the nature of **chunking** is based on a 1-to-1 sound-meaning association. For example, the child's production of [*Goed*] as a lexical chunk necessarily entails that the child would have heard it likewise as a chunk, as found in the input. Well, clearly, children are not gaining access to such erroneous utterances from the direct input (provided that moms and dads, brothers and sisters don't speak that way). So, the errors must be coming from somewhere other than the direct input. If Skinner believes in a direct input-to-output 1-to-1 processing of *what comes in goes out* in terms of language, with the brain/mind simply serving as a memory way-station of sorts, then clearly such a direct 1-to-1 processing cannot account for both **creativity** and **child errors** (creativity in the sense that children can readily apply the rule to novel words, as in Berko's **Wugs test**, errors in the sense as shown above). In fact, it is this coupled phenomenon of creativity and errors which weakened the 'too strong a claim'

made by Skinner in the famous 1957/1959 exchange with Chomsky regarding language and associationism—viz., Skinner's claim that all language reduces to associative memorization. Therefore the only other means by which children (and adults for that matter) can produce such errors if not via external means is via internal means (i.e., via rules—the malformation and/or under-development of rules). Given this, let's turn to what might amount to evidence for a hidden internal **generative grammar** of language whereby systematic structure is sought out in an environment otherwise reaming with uncertainty.

1.4 Biological Basis for Language

We now know that the 'brain-to-language' correlation is physiologically real: that is, we see specific language tasks (such as retrieval of *verbs, nouns*, such as *phrase structure constituency*) activate specific areas of the brain. In sum, what we shall term **Lexical Categories** in this book (e.g., *Nouns, Verbs, Adjectives, Adverbs*) will be said to activate the **Temporal Lobe** region of the brain (Wernicke's area), and what we shall term **Functional Categories** (e.g., *Determiners, Auxiliaries/Modals*) will be said to activate the **Left Frontal Lobe** region of the brain (Broca's area).

When we reach that juncture in our discussion which requires the drawing of tree diagrams, we must keep in mind that we are not simply drawing trees, but rather, what we are drawing is indeed a modeling of what we believe is going on inside the brain: a brain-to-language mapping. In fact, we will come to view trees as being cryptic models of the inner-trappings of our brains, so that when we process some aspect of language, we might visualize what is going on in our heads. Trees allow us to model such a mapping.

1.4.1 Brain/Mind-language relation

It is now largely accepted that language is subserved by two major regions of the brain: **Broca's area** (left-front hemisphere), and **Wernicke's area** (temporal lobe). As stated above, the differing activation areas seem to present us with categorical distinctions between **lexical** substantive words and **functional** abstract words. Also, it has been reported that the same distinctions hold between (rule-based) **Inflectional** morphology—e.g., the insertion of {s} after a noun to make it plural, (e.g., *book-s*)—and (rote-learned) **Derivational** morphology—e.g., the insertion of {er} after a verb to change it into a noun (e.g., *teach-er*). The picture is much more complicated as is made

out here, with some overlap of processing that may blur clear distinctions. However, overall, the brain does seem to behave as a Swiss Army knife of sorts, with specific language tasks activating specific regions of the brain. This **dual distinction** is best shown in brain imaging studies using **fMRI** (functional Magnetic Resonance Imaging) and **ERPs** (event related potentials) whereby different areas of the brain undergo different blood flow as triggered by specific language-based tasks.

1.4.2 Connectionism vs. Nativism

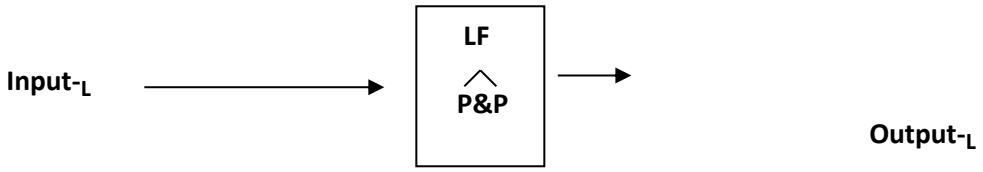
Connectionism.

Some cognitive psychologists and developmental linguists wish to attribute a greater role of grammar and language development to the **environmental interface**. By stressing the 'exterior' environmental aspect, connectionists attempt to show correlations between the nature of the language input and subsequent language processing leading to output. Connectionism suggests that there is often a one-to-one mapping between input and output as based on thresholds of type/token item frequency. Their models assume that though language input is 'stochastic' in nature (i.e., random), the child has an inborn statistical calculus ability to count and uncover patterns which lead to the formation of a given grammatical state. They further suggest that the only way a child can gain access to the stochastic surface level phonomena of language is by brute powers of analogical association. Such powers of association are assumed to be part of the general knowledge the child brings to bear on the data, a general knowledge as found in cognitive problem solving skills.

Unlike the **nativist position** (on the one hand) which upholds the view that the language faculty is **autonomous** in nature and **formal** in processing (i.e., not tethered to 'lower-level' cognitive arenas of the brain), connectionists argue against **formalism** and do not assume (nor believe) such 'higher-level' processing specific to language. Connectionists prefer a more **functionalist** stance in claiming that language development arises in its own niche as the need to communicate increases. Due to their functionalist stance, connectionists don't theoretically need to stipulate for an autonomous rule-based module in the brain. Connectionists rather believe that brut cognitive mechanisms alone are in of themselves enough to bring about language development. In stark contrasts to the nativist position stated below, connectionism assumes language development proceeds much in the same manner as any form of learning. (See Marcus for an overview of the ongoing debate).

Nativism. Other cognitive psychologists and developmental linguists rather place the burden of language acquisition squarely on the **innate interface** by stressing the internal aspect generating the grammar. While innate models also support the notion that the environment is stochastic in nature, they do so by stressing that the perceived input is at such a high level of randomness, with apparently ambiguous surface-level phenomena found at every turn, that one must rather assume a preconceived template in order to guide the child into making appropriate hypotheses about her language grammar. Otherwise, without such an innate template to guide the child, the randomness is simply too pervasive to deduce any workable analogy to the data. An important rationale of nativism is its claim that language development is much too stochastic in nature for the available input to make much of an impact on the child's learning scheme. Much of the work behind nativism is to show just how the child's perceived data is much too impoverished to determine an appropriate grammar of that target language (as was determined by the poverty of stimulus argued earlier in this chapter). In other words, since an appropriate minimum level of order is missing in the input, an innate module of the brain termed **Universal Grammar** (more currently being called the **Language Faculty**) must step in to supply whatever rules might be missing from the environmentally driven input.

The nativist model places its emphasis on the inner working of the brain/mind relationship to language by stipulating that there are innate **principles** which guide the language learner into making appropriate hypotheses about the **parameters** of a grammar being acquired. This Principles and Parameters model as illustrated below shows how (i) the language input first passes through the Language Faculty (LF), (ii) the LF determines the correct parameter settings (Principles & Parameters), and (iii) the parameterized language gets spelled-out in the output:



1.5 The Critical Period Hypothesis

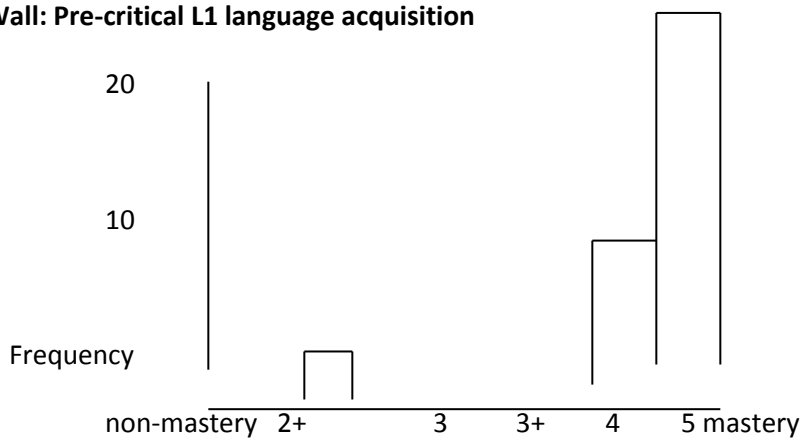
If language is biologically determined, might there be a closing window of opportunity for such a biological system to manifest a full fledge grammar? Many think so. In fact, the critical period has been used to help account for the well-known fact that the learning of a second language (during adulthood) seldom seems to progress as smoothly as the acquisition of a first native language (during childhood). But to speak of a critical period is somewhat strange. One doesn't typically speak about critical periods when we are dealing with 'learned endeavors', i.e., cognitive problem solving skills, etc. For instance, one doesn't necessarily assume that there is some upper age limit that would prevent a wishful adult from, say, learning how to drive a car, granted there is no disability that would otherwise hamper cognitive learning. Conversely, pre-critical period child language doesn't seem to follow the typical **bell shape curve** found in learned activities which show a statistical bell curve of distributional mastery for the given activity. It seems that if there is a critical period, it doesn't support any putative culture-bound 'learning of language' *per se*. Rather, it seems a critical period has more to do with an endowed human gift for 'acquiring a language'—an acquisition that (i) is our free birth right, making-up part of our species-specific genetic code (the mental/internal component), that (ii) must be triggered by the natural input (the material/external component), and that (iii) than closes up at around puberty, fully after the acquisition has been secured. If there is any concept of learning taking place within language acquisition, it would be with the material/external second component, though nativists would prefer to us the term **parameter setting** instead of **learning**, since parameter setting is considered to be done on a more passive, subconscious level.

One of the more striking distinctions made between nativism and classic behaviorism is that the former assumes parameter setting and language knowledge thereof to be of an implicit nature, (i.e., grammar is considered a form of **procedural** knowledge we don't normally access on-line), while the latter affirms that knowledge of language is **declarative**, active and arrived at by a conscious will. Having said this, there seems to be some consensus brewing from both sides of the debate that, minimally, some form of innate *a priori* knowledge or mechanism is indeed required in order for a child to speculate on the range of possible hypotheses generated by the input. Current arguments today, often termed the **Nature of Nurture**, therefore may boil down to only the second component cited here—viz., of whether or not 'learning' is taking place or whether 'parameter-setting' more accurately describes the acquisition process. It seems now all but a very few accept the idea that some amount of an innate apparatus must already be realized by design in order to get the ball rolling. So, it is becoming more recognized that the cited first component which speaks to the mental/internal nature of

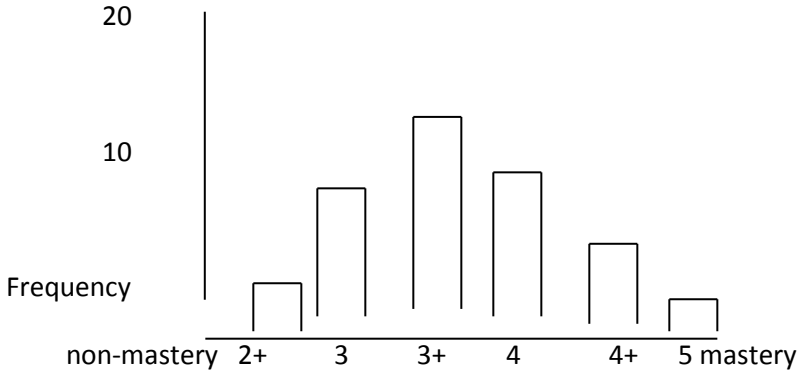
language must be somehow given *a priori* if any feasible theory of language is to be offered—much to the credit of Chomsky and to the chagrin of the early behavioralists of the pre-Chomskyan era.

Bell Shape Curve. Bar charts showing a bell curve for post-critical second language learning (L2) and a 'right-wall' for pre-critical first language acquisition (L1). (Patkowski 1980, taken from Lightbown and Spada, p. 63).

Right Wall: Pre-critical L1 language acquisition



Bell Shape Curve: post-critical L2 language learning



Such data have been used in the literature to support not only claims for a critical period hypothesis for first language acquisition, but also in support of more general claims that L2 is on a par with declarative conscious learning and is fundamentally different from the procedural parameter setting of L1. Note that all learned activities follow the bell shape curve. (For a good discussion and relative history of the subject, see Herrnstein & Murray vs. Gould).

2. The 'Sally Experiment': Lexical vs. Functional Grammar

One very nice way to illustrate the essential difference found between **Lexical and Functional grammar** is to call upon an experiment referred to here as the 'Sally Experiment' (Galasso 1998, class lectures: University of Essex). The experiment offers us a classic case into how ESL students tend to realize distinct units of grammar (ESL=English as a Second Language or L2). The token 'Sally' sentence below illustrates in a very natural way the classic distinction made between what is Lexical vs. Functional, a distinction typically referred to as Substantive vs. Non-substantive units of language. The heart of the experiment relies on the distribution of the /s/ in the two token sentences below: *Sally wears strange socks*.

Sally Experiment.

(3) (a) Sally wear-*s* strange sock-*s*. (spoken by native English/L1)

(b) Sally wear-*ø* strange sock-*ø* (spoken by non-native ESL/L2)

It should be made obvious in the token sentence pair (one of many presented in the experiment) that the phonological unit (or phoneme) /s/ is what is being examined here. However, when one takes a closer look, there emerges an interesting asymmetry in *what gets left out where* in specific ESL/L2 contexts (ex. 3b). ESL students often delete the functional /s/ when producing natural spontaneous speech, even systematically so. It should be said that on the phonological level, all /s/'s throughout the experiment are relatively the same, that is, they are similarly pronounced (notwithstanding some minor r-voicing assimilation that changes the /s/ to /z/ in the token sentence including the word *wear-s*). So, an account of the apparent asymmetric distributional deletion of /s/ cannot be made on the grounds of phonology alone. In the specific case above, it appears that although ESL students may pronounce correctly and produce 100% mastery of the underlined phoneme /s/, (as found in the words *Sally*, *strange*, and *socks*), they tend to optionally omit (drop) the italic /s/ (the /s/'s found in final position e.g., *wear-s, and sock-s*).

This observation forces early-on in our discussion of grammar a further distinction between (i) Phonology, on the one hand, and (ii) Morphology, on the other. For example, if all underlined /s/'s are produced 100% of the time, surely, as expressed above, there is no phonological deficit. The optional omission of final /s/'s however must rather be attributed to an exclusive deficit in some area of morphology (Also, the final /s/ deletion is not said to be positional in nature since ESL students have no difficulty with other final /s/ words, such as in *dance*, *class*—viz., ESL students would not optionally produce *dan* /dæn/, *cla* klæ/ etc.). Hence, via this experiment, the two aspects of grammar are addressed simultaneously—*Phonology vs. Morphology* and *Lexical vs. Functional*.

These two very distinct aspects of language—and, as it turns out, two types of language processing in the brain— introduce us to a very important and seemingly transcendent dichotomy in language, viz., *Lexical vs. Functional Categorical Grammar* (as illustrated below).

3. A Language Typology Continuum

Associative Learning **Rule Formation**

↕ ⟷

(4) **[x] Non-movement** **[y_j [x] y_j] Movement**

<u>Single/Local Move</u> <u>Dual/Distant Move</u>

[fascinating] / [them] [who[m]] / [[celebrat]ing]

⟵ | ⟶

Derivational Inflectional

Isolating Synthetic Polysynthetic

In the opinion of some developmental linguists—and I count myself here among the group—such a processing distinction as shown above might parallel 'brain-to-language' maturational factors such that a hypothesized **single processing stage** [ ] might come on-line earlier in the course of syntactic development than say a **dual processing stage** [[ ]]. The notion of *vertical stacking* of lexical items early on, say, in forming a lexicon, would be an example of this. Such vertical item memorization falls on the continuum calling for exclusive **one-to-one sound to meaning mapping** (a kind of **encyclopedic** knowledge):

(5) *Vertical Processing of Lexical Categories:*

↕ [ ]……..[book]

[ ]……..[tree]

[ ]……..[dance]

This mode of processing contrasts with what might be called a more *horizontal spreading* of rules, such that in a very simple example, Noun + {s} = plural.

Functional categories:

(6) ↕ [book]……[[book] s] ↔ [[N] + s] = Plural

A very interesting extension to this continuum has been suggested for autism. While we all are familiar with the term 'autism spectrum', the very notion that distinct manifestations of autism along with other forms of learning/language impairments might actually sit somewhere along such a continuum has been suggested in the literature—namely, the idea that an 'opposite/inverse effect' of **Asperger's syndrome** has been found reported in **Williams' syndrome (WS)** as compared to **Asperger's syndrome (AS).** One linguistic characterization of the morphosyntax in WS is that WS children exhibit an abnormal vertical-mode of processing lexical items to the extent that +/- frequency of the item itself does not seem to impact the learning of the item either way. (For normal developing children, *frequency* and *statistical* learning is the main source of vocabulary development (storage and retrieval). Such vertical impairment in accessing information from the lexicon would place WS on the far right of our continuum (whereby vertical processing is

↑

distorted). For instance, WS subjects might rather retrieve from the lexicon the lower frequency verb '*evacuate'* in saying, e.g., *I'll* ***evacuate*** *the glass of water for you* instead of the higher frequency verb *pour*. Researchers interpret these data of selective impairment in WS as supporting the theoretical distinction between a computational system ⟷ versus an associative memory system .

On the other hand, Asperger's Syndrome (AS) is well-known for is abnormal (horizontal) processing of the spreading of rules. In fact, the notion of **movement** (as a **Broca's area** manifestation) has been suggested as being lacking in AS subjects. Hence, the move-based spreading of morphosyntactic rules would be expected to cause a problem in AS. It would be interesting to see if AS speakers have a problem with **phonological assimilation** (also a movement-based analogy). Lorna Wing (1981) was the first to identify a clinical diagnosis of language deficits for AS, such that AS speakers have difficulty with horizontal modes of rule-based spreading (since much of their language use is vertical rote-learned). Examples of AS language-based deficits include the more subtle functional inflectional affixes (verbal 3rd person), Case inflection (pronoun and pronoun selection) and other types of inflectional rule-based morphologies. Specific Language Impairment (SLI) seems to exhibit much more of these deficits (while demonstrating normal cognitive skills). It seems rather that SLI impairment specifically targets the (horizontal) morphosyntax of language (hence its name), calling for a clear modular separation of language vs. cognition (a double disassociation).

Specifically regarding normal language development, the ERP, fMRI mappings of cortical regions in the brain to specific language tasks seem to bear out this dual distinction**.** One clear example discussed in the emerging child language literature (and will later be more fully articulated in subsequent chapters of the text) is the notion that while young children, say at 24 months of age, may be able to linguistically processes 'singular vs. plural' number distinctions, at the same time they suffer catastrophic breakdown when the same number information is carried upon inflectional morphology. For instance, it has been widely reported in the literature—going as far back as the classic investigations done by Fraser, Bellugi and Brown (1963), Brown (1973)—that children's production of inflectional plural marker {s} comes online well after the referential/concept of number [+/-PL] is fully made representational via lexicalization.

For instance, while young children may be able to distinguish the [*a/some*] quantifier determiner and thus correctly represent number as attested in their language tasks, the decomposed [[N]s] doesn't appear to be made manifest not only in child utterances but

also in their representation. What this could mean is that early children may utilize the more primitive 'lexicalized' representation of *number* which is available early-on in order to recover, or at least approximate, otherwise morpho-syntactic makers absent in their language representational computation. The fact that the [A/Some] distinction may be at work prior to e.g., the plural {s} inflectional/agreement marker does seem to suggest that semantic force embedded within a lexical item may serve as a surrogate to true rule formation in the early stages of protracted language development. An additional piece of evidence for this is provided by children who do use cardinal number determiners early-on in their speech, though without the plural agreement being marked on the noun—e.g.,

(7) a. [DP [D [+Pl] two] [N [-Pl] boy-Ø]] (two boy)

b. [DP [D [+Pl] some] [N [-Pl] car-Ø]] (some car)

In the opinion of neuroscience, such a difference between lexico-semantic vs. morpho-syntactic psychological language representation surely should evoke real physical processing distinctions found in the brain. And to the extent that the two processing models found in (4) above may be correct—and to some degree in competition with one another depending on how an individual word/morpheme ultimately gets processed based on external factors such as type/token frequency recognition, etc.—there may be times when brute memorizations trumps rule-based formation, and vice versa. Such 'competing' predictions would favor a **Dual Mechanism Model** (see Pinker 1999, Clahsen 1999), and ultimately *race-models* of the two competing processes (Baayen et al. 2002).

Hence, the study of Language & Linguistics is now closer to becoming a true 'Hard Science' than at any other time in the field's history, and rightly so. The oft-cited *biological basis of language* is new proof of how linguists have come to reshape and redefine their considered topics of inquiry. And with advances made in brain imaging technology, the once putative claim for a 'brain-to-language' corollary has now become solidly accepted amongst developmental neuro-linguists in the field today. If psychologists can claim 'behavior as a window into the brain', so too should linguists claim 'language as a window into the brain'. When a speaker speaks, this act essentially evokes changes in the neuro-circuitry of the brain. (Even when a person doesn't speak, the representation of tacit knowledge a speaker has about one's language must sit in a physical configuration in the brain). While such changes may be only ephemeral in relation to the task involved—such that the duration of language-based cerebral change roughly corresponds in milliseconds to the linguistic task at hand—it may very well be the case that the many tiny and incremental changes that have been recorded ontogenetically over human evolution have

made their way in becoming deeply seated phylogenetically in the human genome. To the extent that there is a 'language gene', however, or even a group of related genes, much work remains to be done. Language may prove too complex to be reduced and attributed to a specific host of genes, though good work in that direction has shown some promise (e.g., see research on the FOXP2 gene/protein and its potential link to the evolution of human language).

The study of language and linguistics has become physiologically relevant amongst other bio-neurological pursuits. To begin, there are some popular questions we can ask ourselves here at the outset. For instance: What are the true brain-to-language processes behind the popular thought-based expressions *'I'll need to remember that'* or, *'it's on the tip of my tongue'*? Regarding the latter, what is it that we think we're actively doing when we 'search' for a forgotten word: what are the mechanisms at work behind the search and what do we actually search through? What do we actually believe is happening within the *brain/mind-to-language corollary* when a speaker actually engages in such linguistic phenomena? Such popular notions of language memory processing tend to neatly, though erroneously, partition the equation in a bi-modular subjective/objective manner: that there is some outside retriever of an item or thought, (**the speaker** 'I'), and, some inside stuff which is the making of language and thought (**the item** to be remembered, the string of expression, thought, etc.) and that it's the job of the linguistic processor to somehow pull the objective item from some declarative workspace (say, from a form of working memory) and assign it in a procedural way to the speaker (for potential linguistic formation leading to utterance).

I believe the above is analogous to the naïve 'little man inside your head' theory which unproductively attempts to reconcile this separation of the inner from the outer. However, this apparent and seemingly intuitive separation of speaker-from-item, or person-from-thought, is not at all how the processing works. (After all, there really is no little man inside the head). Of course, the person can never be fully outside of the brain/mind equation searching for an item stored somewhere inside the brain/mind. There can be no such person separated from but communicating with the brain/mind. It must rather be put that it's the brain/mind itself that searches its own brain/mind: brain region-**α**β communicates with a brain region-α**β**. In this sense, the brain must be self-referential. Given this, the question now becomes a complex one:

(8) (i) Which areas of the brain involve the 'storage/retrieval', which does the 'looking-up', and how does it all come together to form the 'syntax'?

and,

(ii) Are there distinct maturational differences related to each respective brain regions which fall along the storage-to-search-to-syntax processing spectrum?

In one very general and perhaps generic sense, I'd like to advance the notion herein that the classic *Procedural/Declarative* cut in mental processing can somehow serve as a transparent overlap to this speaker/(or item)-to-item search relationship. The classic understanding of the cut is to be maintained to the extent that 'procedural' refers to a largely subconscious and tacit processing level undertaken by a speaker (say, e.g., the processes engaged by the person doing a word search), and 'declarative' here refers to the knowledge of the searched item in question (we can consider such items as a declarative piece of object of the world, e.g., a word, an expression, or a thought). (See Ullman for discussion). The duality is part-and-parcel of how the brain organizes itself in workload and partitions linguistic tasks. Extending this analogy a bit further, linguistically, we can begin to see just how the cut might play itself out in terms of language processing. A single processor of storage+retrieval of a speaker-to-word or word-to-word level may be satisfactory served by associative processes which relies on either surface level canonical argument structure (to get to meaning) or to the actual embedded lexico-semantics of the item *per se*. When a speaker calls up a Saussurean Sound-to-Meaning or Meaning-to-Meaning relation—as in the lexical retrieval of /bÚk/$_j$ → [book]$_j$, or in the anaphoric semantic binding of *I$_j$ cut myself$_j$* (respectively), a speaker/item-to-item exchange can be underwritten by mere surface associative means. On the other hand, when recursion is involved by way of piggy-back load processing (viz., when an item already underway in processing might be called upon simultaneously to carry out an additional processing task, then this higher level of activation may trigger a distinct activation in the brain. Broca's area has been closely analyzed here as to potential points of activation regarding the two processes, and recent literature on the topic now suggest that we can actually pinpoint within Brodmann's area the two activations (with BA 44 being triggered by local MOVE, and BA45 being triggered by distant MOVE.

3.1 Structure vs. Form Class: 'How do you do?'

In additional to the Lexical vs. Functional category distinction at the morphological-inflection level, the same distinction holds at the word level: the distinction is labeled *(i)* **Form Class word** vs. *(ii)* **Structure Class word**. One way of observing this lexical vs. functional distinction at the word-level is by considering the token interrogative sentence *How do you do*? where the obvious double usage of the word *do* should stand out. In fact, in some of my years of teaching abroad, I have even had the question posed to me in the following manner—'What does the second *do* mean and why do we have to repeat it so?' The question stands to an extent only insofar as it depends on the following misunderstanding—namely, 'if the two words have identical meaning, then how come the repetitive nature of the phrase?' As we shall see later on in this text, the two *do's* are indeed not one in the same (notwithstanding the perceived identical pronunciations). Herein lies the confusion: The first *do* is actually functional, containing no meaning whatsoever and only serves some abstract functional purpose—here, it specifically serves to form the grammar of a question (interrogative) sentence. It is only the second *do* which is lexical and thus contains very general generic verb meaning (as in the verbs *go* or *feel* in the greetings *How's it going? How do you feel?* etc.).

(*Note*: Regarding child language acquisition and the types of errors children make, it is interesting to note here that while the lexical main verb '*do*' often over-regularizes in past tense to '*doed*' (Me *doed* car, (=I did the car)) such auxiliary verb over-regularization is mostly unattested in the child language data (@ marks an utterance type unattested in the data)—e.g., structures such as @*Doed* you see that? and @What *doed* you see? are very rarely produced if ever by children).

One simple way to uncover this distinction between lexical *do* and functional *do* is to evoke the **substitution test**—a beloved test of linguists which often helps to get a better handle on the nature and distribution of a particular class or category of words. Consider the substitution test below in (9) where we can see the selective distribution between *(i)* the first **Functional Auxiliary-Verb** *do* (Verb1) and *(ii)* the second **Lexical Main-Verb** *do* (Verb2):

(9) Table: The Substitution Test

Wh-Q + Verb 1 + Subject	**Verb 2**
a. How do you	do?
b. do	know?
c. do	speak?
d. do	feel?
e. do	cook?
*f. How know you	do?
*g. How speak you	do ?
*h. How feel you	do ?
*i. How do you %j. How Ø you	Ø ? do ?

(* marks ungrammatical sentence, % marks acceptable in reduced speech, ex. j)

Surely, **How speak you do?* (9g) is an improper, ungrammatical interrogative sentence. This distinction goes to the heart of the issue as discussed above. By misplacing the verbs into the opposing slots, we shatter the syntax and thus the overall meaning of the sentence. More specifically, the lexical *do* (which is positioned in the Verb-2 slot) is the main verb and carries the substantive meaning of the verb *to do*, whereas the functional *do* (Verb-1)—sometimes referred to as the *Dummy-'do' insert*—is merely an Auxiliary verb (void of any verbal meaning) and is inserted between the Wh-word and the Subject in the capacity of an abstract interrogative marker. This is precisely why sentences (4f-i) are ungrammatical—namely, where we ought to have a substantive main verb carrying out its full verbal meaning in the appropriate slot, we have instead a 'Dummy-do' auxiliary verb void of any potential meaning. Returning then to the original question which spawned the above substitution test, we now see that indeed the two seemingly identical *do's* are not alike:

whereas they may be alike on a phonological level /du: /, they are two very different items at the morpho-syntactic/grammatical level. (Note that in fast pronunciation, the first Aux *do* gets reduced and deleted to /hau-yə –du/ (IPA) (=*How ø you do?)*. Conversely, just try to omit the lexical 'do'—e.g., *How do you ø?* As you quickly see, no meaning can be attributed to this utterance since there is no overt lexical main verb.)