For Ben:

Some notes on what makes language interesting

For Ben (first ten minutes of opening remarks from a senior-level 'child language acquisition' lecture)…

Yes…he can handle this! ☺ *It's Boy-scout stuff…*

1. Structure

merge means add one item with another.

move means displace an item from an original position.

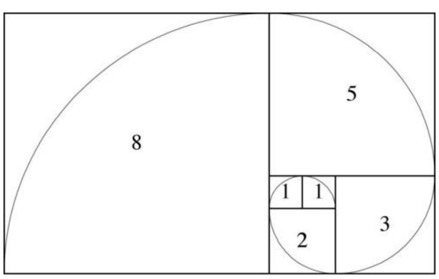
Adjacency means two items which sit next to each other.

The Fibonacci code

The very idea that the way we humans string words/items together may have ancestral links to spiral formations found in shell fish is nothing short of stunning. Yet, the 'golden ratio' of Fibonacci holds: 1,1,**2,3,5,8**,13,21,34… etc.… for our language design. (Or, if you prefer to read the ratio as a binary rule, then [0 = 1], [1= 0, 1].

(Merge (add) first two numbers (adjacent) of the sequence to get the third number…and keep going: 1+1=**2,** 2+1= **3,** 3+2= **5,** 5+3 =**8**, 8+5**=13…**

(0) 'Fibonacci Spiral Formation' (like shell fish, snails).

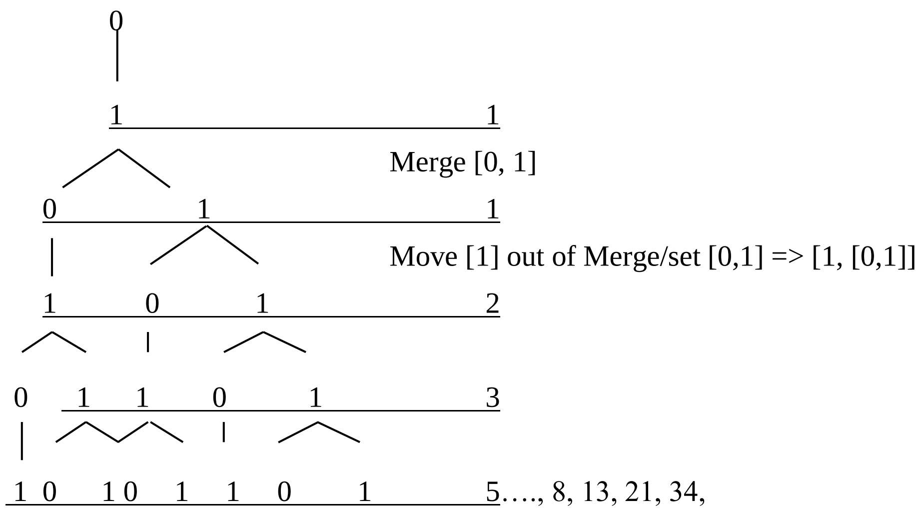


Here is the rule that **explains everything ever designed by nature** (the Fibonacci code):

0=1, 1=0,1. See how it works below through design:

Tree Diagram: ‘Top-down’ design: merge + move: 0= 1, 1= 0,1…

(1)



(2) So there are two ways the brain processes information via design:

(a) **Linearly** [ ]: where adjacency counts: [ ] + [ ] + [ ] etc. simply add adjacent objects/words together [x] [y] [z] where x affects y and y affects z (a domino effect). For example ‘Ben is riding a unicycle’ (five words sit next to each other).

(b) **Non-linearly**: [[ ]]: where two things don’t have to sit next to each other: [x [y]z] where x affects z but not y).

This non-linear stuff is **very strange**. All computer languages, games, etc. depend on bits of information that sit next to each other (like binary code of 0s and 1s for computers)

Computer language of zeros and ones (0,l) depend on adjacency.

But not language (language is very strange…things can affect other things from a distance. For example:

(3) ‘[Ben] [is] riding his unicycle’

(4) Question: Is Ben ~~is~~ riding his unicycle?

To make it a question you invert the word ‘is’ which sits next to the word ‘Ben’: so, [Ben] + [is] then invert [is] to get [Is] [Ben] ~~[is]~~…? So fine, **this is linear**. But now look at this sentence:

(5) ‘Ben who is my friend’s son is riding his unicycle’

If you invert the closest/adjacent [is] you get the wrong structure:

Is Ben who ~~is~~ my friend's son is riding his unicycle?
(Is Ben who _ my friend's son is riding his unicycle?) (= ungrammatical).

Did you notice here that 'closest adjacency' just doesn't work: the closest [is] cannot invert. We must rather turn to the tree diagram in (1) for some structure

Embedded structures within structures look like this: [[ ]]…not just linear [ ].

(your grammar class calls them relation/embedded clauses)

(6) [Ben [who is my friend's son] is riding his unicycle]

Is [Ben [who is my friend's son] ~~is~~ riding his unicycle]? = correct question
(Is Ben who is my friend's son _ riding his unicycle?)

Even though 'is' (in 6) is *distant* in closeness (adjacency), the correct 'is' is *closer* in structure.

Here's the structure just like our tree diagram in (1) :

[Ben [who is my friend's son] is riding his unicycle]. [[ ]]…

It looks like this [[ ]]…

…and not like this [ ] .

[Ben who is my friend's son is riding his unicycle].

Fun stuff yeh?…linguistics is like a puzzle…but not exactly like your rubik's cube.
8/28/13/jg

2. A Language Typology Continuum

Associative Learning **Rule Formation**

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

Single/Local Move Dual/Distant Move

[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):

(8) *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:

(9) [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.,

(10) 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 (7) 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:

(11) (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.