The Architect's Rule Book

by R. Salvador Reyes [Excerpted from "Narrative Complexity: A Consciousness Hypothesis," Essay #5-Memory & Cognition, pp. 127–135.]

Returning to our model's inner-architect and his syntactic, narrative-building rules —the next obvious question: where do those rules come from? There's at least one clear source of our rules: we learn them. In the view of Narrative Complexity, it seems absurd to assume that human babies enter the world with an understanding of *all* the myriad syntactic rules that govern sentence-building. Similarly, the narrative or causal rules that govern a specific skill-set (from chair-building to exploring physics) need to be learned through experience or study.

The other likely source of these rules at first seems more vexing to consider: we're actually born with them. This is vexing because it begs the questions: *What are these rules? What would they govern? How could they be purely fundamental & yet useful enough to begin building a complex, larger, inter-causal grammar?* According to our theory, these rules are the broader frameworks and most foundational principles—the type that help us to determine & recognize, for example, what a rule actually *is*, and how to construct new ones from the world around us. (Thus, *all* rules are ultimately built upon or somehow derived from these inborn rules.)

These are the kinds of rules that help us to understand—even before we've acquired language—that data usually requires a beginning, middle & end to make it useable. Thus, our likely-inborn fundamental rules are the rudimentary beginnings of *syntax*, whose first & most-basic purpose is to allow data to have start- & end-points—to define its limits & give it handles or borders, which are necessary to manage information as narrative parcels (essentially, as modular data packets).

And lest there be any confusion among adherents of "Universal Grammar" theories, what I am suggesting here is a much more scaled-down & fundamental-building-blocks version of inborn syntactic rules. ("Universal Grammar" theories propose that a broad range of specific & highly-sophisticated syntactic or grammatical rules have evolved to be inborn & essentially language-ready in all humans—a theory that's resoundingly debunked in Terrence Deacon's *The Symbolic Species*. [10])

How could a very young human brain's experiential recording mechanisms define such narrative or sequential beginnings & ends without the benefit of already-accumulated, rule-building life experience or without using the tools of language to “measure” such narratives? In essence, this is similar to asking: how did *any* pre-language mammal determine what defined a behavior- & prediction-aiding experiential data pattern as a self-contained, yet modularly-constructed unit?

More *specifically*: how did those earlier mammal brains (like dogs & primates) create non-linguistic-but-still-modularly-composed "proto-narratives" that allowed the determination of causal relationships & provided the capacity to use widely-varied, multi-sensory cortex-recorded experiences to aid in determining future behavior that helps to repeat (or create usefully-novel versions of) those causal sequences?

In the view of Narrative Complexity, our old friends *pain & pleasure* play a key role in catalyzing this process. Whenever strong pain or pleasure are experienced (i.e., an injury or a yummy) by pre-language mammals or very young humans, this experiential data module is viewed as a potential "end-point" (basically, as a gain achieved or a loss inflicted). Determining the "starting-point" of this narrative might then be as simple as identifying the most temporally-recent & recorded "high-attention" stimulus—a loud sound, a sudden movement, a novel scent, etc. (*basically, “spike” events that exhibit a certain category of specific attributes that allow them to be rudimentarily catalogued & cross-referenced as proto-narrative components*).

This kind of *retroactive narrative construction* (which is a cousin to the kind of “remembered present” that iconoclastic philosopher Daniel Dennett posits is at the center of conscious experience) is neurally possible because of the mechanics of “short-term memory” (or more accurately, the mechanics of priority-based data imprinting & the resulting memories’ varying imprint “half-lives”).

Those mechanics likely allow higher-attention/impact stimuli to hang around a little longer for soon-after pinging & comparison. In fact, this method of narrative construction might’ve been a powerful driver in determining how long a piece of recent data remains "viable" for possible use and thus, remains available to achieve longer-term imprinting. If recent experiential data does not attach itself to one of those pain/pleasure-spurred & retroactive narrative structures, the data is allowed to fade away.

Once these sequential, temporally-based end & start boundaries have been defined, it seems it would be easy to include other types of high-attention/impact *(spike)* experiential data (temporally-located within those boundaries) as different kinds of specific predictive modular elements within this narrative: high-attention/impact actions or reactions that might be identified as (assumed) elements of causality within this sequence.

Of course, in a primitive system like this, there would be lots of room for narrative-building errors, unreliability of data, and confusion between actual causes & mere correlations. But this is likely why the mechanisms of repeated recall—and its uses in strengthening & altering frequently-pinged recorded data patterns—are central to mammalian cortex-based memory systems (recall uses that are *not* central to those earliest reptilian pain/fear-based amygdala memory systems). These mechanisms were useful to mammals because they helped them to continually check & revise those old narratives based on new experiential data. This allows narratives that don't repeat reliably to either be effectively revised or ultimately discarded (if, for example, their unreliability & "untruth" leads these bad narratives to match less frequently with future actual experienced sequences, leading to less recall).

For this kind of mammalian proto-narrative, component-based & dynamic cognitive system to work efficiently, it would likely have to operate as a more primitive version of the same thalamocortical loop that's at the heart of human consciousness. Consider: in order to easily "go back a few steps" in one's experience & accurately temporally locate the likely "beginning" of a just-completed sequence, new incoming data must be sequentially fed into the same system that just recorded the data from earlier in the experience.

As in humans, the experiential data loop in these creatures is like an ever-circling train that picks up new cars via sensory data input and drops them off in the brain's subconscious recording/associating mechanisms (where they hang around just long enough to determine if they were ultimately part of anything useful & worth remembering long-term). Indeed, this primitive system's effectiveness in generating useful, dynamic behavioral responses based on comparatively-related, cortex-recorded & narratively-constructed high-impact experiential data was likely a key driver in the development of the modern mammalian loop of consciousness.

And if we shift our "wayback machine" into overdrive & travel into *hyper-speculation space*, we might glimpse the creature that I believe represents the earliest key evolutionary moment in the brain's journey toward this modern loop of consciousness: *lamprey eels* (jawless fish who were among the very earliest vertebrates—preceding sharks & *jawed*-fish).

Recent research on lamprey eel brain circuitry has revealed data pathways that I believe present a fascinating primitive correlation to our human loop: the integration of electro-sensory data (used to detect & track nearby movement) with visual data in the optic tectum (which will later contribute heavily to the development of the modern cerebral cortex) via the dorsal thalamus (which will later contribute heavily to the development of the modern thalamus) & medial pallium (which will later contribute heavily to the development of the modern hippocampus, a crucial neural tool that we'll discuss next). [11, 12]

In the view of our theory, this is essentially the first appearance of what will become the thalamocortical loop of human consciousness. In addition to this circuitry primitively mimicking our own primary experiential data pathway, it also accomplishes something rather sophisticated: internally depicting (& tracking objects within) a multi-dimensional external environment via the integration of multiple sensory input sources (each of which are handling different kinds of stimuli in different ways, yet must "cooperatively" depict an integrated representation—a representation that critical behavioral & action decisions are entirely reliant upon). In other words, *once upon a time* as eels swam about in those vast ancient seas, their sleek little selves were showing off a really, really cool new & super-clever way to view & interact with the planet earth—a way that would hang around for a very, very, very (*and still counting*) long time.

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Returning to us humans & that matter of determining narrative limits or borders in order to *define* an actual modular memory structure—this task leads us to a specific part of the brain: the hippocampus. Research has shown that in humans the hippocampus is primarily involved in both spatial tasks (area maps) and memory tasks that help create long-term memories.[13] The "modern" hippocampus (having slowly evolved out of that medial pallium) essentially first appears in amphibians, where it is only involved in those spatial tasks.

It makes sense that the first vertebrates to explore land needed an improved spatial tool & system to help them navigate this new *non-fluid* environment. And the hippocampus conveniently appeared between those ancient creatures' now-expanding optical lobes and their age-old cerebellum—a perfect place for coordinating what a creature sees & maps with its locomotion.

It's not until early mammals that the hippocampus also becomes involved in the formation of memories—which (according to our theory) is also the same time that those modular neural structures begin appearing in those early cerebral cortexes. Thus, it's not hard to imagine that the hippocampus' original role as a definer of borders & mapper of space led it to take on a similar role in this new & suddenly very active process: the recording of modular cortex-based memories (and the hippocampus was *already* talking to part of that cortex—the entorhinal cortex—in the management of those spacial maps). [14]

Science has shown that the hippocampus helps to transform current or recent incoming data into long-term memory data, and damage to the hippocampus can cause problems like the inability to form new memories.[15] This would make sense if, indeed, the hippocampus is involved in outlining incoming data & defining it as a distinct narrative parcel—basically firing (and thus searing) a narratively-defined set of neurons together and creating one of those modularly-constructed but still self-contained memory parcels. If the hippocampus isn't working, incoming data essentially remains "undefined" in our memories; even if it is narratively-constructed, it's like an unending sentence whose yarn is always lost because it rolls perpetually away without ever being clipped & saved.

And in the view of Narrative Complexity, it is some of those *inborn rules* that help to communicate to our hippocampus how & what data is snipped & stored—helping to create those "modular memory maps" by employing some of the same tools that the hippocampus originally used to create its spatial maps. (And if you're looking for a neural model for how our hippocampus interacts with those right hemisphere memories, I'd explore the very recent discoveries about how a our hippocampus works with grid cells to create & maintain those detailed spatial maps. [16])

Another major example of an inborn or pre-programmed rule set is something we discussed at the end of our second essay: music. As we hypothesized, music seems to be a kind of pattern primer that gives our mostly-blank brains a set of basic data-relationship rules to model subsequent data rules upon. And the complexity of both the patterns of music itself & our emotional responses suggests that our brain could easily come pre-programmed with a full set of fundamental, but robust rules that our cognitive processes use as a kind of narrative-building starter kit and guide the dynamic creation of new rules.

Which brings us back to that other source—learned rules. How does our brain actually *create* new rules? When contemplating the creation of new rules, it helps to compare them with another predictive cognitive device—one that we explored in our emotions essay: *beliefs.* In the view of *Narrative Complexity*, the evolutionary roots of our belief-building system (likely spurred by learning to prefer cooked meat over raw) are actually found in this more-ancient rule-building process.

In our emotions essay we described beliefs as essentially high-value, high-validity prediction tropes. These beliefs are intended to reliably predict (across a wide variety of settings & circumstances) what will likely result from a specific kind of action or behavior. And these beliefs are *all* arrived at through study or experience (*no inborn rules here*). When we learn a belief-building pattern-prediction from a well-trusted source or if we have repeatedly experienced events (especially high-impact ones) that we perceive to support the pattern prediction, then it can rise to the level of a belief—leading the prediction to be more frequently & broadly applied.

All of these things are essentially true about syntactic rule-building as well. Rules are intended to reliably predict (across a wide variety of settings & circumstances) what will likely result from the specific usage of a narrative or linguistic syntactic element. In addition, we can learn a rule from a trusted source & immediately begin applying it (*a teacher explaining a rule of grammar*). Or we can learn a syntactic rule via repeated experience, which is appears to be the primary and by-far most effective method of rule-building. This is likely why the immersive aspects of more-advanced reading instruction techniques (like whole language) have proven to be effective methods for teaching the rules of reading & writing.

Our brain is *trained* to pick-up on & build these kinds of rules through repeated exposure, experience & application. And like beliefs, all of this powerfully convincing (trusted-source or high-impact: "I'll never do *that* again") or repeated evidence helps to make a rule "stronger"—more likely to be frequently & broadly applied. *In pluralization, adding an "s" is essentially a stronger (higher priority) rule than unique pluralization. Thus, in any ambiguous or unfamiliar linguistic circumstance requiring pluralization, we will likely choose to add an "s" instead of attempting a unique pluralization.*

This experientially-based, immersive-learning process is the foundation of human language acquisition. And at the center of language acquisition is the construction of another key narrative-building resource: our *vocabulary.* Science has speculated that our brain contains, essentially, a dictionary of words that it builds over a lifetime. [17] In our theory, this vocabulary resource is distinct from the words stored in our memories, although those memory-stored words are the original source of (and continually help revise) this dictionary. Just as we build distinct rules & beliefs from the patterns in the emergent right-hemisphere data that sparks them, we build our vocabulary from the same pool of emergent data.

To describe words in more specific systematic terms, in our view they are, essentially: modular cognitive/neural components that possess a wide array of defining semantic & functional attributes and external associations that all vary greatly in malleability & strength, and that together determine the full range of the word's semantic content, syntactic capabilities & symbolic capacities—all of which can be (but is not always) embellished and/or revised with every experienced or studied usage of the word.

I also think it's very possible that this word-based vocabulary resource actually contains another set of items: people. I believe that the names of people we know are stored in our vocabulary like words; those names contain our most fundamental "definition" of that person. (If not actually contained *within* this vocabulary resource, our "people resource" is still likely a similarly-constructed & closely-related resource that's used at the same point in the narrative-construction loop.) And the most important part of that definition ultimately: whether or not the individual is judged as an *Agent of Gain* or an *Agent of Loss* (discussed at length in our emotions essay).

This would be the perfect place for our brain to store this person-associated value (one that is absolutely essential to emotional production, and one which would allow that *potential* value judgement about someone to remain separate from—while still being impacted by—a *known* gain/loss judgement about them, recorded in our data storage). The same process that we use to convert emergent memory data into rules & other vocabulary could easily be used to define people & calculate their current value. And this catalog of people (represented by their names) would be a resource as vital as words themselves when building these narrative parcels.

Of course, who's the most important person in our lives? *Numero uno:* ourselves. Much of the latest research strongly suggests that *self-related* descriptive data (personal traits, abstract qualities, behavioral characteristics, symbolic individuals or items, etc. that we associate with & define our identity) is stored separately from all of that narratively-based, associative, right-brain data. [18] And if we're looking for a likely left-brain location for this *definition of self*—that dictionary containing the definitions of words & people seems like the perfect place to stash *us*.

This word-, people-, & self-filled vocabulary resource is likely assembled & applied in the same loop locale as rule-building. This is *because* of the role words play in assembling a narrative parcel. Many of the words required to complete a parcel's syntax likely come straight from (or are *direct* vocabulary matches from) the emergent pool of data. But this mathematic or linguistic syntax also requires other words, the connective words and/or words that need to represent previously unassigned "values" (essentially, numbers or ideas) that are also part of this new equation. Those other words are drawn from our vocabulary.

Think of it this way: when we watch Jack grow hostile toward Jill and anticipate him pushing her (and Jill falling) our brain basically says "If Jack pushes Jill, she will fall." Here the sights of Jack & Jill come from that pool of emergent data (providing a direct correlation to their names). But it is the observation of Jack's hostility (not the sight of him "pushing" her, which hasn't happened yet) that's the actual *source* of the word "push."

And where exactly does the word itself come from? That vocabulary resource. When Jack's hostility data emerges, it helps us recognize a pattern in the moment, which calls up related rules—which in turn define the linguistic syntax used to express this pattern. The data also helps us to choose an appropriate word from our vocabulary to represent this value or idea as required by the defined syntax. Basically, during this syntactically-based narrative-building process, our brain has three main sets of resources that it applies to emergent data: a set of inborn rules, an accumulated set of learned rules, and an accumulated set of learned vocabulary. (And right beside them on our neural shelf is that accumulated set of beliefs.)

Keep in mind that all of these resources (although probably more-neatly organized & prioritized) are still using the same basic kinds of neural structures that our data storage uses. Thus, each of these massive collections includes within it a wide array of associations between the different rules or words. Our efficiency in managing *and* our individually-unique handling of these rules and vocabulary is likely affected by the way in which we've set-up these associations between them. Great "thinkers" (scientists, writers, philosophers, professors, etc.) likely have very-efficiently arranged & prioritized sets of rules governing their area of speciality.

However, this kind of rule-system & linguistic efficiency is not likely the same as what we generally consider to be *intelligence* (which reflects neural abilities that are very difficult to improve). We'll explore intelligence in detail shortly, but here's a quick example of why this is true: when we take an IQ test (designed to specifically judge "intelligence") we aren't actually using our system of learned rules to discern & respond to patterns. Rather, we are recognizing & applying patterns that are intended to be demonstrated *within the question itself* (and IQ test answers intentionally do not require a deep vocabulary). Thus, these kinds of tests isolate our more fundamental (and likely inborn) pattern recognition & application abilities.

And the essential sameness between rule/vocabulary/belief-recognition/building/application appears to be another effect of our brain's looping elegance. All of these resources are assembled & applied at basically the same point in the loop. As soon as our brain builds a narrative using rules & vocabulary, it immediately judges it for necessary emotional production. Thus, beliefs are used to help emotionally-analyze a narrative in the adjacent micro-moment after rules & vocabulary are used to build the narrative. This means that the same or very closely-related parts of the brain could easily handle all three tasks, giving those areas an efficient redundancy of purpose (and a likely evolutionary connection in their development).

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Footnotes:

10. Deacon, Terrence. *The Symbolic Species*. Norton, 1999.

11. Robertson, Brita, et al. "GABA distribution in lamprey is phylogenetically conserved." *Journal of Comparative Neurology* 503.1 (2007): 47-63.

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13. Burgess, Neil, Eleanor A. Maguire, and John O'Keefe. "The human hippocampus and spatial and episodic memory." *Neuron* 35.4 (2002): 625-641.

14. Fyhn, Marianne, et al. "Spatial representation in the entorhinal cortex." *Science* 305.5688 (2004): 1258-1264.

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17. Ullman, Michael T., et al. "A neural dissociation within language: Evidence that the mental dictionary is part of declarative memory, and that grammatical rules are processed by the procedural system." *Journal of cognitive neuroscience* 9.2 (1997): 266-276.

18. Marsolek, Chad J., et al. "Hemispheric asymmetries in motivation neurally dissociate self-description processes." *Emotion* 13.3 (2013): 462.