Universal technology of language

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Abstract

This paper aims to demonstrate that in nature exist several fundamental mechanisms, which regulate the complexities. Such a regulatory process introduces two phases of complex systems evolution: the adaptability of undifferentiation and the efficiency of the differentiation that causes stability.

The same two steps regulate neurogenesis by producing undifferentiation and differentiation. It transforms unstructured information into structured data.

This paper discusses why the neurogenesis manifests distinctly in humans versus other animals and how this aspect makes an immense difference in achievement.

Further on, I demonstrate that the mechanism above complexity participated in generating a language-ready brain in humans that serves as a mental blueprint and textbook that can assemble language and factual technologies.

The language-ready brain developed in-depth the processing of linearity that is specific to all life forms. The language is initially processed in mental mapping as a complex nonlinear outcome. Further on, such nonlinear data can be naturally reduced to linearity by decreasing dimensionality. Every reduction causes loss of its initial variances that represents information. **Every process of diversification produces a loss of the initial data**.

During most of the Paleolithic era, the brain used a prevalence of nonlinearly structured data (like olfactive, sensory, and emotional outcomes)—such type of data required nonlinear processing. The language development **highlighted the linear transformation mechanism** that also **increased the diversification process**, **significantly extending the consciousness**.

Every consciousness is linear, but it became vastly developed in humans, paralleling the linear path of language and giving rise to linear technologies.

Keywords: codimensionality, covariance, correlation, context

Introduction

According to Wikipedia, in 1975, Charles Berger and Richard Calabrese created uncertainty reduction theory "to explain **how communication is used to reduce uncertainties** between strangers engaging in their first conversation together." Claude E. Shannon and Warren Weaver (the fathers of information theory) suggested that "uncertainty is reduced when the number of alternatives is limited, and the alternatives chosen tend to be repetitive." This type of **selection increases predictability**. The horizon of predictability is often time.

Because technology follows the blueprint of language, such **technology is intended to reduce uncertainty, too**.

The structured data represents a mental **selection** that implies a quantitative definition.

Such definition can occur only when two or more elements can be **compared** and when **one element** could be **chosen as the reference term or the base of comparison**. **Comparison implies** a rapport or **a proportionality** that can be established between two or more entities. All measurements are the multiplication or proportional divisions of an element that is chosen as the base unit.

In language, diversification comes in the form of letters, words, numbers, etc., which are the symbols' quantitative transformation.

Prediction refers to a future state of a system. Its role is **to estimate how a motion follows commands**. Such a **motor prediction** is internal to Central Nervous System (CNS). It is not a fixed mechanism, and hence, as a plastic feature, it needs to be learned and updated by experiencing an error-and-trial procedure. It is common to all animals or beings.

The same selection mechanism **is involved in prediction** because here, too, **it intervenes in a comparison between probabilities** or variations. One probability is compared with another by analyzing a previously predicted outcome with an actual one.

The **role of comparison** is to reduce the uncertainty because it filters information, eliminating the unwanted or low-relevance data that cannot be appropriately compared. It can also highlight the data needed for prediction and control or enhance other relevant sensory information.

Structuring implies a **dimensional reduction**. Evolution means variation, and variation implies information. Selection chooses only the elements, which can adapt or fit changing conditions.

The dimensional space reduction can occur only when two spaces of different dimensionality share one or more properties. I call the object of such sharing the presence of a **common factor** that is the property that is shared. Such a "common factor" ranges from **codimensionality** to **covariation**, to **correlation**. A "common factor" is, in fact, a natural **bridge**. Covariance is maximal when the bond is linear. Correlation is scaled covariance.

A higher dimensionality translates into a lower one by operating a mental hyperplane processing that **relies on existing codimensionality** (we will see later the details of that process). Further on,

the sharing or relationship is driven by **covariation** that exists between variables. When these two steps are accomplished, it arises a **correlation** developed at a linear level.

Thus, all quantities are arbitrary by their nature, and the relation between them is established by natural "**bridges**," which allow their computing when linearity is achieved.

Our brains can compute three space dimensions, extracting the elements used for comparing. It occurs a rapport established between various properties (like length, weight, etc.). Something is twice as long or twice as heavy as another. In this case, that "another" becomes the "base unit of measurement."

In language, various vocalizations turned compared according to their physical properties. In the practice of speech were used natural **codimensionality**, **covariation**, and **correlation**. These tools are "**bridges**," which naturally exist between the vocalized elements.

Stanford W. Gregory in Analysis of fundamental frequency reveals covariance in interview partners' speech published in Journal of Nonverbal Behavior 14, 237-251 (1990) indicates:

"Spectral analysis of the fundamental frequency band in speech reveals covariance of voice energy levels and thus a possible form of rudimentary social synchrony. Though a number of researchers have observed this phenomenon of paralinguistic covariance, techniques for examining it have not been exploited..."

"This study reports on research showing that the **acoustic signal conveying covariance information** resides in the fundamental frequency band of the speech spectrum…"

"Research conclusions present an efficient, lucid, and reliable method for analyzing the paralinguistic mode of nonverbal behavior, and, in addition, offers evidence that the nonverbal, vocal channel of communication carries a signal embodying a semantic message" (that regards the meaning).

Language studies, where the **language is a complex system with multiple dimensions**, demonstrate **emergent dimensionality** across development. Out of the interactions between the individual elements in the systems, behavior emerges at the system's level as a whole. This so-called higher-order behavior cannot simply be derived by aggregating behavior at the elements' level. (the previous paragraph was quoted from the paper A review of common characteristics of complex systems distributed by the University of Groningen).

Here vocabulary, grammar, narrative, discourse have their dimensions developed as independent abilities.

Lucio Biggiero of University La Sapienza (Rome), in May 1998 stated:

"The **semiotic complexity** represents the infinite possible interpretations of signs and facts, while the **semantic complexity** consists of an infinite possible interpretation of words and texts. Artificial, natural, biological and human systems are characterized by **the influence of different sources of complexity**, turning them more complex".

The apparent dimensionality of different language systems would mostly be emergent rather than innate.

Many linguists use a correlation matrix in their studies because linguistic relationships become more robust when the correlation coefficient is further away from zero. Correlation is a scaled covariation.

Covariance is employed as a statistical measure of the directional relationship between two elements or assets in finances. It is used to **reduce risk by providing diversification**. Hence, diversification produces an uncertainty reduction.

One may consider the language as a toolset. But such a toolset assembles things similarly with every known type of technology because it exploits the natural properties embedded in the matter's fabric. For this sake, all technologies are a disguised copy of our language.

Every language can generate an infinity of other languages. Technology can produce an infinity of different technologies by playing with its assembling/disassembling capacity.

Verbal and its utterance are not the only language: here, there are the sign, visual, musical, mathematical, and many more types of languages. All these languages use the same assembling and disassembling process, known more generally as analysis and synthesis.

As Professor Dr. Jon Dron with Athabasca University, Edmonton, Canada, has stated in a seminal paper with the title "Is language a technology?":

"We can use language to manipulate ideas, create and transform concepts, design, explore, analyze, and more to achieve some goal or goals. We can use language to manipulate language, to construct things in language, and use those constructions to make other constructions".

"It is in many ways the fundamental human invention, hugely more important than everything else, like fire, the wheel, or the Internet. To be human without language is barely conceivable; a lack of language to become widespread, we will no longer be humans".

"Language is the ability that enables us to symbolize, abstract, construct, amplify, and enhance, but also it generates the opportunity to spread technologies, build ideas, learn, create, discover."

"It's a wonderful virtuous circle that leads to an ever-expanding explosion of knowledge in our species as a whole even though we, as individuals, are likely getting dumber and are very likely dumber than some of our distant extinct cousins. It is not intelligence that makes so successful as a species: it is how we use technology to amplify that intelligence".

Assembling combines several simple elements, creating complexity, where the original properties turned significantly changed, while some properties become amplified.

Humans before language were very similar to all other animals. Such different animals could climb a few steps up on the scale of intelligent evolution. But language made us rise to the top and continues to amplify such a distinction.

I would say that "intelligence" is in the language that is transmitted to technology. In other words, **"intelligence" is the result of "assembling/disassembling." Intelligence naturally resides in "complexities" that result from "assembling/reassembling."**

A complex system generated by initial flexibility needs a certain level of variety caused by **differentiation** because it **introduces stability**. Even when the dimensionality is reduced by differentiation, causing a loss of information, by collecting those differentiated parts, novel self-organization intervenes to produce an emergent property of the system, a property that the individual components do not have.

The "**intelligence" is an emergent property of that complexifying system, not a mental feature developed by the brain**.

Hence, the **differentiated parts' assembling produces a collective "intelligence"** in the form of a novel but an emergent property of the whole. Novel high-level properties make that system behave intelligently. They are directly generated by collective dynamics of the nonlinear interactions among the components. The new emergent order appears like a macro result of the nonlinear micro-interactions.

Every complexity tends to grow exponentially, increasing a type of chaotic evolution that opposes "order." The complexification in dynamic-adaptable-systems needs additional energy to minimize chaotic growth and preserve a form of equilibrium. All biological systems are negentropic. Negative feedback loops maintain the system equilibrium. If the energy needs are not appropriately fulfilled due to intervening positive feedback loops, the system falls apart.

As it appears, the **"intelligence," derived from complexities, naturally tends to increase exponentially**. But this does not characterize a mental state or process in itself: **it indicates that the mentioned process continues to evolve exponentially on its own, producing an exponential augmentation of newly generated complexities**, which become the subjects provided to further disassembling/assembling operations. Hence, it is nothing mental about such evolution. It is there a natural mechanism that works until it breaks apart, crossing into chaos.

I would say that brain processing does not evolve because the **mentioned mechanism independently acts on its terms**. By contrast, the brain deals with a continual reduction in initial information that reduces the nonlinear quality of processed data. It diminishes the initial meaning and causes progressive dumbness.

I like to quote James Ladyman, James Lambert, and Karoline Wiessner with a significant example in their paper What is a Complex System? They explain:

"For example, when they undertake complex tasks, the ants behave as they do because of the way they interact with each other. On the other hand, no individual ant has any idea what they are doing, and left to their own, they will exhibit much simple behavior."

As some scientists see it, we have turned dumber in the last century, while our power of assembling increased; even then, we are capable to "assemble" an ever-increasing number of new

technologies. As the mentioned process evolves exponentially, in each step, we lose some of the initial information. This makes our brain lose access to prime data, and thus, the processing becomes increasingly dumber.

Method and materials

I used in this paper the data provided by the Information Theory and many associated ideas. I corroborated the mentioned data with neuronal biology and information on the neurogenesis process.

This paper's core is based on Professor Jon Drone's publications from Athabasca University, Edmonton, Canada (as mentioned in references).

I used information, as quoted, from Professor Salikoko S. Mufwene of the University of Chicago. His article I mentioned was included in the paper In Search of Universal Grammar: From Norse to Zoque, edited by Terje Lohndal, John Benjamins.

I have also quoted Dr. Srishti Saha on the connection that exists between covariance and correlation because it shows how the mechanism of language functions at its fundament.

I quoted James Ladyman, James Lambert, and Karoline Wiessner from the University of Bristol, UK, with the paper What is a Complex System?

I also used Motor prediction, written by Daniel M. Wolpert and J. Randall Flanagan, with a Primer paper.

I have drawn my conclusions, which might justify that the language-ready brain produced a significantly novel and different brain-set to equip a new Homo species mentally.

This paper is associated with several other articles of mine that profile the case of a new mental species that recently evolved out of Homo sapiens.

The results

The results indicate that neurogenesis can explain the facts that made the language behave like technology.

But first, let's see how our Mathematics transforms a nonlinear product into a linear result.

Here, there are two steps:

-in the first step, the nonlinear input data is transformed into a higher dimensional space by using a nonlinear mapping;

-the second step generates a linear separating **hyperplane**; a hyperplane is a subspace whose dimension is one dimension less than that of its ambient space.

As Wikipedia explains, "the difference between a subspace S and its ambient space X is known as the **codimension** of S concerning X. Therefore, a necessary condition for S to be a hyperplane in X is for S to have codimension one in X."

I would say that a language-ready-brain became possible when anatomical changes and transformations solely **allowed the cognition, but not the olfaction, visual or other senses, to identify codimensionality, covariances, and correlations**. Only such features, being used as natural bridges, permitted language development by operating mandatory disassembling/assembling, analysis/synthesis.

In neural networks, the neuroscientists see a similar transformation path, where a **neural type of hyperplane** generates a nonlinear mental mapping that may qualify for unconscious nonlinear structures.

Such a process is said to occur in all types of brains.

Let's see the three stages of human neurogenesis.

The **first stage** of neurogenesis produces **undifferentiated neurons**, which can adjust to almost every challenge. These unidentate neurons represent a sum of all probabilities that exist. They behave nonlinearly and have **no structure**.

In the **second stage**, the brain prompts to make a selection out of such undifferentiation. In this second stage, it is generated the **mental mapping** that contains **nonlinear structures**.

In the **third stage**, the cognitive mapping of nonlinear structures is transformed into **linear structures**. This last step generates consciously expressed linear outcomes.

Overall, the mechanism switches from nonlinear quality into linear quantity by lowering that dimensionality. The process mandates the existence of a codimension that intermediates the translation.

For example, the first defined quality probably was that of daylight. Several days are complete by a multiplication process, a designed cycle named week, month, or year.

The concept of a day was nonlinear and multidimensional, too. By reducing this multidimensional detail, a detailed quantification was created like that of the hour. The dimensionality of an hour was further reduced, making minutes or seconds.

Each of these subdivisions is produced by the introduction of a mental **hyperplane processing**. Each subdivision is one dimension less than the original product. Each subdivision represents a disassembling that reduces the actual variance that is the original information.

Combining the disassembled pieces, the process does not build the original nonlinear dimensionality of the whole again. The **reconstruction error (information loss) is defined as the mean squared distance between the original and the reconstructed points**.

Dimensionality reduction comes at the cost of information loss.

That is why the sum of the parts is never equal to the nonlinear whole.

But it matches the linear whole. As it seems, our brain and mathematics cannot restore an initial nonlinear dimensionality that existed before hyperplane processing occurred.

However, mental selection processes reach those elements of reality, which possess minimal variability, indicating a slow rate of change, which can be mentally computed, controlled, and predicted.

All **low change phenomena and processes are linear and possess a maximal covariance level**, allowing "bridging" and manipulation.

A linear space enables the brain to compare the elements using the "bridges" because covariance is maximal when the bond is linear.

Linear selection suffices to increase the rate of survivability because it **provides prediction, control, causality**, which all result from "bridging." In all, such a linear selection is a short-term and fast approach required by the immediateness.

Discussion

I could assume that the undifferentiated neuronal stage of neurogenesis would be familiar to all animals. It provides a potentiality for all probabilities. It is fully nonlinear, but no one on this planet can consciously compute nonlinearity.

As it is the case, our brain and all animal brains could process nonlinear data, but the result remains unconscious. Even then, it is known that the unconscious processing provides much of the data expressed consciously. This type of transfer is caused by those **bridges** mentioned above that **allow selection/differentiation**.

In a nonlinear data structure, such data is hierarchically connected and is present at various levels. These nonlinear structures use memory very efficiently. The data remains the same, disregarding an increase in its amount.

However, linear data structures are not memory friendly and cannot use memory efficiently. When this data's complexity increases, the size of the number of data increases, too, causing a significant burden for memory accumulation.

The intuition is nonlinear, introducing a correlative approach. Our ancestors may have confused the **correlations** they made for a natural type of causality. But here, Dr. Ciaran Lee, Senior Researcher Scientist at Babylon and Honorary Senior Research Associate at UCL, stated the following: "We combined multiple correlating variables from incomplete medical datasets and showed, with a high degree of confidence, which correlations mean causation."

Several other researchers in Artificial Intelligence found causative variables and identified correlative causation. Hence, if our ancestors were somehow wrong about the correlations, that thing was right only in part of their estimates. Such a partial correlativity occurs because it exploits

only one or more codimensionality. The rest does not show codimensionality, and therefore, it does not fulfill a causal correlation.

In Mathematics, nonlinear correlations are considered fallacious. But in Genetics, some new methods are used to quantify a global nonlinear relationship; and, they find evidence for some local nonlinear correlations. Probably again, such a case arises because of a limited codimensionality.

A minimal linear selection should occur in all animal brains because only such a selection can deal with the surviving needs. The surviving choice stands for the reduction mechanism that introduced linearity into the animal world.

So, the linear section always existed because it defined surviving and was always intermediated by the aforementioned **natural bridges** embedded in the fabric of matter.

Hence, all animals would have a minimum of consciousness, and it would differ from one species to another.

All animals process the bulk of perceived data by the olfactory system and other senses, which are nonlinear. Their limited developed cognition (because their neurogenesis output does not support it) selects only a small amount of structured data that refers to minimal communication, minimal control, and planning. This minimal selection is bridged to their conscious processing, becoming structured.

In humans, because of their switched type of neurogenesis, **the cognition processing extensively prevails**, while it provides an enormous increase of structured data. All such structured data are turning conscious. The same structured data becomes available for communication, planning, control, and socialization, which functions are hugely developed in humans compared with the rest of the animals.

There is a clear distinction between very many selections produced by cognition and a significantly much smaller amount provided by olfaction and other senses. These senses have little room for development.

By contrast, the **cognition behaves with extreme plasticity** because it remains open to vast sets of unstructured information, turning structured. By structuring, awareness produces continual adaptation.

From language practice, such a process was applied to all deals with the surrounding material world. Everything turned dissembled and reassembled, making products for daily needs, which, at the moment, have increased the species' immediate survivability.

In my opinion, humans survived by acquiring the language ability. It came in parallel with a general adaption to various challenges, which prompted African migration.

But here, the Theory of Complex Adaptive Systems tells a different story.

Efficiency would have a complexity profile where it resides a **lower complexity** that extends on large-scales. In creating a large-scale complexity, the lower-scale complexity was sacrificed and resulted in **non-adaptive trends**. This situation is well reflected in the production in Africa of only one to two haplogroups.

It seems to be the picture that defines humans before migrating out-of-Africa. These humans were not adapted to challenges posed by out-of-Africa pathogens and other different environmental conditions. They were not adaptable to unforeseen variations occurring within their biology and within the environment. Hence, their repeated attempts to leave the continent eventually produced devastating results.

Such a situation indicates that a major switching in human neural activity occurred just before archaeologists and geneticists dated a mass African migration out of the continent.

Consequently, **we can suggest a first but significant switching in human neurogenesis around 55-50,000 years ago**.

The assumed switching indicates that neurogenesis increased suddenly, causing a **rapid augmentation in the production of undifferentiated neurons**, which show greater complexity and produced higher neural plasticity. The new mental setup sacrificed its original large-scale behaviors, reducing individual complexity. On the other hand, the switching allowed large-scale cooperation within the communities. The **neural efficiency was replaced by high neural adaptability**.

However, the Complex Adaptive Systems Theory stipulates that the systems may fluctuate between the mentioned states over time. Our history is full of such behavioral fluctuations, switching from grand cultures, expressing efficiency and stability, to their total alienation caused by conquering migratory people, who came with higher brain plasticity and adaptability.

The complexity states and processing in all brains may cyclically oscillate between "efficiency" (stability) and "adaptability" (flexibility).

It has been argued that "language is a natural collective technology that evolved primarily to facilitate efficient communication in populations" (Salikoko S. Mufwene, University of Chicago). It was found that language implies several other things, which are as important as the communication itself: they are **planning** (all utterance is designed in mind), **control** (the reason of language is to control the audience, and by such authority, the statement can be shared), **socialization** (there is no reason one to talk for himself only).

Thus, in my opinion, the **essential clue implied by language was a new capacity to structure data through the only available venue that was cognition**. The other senses allow limited plasticity, and they could not support the size of the complexity, like that imposed on cognition by the advent of language.

Development of utterance found the sound equivalence for mental symbols. It replaced the initial sign (from sign-language) with a vocal counterpart that was still a sign (for a symbol). For this reason, signing and utterance coexisted for a long time.

The leap forward started some 60-50,000 years ago, probably introducing the first coherent "mental mapping," but the language revolution occurred only 40-30,000 years ago when a chain of other geophysical events favored another new increase in human neurogenesis.

As it is known, humans developed neurogenesis distinct that other animals because the **human brain drove the flow of new neurons toward other regions of the brain that were not in charge of olfaction or other senses**.

For all other animals, neurogenesis renews and improves olfaction and other senses because the animals use olfaction to scan the environment in-depth. For example, there is known that most animal olfactive systems can check for many miles away that is a much extensive ability than optical/visual scanning. It is like seeing around the corner.

Also, the olfactive system of animals must disseminate within the complexity they scan. In other words, the animals know well beyond their visual capabilities what is going on in the environment. It occurs a selection that causes partially structured data.

I have to note that most specialists estimate, but only based on limited experiments on feral individuals, that a languageless person would have a very primitive consciousness, with weak memory and limited cognition. No investigation into neurogenesis processing was performed.

However, this limited studied aspect shows the **eventuality of losing language** at an early age **would inflict significant functional changes in the brain**.

Modern people think the way they talk. Not talking and not hearing any talking around you will influence your thinking process to adapt differently to such a non-communication condition. These individuals made for surviving a mentally driven selection based on non-communication approaches, even when their neural network was genetically set up otherwise.

It is known from fMRI tests that the congenital blind people performed in all categories similarly to normally sighted individuals because of an existing identical genetic matrix. In the meantime, it was found experimentally that all perceptions work in tandem as being genetically interrelated. Hence, when temporarily or permanently occurs the diminishing one perceiving power, the brain compensates by enhancing other senses.

Here, it may be concluded that the development of human language gradually diminished other senses.

Many studies have analyzed the role of humanly sensed olfaction in reasoning and thinking. They showed that humans still possess an olfactory logic rooted in deep ancestral genetics.

It is also known that the language can evolve on its terms that would be somehow independent of perception. There is widely assumed that **language has displaced or interrupted other forms of thoughts and interaction**, like those based on olfaction and emotion.

Language development significantly enlarged socialization, prompting self-domestication that altered the old emotional aspect that had primarily driven a prehistoric person's reasoning.

The neuronal verbal plasticity improved human capacity to adapt to new environments and conditions, prompting them to migrate around the planet successfully.

Neural specialization contributed to significant memory, learning, and cognition improvements, gradually building up the modern brain.

Conclusion

However, the disassembling/assembling process in our brain led to a partial loss of initial information. As much as the practice of language evolved, more of the initial information was lost. The same process of information losses was translated into the buildup of technologies.

Initially, the reduction of language dimensionally reduced the environmental uncertainty associated with cognition (beliefs and attitudes) and behaviors. It switched to linear uncertainty that hides behind an information loss.

The technology worked as an extension of the language. It introduced the predictability and direct control over the uncertain inhabiting the natural outcomes. It produced a linear rebuilding where were introduced processes and functions with predictable/controllable results. But the entire construct remains linear while hosting significant information losses from initial data. As technology developed, the information losses proportionally augmented, instantiating us further away from natural reality.

As it seems today, the initial **individual uncertainties** were communicated to a collective and an ever-extended social level, **becoming social uncertainties**. Hence, personal uncertainty was reduced only at an apparent and temporal level, serving the moment's surviving needs.

Technology introduced a contaminant concentration ratio that exponentially accelerates as more technology is created and displayed within the environment. These contaminants are linear and profoundly change the nonlinear habitats and ecosystems, devastating their original qualities and compromising their nonlinear life-supporting capabilities.

Such linear contaminants vastly affect the surroundings because they would like to interact unobservable with one another in ways far from our understanding.

We have these linear contaminants because we cannot restore the initial dimensionality without errors that assumedly resolute natural recycling.

However, as many scientists admit today, our technology-end-result overall increased the uncertainty in an existentially hazardous manner.

Acknowledgment

This paper aims to explain how the language was produced by enhanced neurogenesis and why it embeds all technology features.

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