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The Logical Linguistics: Logic of Phonemes and Morae Contained in Speech Sound Stream and the Logic of Dichotomy and Dualism equipped in Neurons and Mobile Neurons Inside the Cerebrospinal Fluid in Ventricular System Interacting for the Unconscious Grammatical Processing and Constitute Meaning of Concepts. (A Molecular Level Bio-linguistic Approach)

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Abstract: This is an interdisciplinary integration on the origins of modern human language as well as the in-brain linguistic processing mechanism. In accordance with the OSI Reference Model, the author divides the entire linguistic procedure into logical layer activities inside the speaker's and listener's brains, and the physical layer phenomena, i.e. the speech sound stream or equivalent coded signals such as texts, broadcasting, telecommunications and bit data.

The entire study started in 2007, when the author visitedthe Klasies River Mouth (KRM) Caves in South Africafor the first time, the oldest modern human site in the world.The archaeological excavation in 1967-68 (Singer Wymer 1982) confirmed that (anatomically) modern humanshad lived inside the caves duringthe period120 – 60 Ka (thousand years ago), which overlaps with the timing of language acquisition, 75 Ka (Shima 2004). Following this first visitIstarted an interdisciplinary investigation into linguistic evolution and the in-brain processing mechanism of language through reading various books and articles.

The idea that the human language is digital was obtained unexpectedly. The Naked-Mole Rats (*Heterocephalus glaber*) are eusocial and altruistic. They live underground tunnel in tropical savanna of East Africa. (Wilson 2012) They are also naked like Modern Human with thin skin and thin hair, and are highly vocal known for their eusocially structured and altruistic society. But they have just a total of 17 different sound patterns in their communication. Such huge difference in vocabulary between modern humans and Naked Mole Rats forced me to think of the digitalsystem.

After 8 years of interdisciplinary research, I came to the conclusion that logical elements of phonemes and morae contained in the speech sound stream interact with sign (=word) memory represented by mobile neurons (= memory B-lymphocytes)inside the cerebrospinal fluid (CSF) in the ventricular system. Phonemes and accents in speech (sound) are modern human uniquelogical properties in vocal sound. The transmitter for logical speech (sound)coincidently developed within two distinctive Neolithic cultures, Still Bay (72-71 Ka: thousand years ago) and Howiesons Poort (65-58 ka) both techno-complexesin the Middle Stone Age (MSA) in South Africa along its southern coastline.

The spinal sign reflex mechanism of vertebrates is hypothesized as neuro-immune cell interaction inside the CSFof the ventricular system. The logic of dichotomy displayed in Antigen-Antibody responses (or Idiotypical Networks, Jerne 1974) cooperate with word stimuli. Human language uses the spinal reflex mechanism as a physical sound→ logical inner speech decoder.

The automatic grammatical processing is performed byconverting the sound localization function at the brainstem auditory nuclei, which explains the monaural sound audition of mother tongue speechwith the exception of Piraha. Piraha keeps binaural sound audition for the mother tongue speech, but without grammatical modulation.

The meaning of complex logical concepts for sciences is established through repetitive and extensive thought operations. It is advised to differentiate the usage of logical concepts in accordance with logical orders.

The future development of modern humans depends on how we correctly use language. Cartesian *"Cogito ergo sum"* should be modified to"*Words think: Concept devices representing individual word signs network inside the brain cerebrospinal fluid, which is thought.The more correct, accurate and appropriate words we use, the more correct our thoughts are and the further we advance."* Thereasoningof human beings does not exist as itself, but it can exist when we fully respect the accumulation of common human culture and represented in linguistic information asanintellectual genome and adjust the individual neural networks inside the CSF.

Keywords: Modern Human Evolution, Origin of Language, Laryngeal Descent, Monaural Audition of Mother Tongue, Automatic Grammatical Decoding, Complex Logical Concepts, Immune Networks, Cerebrospinal Fluid, Ventricle System, Dualism, Dichotomy

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Introduction to Interdisciplinary Analyses for Digitally Networked Automata

Human language is a complex, i.e. interdisciplinary and invisible system, and thus its mechanism is beyond our immediate and instant perceptibility. In order to understand such animperceptible language mechanism, schematic reference models are useful, because they subdivide the complex system into perceptible sub-systems. "*It is clearly necessary to subdivide the problem that they represent into several parts. ... The organisms can be viewed as made up of parts which to a certain extent are independent, elementary units*." (Neumann 1951)

The human central nervous system (CNS) which operates linguistic communications can be subdivided into (i) Vocal Tract and Motor Control for Speech Sound Generation, (ii) Voice/Speech Waveform as Physical Sound in the ambient environment, (iii) Ear and Auditory Nuclei in CNS, (iv) Reflexive Actions and Recall of Memories, (v) Automatic Grammatical Processing Unit and (vi) Conceptual Devices.

General and Interdisciplinary Definitions for Concepts

To consider the interdisciplinary phenomena, it is necessary to establish concepts which are consistent in the entire system with as clear and as transparent definitions as possible. It is known that the similar phenomena and/or materials are named differently in different disciplines, and the same name is used in different meanings in different study areas. (See Appendix-A)

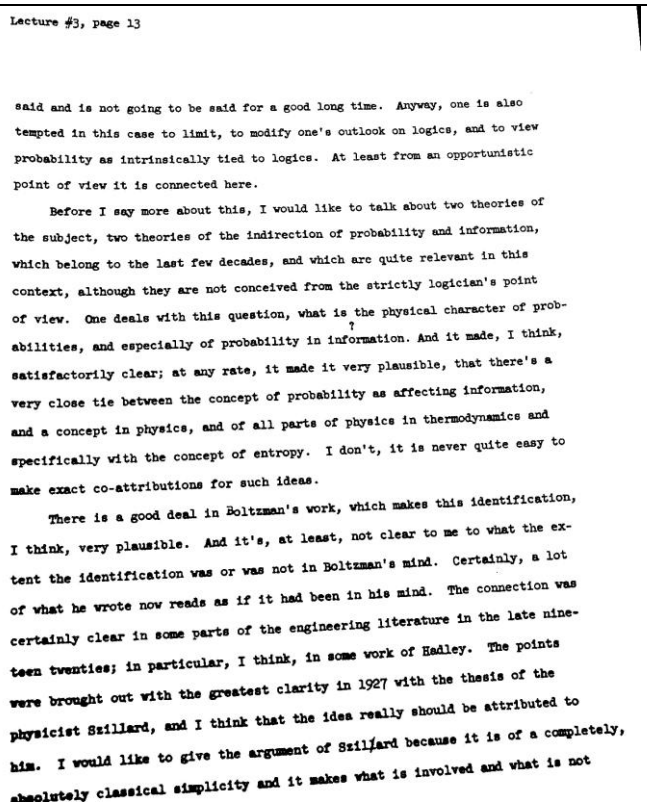
Anexample is"vocabulary" in linguistics, "consciousness" in psychology and "word memories" in neurosciences, which are all related to word memories generated as, acquired by and stored in "concept devices". They are the same or they overlap each other. In this article, whereI use "word memories", then "vocabulary" should be paraphrased as "aggregate of word memories", and "consciousness" as "aggregate of word memories and their networks insidethe brain". Biologically they are all functions of concept devices.

Another example is Herbert Spencer's suggestion that instinctive reactions are reflexes, as cited by Pavlov. (1927) "The study of instincts" (Tinbergen 1951) can thus be treated as the study of reflexes, and be regarded in the same manner with Pavlov's experiments of conditioned reflexes. Pavlov concluded, "It follows from all this that instincts and reflexes are alike the inevitable responses of the organism to internal and external stimuli, and therefore we have no need to call them by two different terms." Following his conclusion, I equated Tinbergen's concept "Innate Releasing Mechanism" with Pavlov's "Reflexes".

An example of the same word representing opposite meanings in different disciplines is "entropy" in information theories and in thermodynamics. "In information theory, entropy is a measure of the uncertainty in a random variable. (In this context, the term usually refers to the Shannon entropy)" while in thermodynamics, entropy (usual symbol S) is a measure of the degradation or displacement of components caused by thermodynamic environmental effects. It is not ideal in interdisciplinary analysis that a word should have two different meanings.

I investigated von Neumann's Automata theories (1951; 1986) and discovered that he predicted that information theory should consist of formal logics and thermodynamics. (Figure-1) On the other hand, Shannon did not reply to interviewers questions of the IEEE and OMNI how he had got the idea of entropy and why he named it as "entropy". In order to avoid confusion in this article, Shannon's theories should be put aside ashe did not explain at all how he conceived his idea, and there is a contradiction between his theories and figures. (Figure-2)

In this way, any important concepts should be investigated and evaluated so that they can freely circulate among subsystems without confusion and, thus, interdisciplinary knowledge should be consolidated. I believe the unification of conceptual definitions is the prerequisite of axiomatic thought.



Lecture #3, page 13

said and is not going to be said for a good long time. Anyway, one is also tempted in this case to limit, to modify one's outlook on logics, and to view probability as intrinsically tied to logics. At least from an opportunistic point of view it is connected here.

Before I say more about this, I would like to talk about two theories of the subject, two theories of the indirection of probability and information, which belong to the last few decades, and which are quite relevant in this context, although they are not conceived from the strictly logician's point of view. One deals with this question, what is the physical character of probabilities, and especially of probability in information. And it made, I think, satisfactorily clear; at any rate, it made it very plausible, that there's a very close tie between the concept of probability as affecting information, and a concept in physics, and of all parts of physics in thermodynamics and specifically with the concept of entropy. I don't, it is never quite easy to make exact co-attributions for such ideas.

There is a good deal in Boltzman's work, which makes this identification, I think, very plausible. And it's, at least, not clear to me to what the extent the identification was or was not in Boltzman's mind. Certainly, a lot of what he wrote now reads as if it had been in his mind. The connection was certainly clear in some parts of the engineering literature in the late nineteen twenties; in particular, I think, in some work of Hadley. The points were brought out with the greatest clarity in 1927 with the thesis of the physicist Szillard, and I think that the idea really should be attributed to him. I would like to give the argument of Szillard because it is of a completely, absolutely classical simplicity and it makes what is involved and what is not

Figure-1 Type written version of von Neumann's 1949 Illinois Univ. Lecture-3 (Tokumaru 2015)
(Photographed at US Library of Congress, Manuscript center in March 2015 by the author.)

Reference Models as a Guide Map to Locate the Point of Discussion

As the entire linguistic mechanism is beyond our recognition, it is useful todivide the whole system into subsystems viaReference Models. Fig.-2 Schematic Diagram of a General Communication System (Shannon 1948), which contradicts his theories.Because "Noise" in the channel is a function of "k" (Boltzmann Constant) and "T" (Absolute Temperature), indicating "entropy" of communication theories can also be a thermodynamic concept.

Human linguistic communication is divided into subsystems as shown in Table-1.

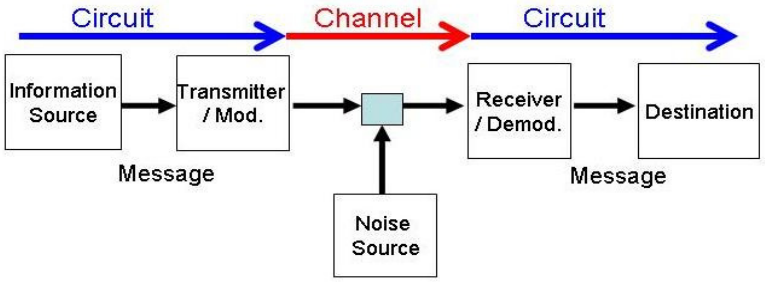


Fig.-2 Schematic Diagram of a General Comm. System (Shannon 1948) with distinction of Circuit and Channel by the author

Table-1: Fig.-1 Elements and Anatomical Organs (Analytical Comparison)

Information source	Brain (Desire / Motor Control)
Transmitter	Vocal Organ / Mouth
Signal	Speech Sound
Receiver	Ear / Auditory Nuclei / Brainstem /Auditory Cortex
Destination	Brain (Memory Networks / Motor Control)

Fig-2 model corresponds to analog communications, which communicate physical signs. In complex human digital communication, grammatically aligned logical properties are exchanged usinga physical carrier, (such as a)speech sound waveform. In order to analyze the complexity of human digital communication, we need to refer to the OSI Reference Model containing logical and physical layers, which is used for the analysis of computer networks.In Fig.-3, human linguistic activities are tentatively deployed in the OSI Reference Modelfor in-depth analysis and evaluation.

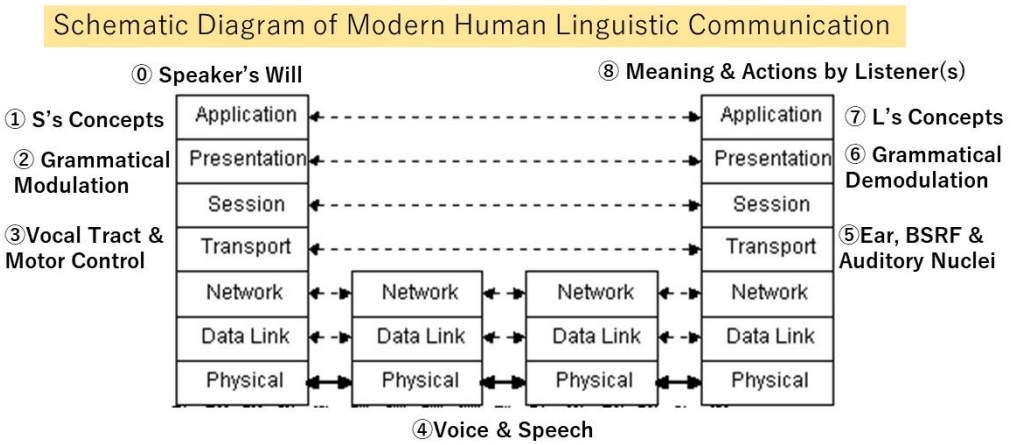


Figure-3 An OSI Reference Model for Computer Network Analysis with indication of Human Digital Linguistic Subsystems (⓪ to⑧) added by the author. (S=speaker, L=Listener, BSRF= brainstem reticular formation)

The OSI Reference Model (Figure-3) is a logical and digital development of a physical and analog system outlined in Fig.-2. (Tanenbaum & Wetherall 2011).This model was invented to analyze complex digital computer network system. In Fig-3, the top three layers (Application, Presentation and Session) are logical layers, the bottom three layers (Network, Data Link and Physical) are physical, and the middle layer of Transport is in charge of logical/physical conversion.

To my understanding, mammal vocal communications are based on physical signs and intensity thus analog, while human speech uses logical signs thus it is digital. In order to get a better understanding of how digital human language is, refer to Table-2. Comparison of Digital / Logical Systems. Computer Networks, Genetic Expression of Eukaryote and Human Language are all digitalsystems.

Comparison of Digital / Logical Systems			
System	**Computer Networks**	**Genetic Expression in Eukaryote**	**Human Language**
Digital Signal Unit	Voltage Bit	RNA	**Syllable ***
Micro Energy	Repulsive Force of Electron	Chemical Bonding	Accented Waveform *
Multi Value	2 (Binary, On/Off)	4 (A=U, G≡C)	112 (Japanese), 3400 (English) syllables
Low Noise Environment	CPU Register	**Inside Nucleic Membrane ***	Inside CSF in Ventricular System
Modulation Switches	Communication Protocol Switches	Non-Coding RNA	Grammar
Modulation Mechanisms	Protocol Switches	Post Transcriptional Modulation	Auditory Nuclei in Brainstem and Celia of CSF Contacting Neurons
Content	Data	Genome	Concept
Pattern Recognition	n/a	Translation by tRNA	Epitope/Paratope

			(Antigen-Antibody Response)
Information Unit	***Packet***	***mRNA***	***sentence***
Error Avoiding RedundancySystem	**Verification of Error Correction Code ***	Degeneracy in Codon (64 → 20 amino acid)	Sound Symbolism
Long Term Memory	Magnetic/Optical Media	DNA Double Helix	CharacterSet
Digital Evolution Trigger / Digital Breakthrough	Error Correction Code and High Speed CPU	Nucleic Membrane for Low Noise Environment	Syllables containing micro-energy enabled by Laryngeal Descent
Analog System before Evolution	Computer Communication	Prokaryote	Sign Reflexes and Analog Communications.

Table-2 Comparison of Digital Systems (* indicates the final acquired element)

Laryngeal Descent for Vocalization of Syllables

The Oldest Modern Human Site, Klasies River Mouth Caves

On the Indian and Atlantic Ocean coasts of South Africa, there are many caves where humans lived in the South African middle stone age (MSA, 300 – 30 Ka). MSAis important because it overlaps with the timing of the birth of the modern human and language. Among them, Klasies River Mouth Caves (34.06 S, 24.24 E, Figure-4/6) are known to be the oldest modern human site located in the Eastern Cape Province, about 150km westof Port Elizabeth. The hollowed caves face out onto the merging zone oftheIndian and Atlantic oceans, and were made in the sand stone layer through erosion by the strong waves.

This sand stone layer was lifted up to an altitude of several hundred meters above sea level approx. 400 million years ago and the cliff was created 145 million years ago when Gondwanaland was broken up. It is interesting that the separation took place at the same time as the gigantic Morokweng meteorite impact (23°32'E, 26°28'S), equidistant from the southern coastline of South Africa.

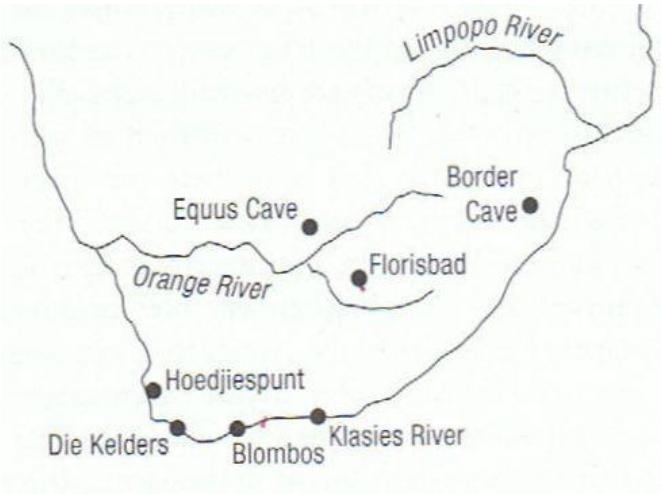


Figure 4. Middle Stone Age sites in South Africa (Deacon & Deacon 1999)

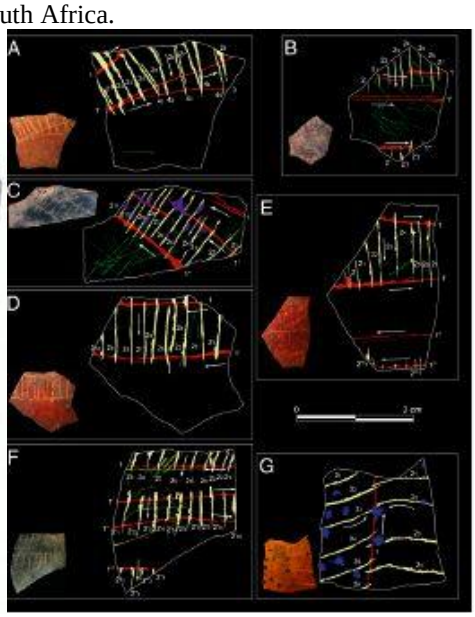


Figure 5. Engraved Ostrich Eggshell (Texier 2010)

Fig.6 Klasies River Mouth Cave No.1/2

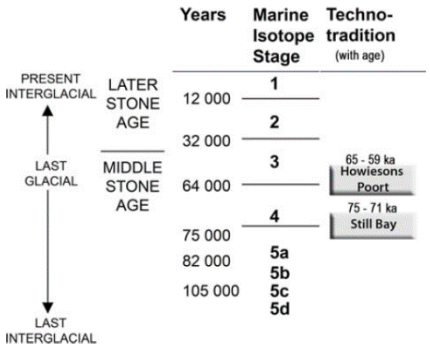


Table-3 MSA and HP/SB

Caves1 and 2 are on the South African government's provisional list for UNESCO World Heritage. At cave 1, large scale excavations conducted in 1967-1968 led by British archaeologist, John Wymer, revealed that the human occupation had begun very early in the late Pleistocene, as old as 120 Ka. Singer and Wymer (1982) outlined the stratigraphy and MSA cultural succession and discussed the significance of shell and animal bones, human remains, and artifact assemblage. (Rightmire, Deacon, Schwartz, Tattersall, 2006)

Although KRM 3 and 5 are not regarded as important as KRM1/2 by archaeologists, KRM3/5 provided a more comfortable living environment than KRM 1/2. KRM 3 with its very high ceiling, vast open space, a lot of beautiful stalagmites, warm, ~~an~~ easy access to potable water and a breathtaking west facing aperture for an ocean sunset view seems to be the most impressive and comfortable. KRM 5 is much narrower than KRM3, and it provides a cleaner environment to live as currently KRM3 is occupied by bats and their faeces.

Analysis of the KRM fossils, especially those of mandibles, are on-going by various researchers. (Rightmire G.P., Deacon H.J. 1991; Royer D.F., Lockwood C.A., Scott J.E., Grine 2009) At the conclusion of a comparative study, Royer et al (2009) stated that 'This study demonstrates that size variation in the Klasies River mandibular and dental samples is greater than in modern human populations, supporting the hypothesis that this MSA population was more dimorphic.' And 'In contrast, there is little evidence for high levels of mandibular or molar size variation among samples of Neandertals.' This dimorphism is interpreted as sexual dimorphism and 'the degree of dimorphism exhibited in the Klasies specimens was not unique among middle and late Pleistocene hominins.' The author presumes that the dimorphism in the Klasies specimens might indicate an evolution of a mandible.

Critical Importance of Middle Stone Age South Africa for the Birth of Modern Human

The statistical analysis of SNP (single nucleotide polymorphism) in mitochondrial DNA revealed the African origin of modern humans, and in the 21st century, the Recent Single Origin Hypotheses of Modern Human (RSOH) is generally accepted byanthropologists. (Cann et al 1987) If we take the results of analysis by archaeologists and linguists into account, there is no other hypothesis for modern human origin than RSOH,

According to linguists, there is 'considerable parallelism between genetic and linguistic evolution', and the Khoisan language is supposed to be the oldest language. (Cavalli-Sforza et al 1988). Archaeologists narrowed down the birth place of modern humans as Hunter-gatherers in South Africa (Henn et al 2011). It is time to overlay the hypothesis of modern human evolution onto that of linguistic evolution.

Goodwin and Riet Lowe (1929) proposed a three stage division of the Stone Age into the Earlier (2.5Ma– 250Ka), Middle (250Ka – 22Ka) and Later (22Ka – 2Ka) Stone Ages. 'The Earlier Stone Age (ESA) is characterized by large bifacial (flaked over both faces) artefacts, with handaxes being the diagnostic form. The Middle Stone Age (MSA) was characterized by the use of cores – pieces of stone skillfully prepared to produce flakes of regular triangular or parallel-sided shape. The definition of the Later Stone Age (LSA) suggested a technology designed to produce microlithic (small) tools and blades, but stressed the association with the San rock art and burials.' (Deacon & Deacon 1999)

The above division into ESA/MSA/LSA is basically respected and followed by the contemporary archaeologists. (Table-4,Lombard, M., Wadley, L., Deacon, J., Wurz, S., Parsons, I., Mohapi, M., Swart, J. & Mitchell, P. 2012)

TABLE 1. *The South African and Lesotho Stone Age sequence based on current data. The dates are not a neat fit because of variability and overlapping ages between sites.*

Period	SAL technocomplex	Also known as (including regional variants)	Broadly associated MISs
Later Stone Age <40 ka	*ceramic final Later Stone Age* <2 ka	ceramic post-classic Wilton, Late Holocene with pottery (Doornfontein, Swartkop)	MIS 1
	final Later Stone Age 0.1–4 ka	post-classic Wilton, Holocene microlithic (Smithfield, Kabeljous, Wilton)	MIS 1
	Wilton 4–8 ka	Holocene microlithic (Springbokoog)	MIS 1
	Oakhurst 7–12 ka	Terminal Pleistocene/early Holocene non-microlithic (Albany, Lockshoek, Kuruman)	MIS 1
	Robberg 12–18 ka	Late Pleistocene microlithic	MIS 2
	early Later Stone Age 18–40 ka	(informal designation); Late Pleistocene microlithic	MIS 2 to MIS 3
Middle Stone Age >20 to <300 ka	*final Middle Stone Age* 20–40 ka	(informal designation) MSA IV at Klasies River, MSA 4 generally	MIS 2 to MIS 3
	Sibudu 45–58 ka	late MSA/post-Howieson's Poort or MSA III at Klasies and MSA 3 generally (all informal designations)	MIS 3
	Howieson's Poort 58–66 ka		MIS 3 to MIS 4
	Still Bay 70–77 ka		MIS 4 to MIS 5a
	pre-Still Bay 72–96 ka	(informal designation)	MIS 4 to MIS 5
	Mossel Bay 77–105 ka	MSA II at Klasies River, MSA 2b generally (Pietersburg, Orangian)	MIS 5a–c
	Klasies River 105–130 ka	MSA I at Klasies River, MSA 2a generally (Pietersburg)	MIS 5d–e
	early Middle Stone Age 130–300 ka	(informal designation)	MIS 6 to MIS 8
Earlier Stone Age >200 ka	*ESA-MSA transition* >200–600 ka	(informal designation) (Fauresmith, Sangoan)	MIS 7 to MIS 15
	Acheulean 300 ka-1.5 Ma		MIS 8 to MIS 50
	Oldowan 1.5–2 Ma		MIS 50 to MIS 75

Table-4 Division of South African Stone Ages

MSA with Fire to Cook, Coastal Caves, Secondary Altriciality for Large Brain and Eusociality

The South African MSA flourished along the seashore. Hunter-gatherers foraged along the seashore for shells and fish, and probably cooked seafood over fire. As there are a lot of hollowed caves along this coastline, they started to use caves for their homes. Such caves in the sea cliff at 20 m above sea level provide an extremely safe environment against any enemies or predators. In such an environment, new born babies can stay in the cradle for one year without having to fend for themselves and modern humans could bear infants at a relatively premature (or secondary altricial) stage as primates which are precocial animals, while the brain is still growing at its rapid fetal rate. (Martin 1990)

Human babies are born in a helpless condition. Portmann (1944) named this phenomenon as "secondary altriciality", as primates are precocious. Martin (1990) conducted a comprehensive and comparative study on primate brains, and indicated that the big brain size of humans is achieved by the helplessness or "secondary altriciality". Having spent 9 months in the mother's womb, a human infant is born helpless and stays in the crib for another year under intensive post-natal care while its brain size continuously grows at the same rate as inside the womb, i.e. proportionally with its weight increase. The author surmises that this "secondary altriciality" was possible inside safe caves. In addition to brain size increase, the intensive care of babies seems to work for initialization of linguistic processing and thought. (Table-5, Figure-7)

In general, "(w)hen relieved of the necessity of any importance of evolving to protect one's self from extrinsic hostile forces of nature, the juvenile organism is freed to devote a greater proportion of its calories to the task of becoming a better adult." (Alexander 1991) Thus newborn babies in the crib are able to spend their entire energy and full attentiveness to learn their mother tonguefrom the vocal stimuli of their mothers and grandmothers speaking to them. In fact, the mechanism of language acquisition is same for adults and infants. Grammar is difficult to learn even for infants and they have to spend several years to become able to use grammar correctly without worrying themselves about food and safety. They behave as "learning apes", or *"Homo Sapiens"* in its true sense.

Altricial + Precocial = Hybrid

	Altricial	Precocial	Hybrid Altricial Primate
Animals	Carnivoire, Insectivore, Rodent	Herbivoire, Primate, artiodacty. Cetacean	Modern Human
Number of litter	Several or Many	One	One
Gestation length	Short	Long	Long
Born to be	Helpless	mobile from the moment of birth	Helpless (big brain & immature legs/hands)
Postnatal brain weight increase	3.8~11.7	1.4~4.8	3.6~3.9 (Very Large Brain)
CNS myelination	Postnatally	Completed in the womb	Completed in the womb
Safe Den / House	Safe Den	No Den	Safe Cave
Purpose/Requirements	Agility of Mother & Hunting Education	Safety of child	Intensive Child-Care for Language Education

(A. Portmann 1944 modified)

Table-5 Altricial + Precocial = Hybrid or Secondary Altricial

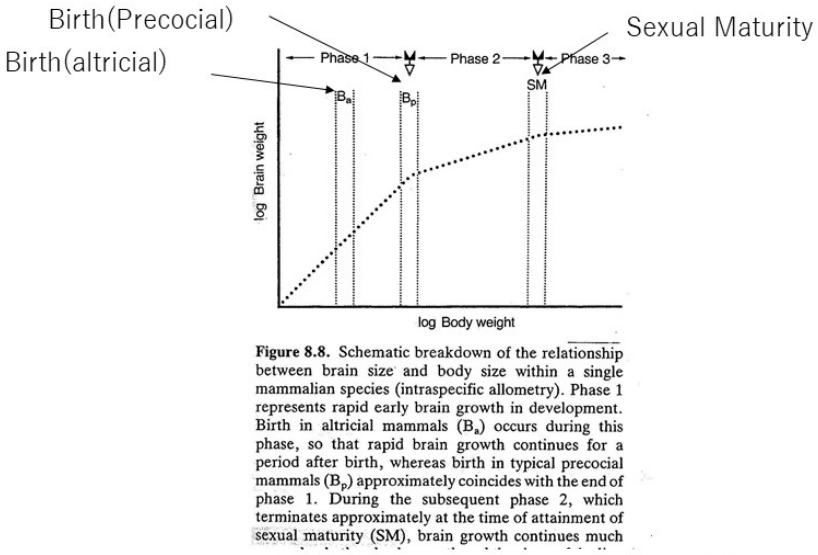


Figure 8.8. Schematic breakdown of the relationship between brain size and body size within a single mammalian species (intraspecific allometry). Phase 1 represents rapid early brain growth in development. Birth in altricial mammals (B_a) occurs during this phase, so that rapid brain growth continues for a period after birth, whereas birth in typical precocial mammals (B_p) approximately coincides with the end of phase 1. During the subsequent phase 2, which terminates approximately at the time of attainment of sexual maturity (SM), brain growth continues much

R.D. Martin "Primate Origins a volution"より

Figure 7 Brain Development of Altricial/Precocial Infant after Birth

Wilson (2012) provides extensive discussions on the origin of Eusocialism for humans, without differentiating between Early and Modern Humans. Consequently, he explains the origin of human eusociality, i.e. kinship and altruism, with gradualistic eugenetic natural selections, or in other words, without hypothesizing the timingor environment.

On onehand, he provides general scientific arguments based on his study on the eusocial origins and evolution of the Hymenoptera, the insecttaxonomic order that includes ants, bees, and aculeate (stinging) wasps. "One solid principle drawn from this analysis of the hymenopterans, and other insects as well, is that all of the species that have attained eusociality, as I have stressed, live in fortified nest sites. A second principle, less well established but probably nonetheless universal, is that the protection is against enemies, namely predators, parasites, and competitors." (underlined by the author)

"Competitors" belong to the same species but to different group. Kinship and altruism are for one's own group, and are inextricably associated with hostility and xenophobia against other groups.

The most complex systems are those possessing eusociality – literally "true social condition." Members of a eusocial animal group, such as a colony of ants, belong to multiple generations. They divide labor in what outwardly at least appears to be an altruistic manner." (Wilson 2012, p109)

Eusociality and what we like to call altruism can be born of the flexible expression of a single allele (gene form) or ensemble of alleles, whenever parents were already building nests and feeding their young progressively. The only thing needed is group selection, acting on group traits that also favors families that stay at home. Then the advance to ecological dominance can begin. A new level of biological organization is attained. (Wilson 2012, p152)

Both modern humans and the Naked Mole Rat (*Heterocephalus glaber*) show the above two principles: the fortified nest and a kinship/xenophobia mentality. It is plausible that modern humans are not an exception in nature but one of ordinary eusocial animals that evolved in MSA South Africa living inside caves.

The author surmises that modern human eusociality started for the benefit of child care: human intelligence is not an individual characteristic but the heritage of a group, and because individual linguistic processing and thought circuits should be delicately constructed. Kinship is not a cause, as Wilson supposes, but a result or catalyst of eusocial life style.

The so called "grandmother hypothesis" can be evaluated as a behavior of a eusocial animal. The progressive and dedicated care of the brood by a menopausal female member, grandmother, is unique to humans among primates. But it is common among eusocial animals. The universality of generous affection of grandparents toward their grandchildren indicates that it is coded intothe genes of eusocial animals. Grandmothers are the modern human equivalent and they take care of babies as dry nurses and read bedtime stories or folk tales, which prepares the in-brain linguistic processing circuits.

To conclude the analysis on the natural and social conditions in MSA, although (i) fire to cook, (ii) coastal caves were safe houses, (iii) secondary altriciality for alarger brain and (iv) eusociality were favorable conditions for human development, apart from fire, they are not unique to humans and none triggered the evolution for digital language and distinctive Neolithic technolomplexes in the Still Bay (72-71 Ka) and Howiesons Poort (65 – 59 Ka) periods.We shouldn't explain our sophisticated and omnipotent language as a product of kinship or large brain. It developed when humans acquired logical properties of phonemes and morae in their speech voice.

The author hypothesizes that the linguistic evolution took place in MSA South Africa. Although many anthropologists and archaeologists suppose it took place in the Great Rift Valley area without any supporting hypothesis, it is unlikely that the evolution of language and modern humans took place in Olduvai Gorge, Tanzania, or near Lake Victoria, because of the extremely severe living conditions for naked and helpless babies:(i) there was no stable potable water supply in Olduvai Gorge, (ii) presence ofpredators such as lions, hyenas, snakes, crocodiles, etc. (iii) aggressive insects such as fierce army ants, mosquitos and flies, (iv) endemic diseases such as malaria, parasitic bilharzia, etc. (Morell 1995)

Two Distinctive Technocomplexes in MSA and the Acquisition of Logical Properties in Speech Sound

"*Howiesons Poort was the name adopted by Goodwin and van Riet Lowe (1929) for one of the variations they distinguished in the Middle Stone Age in South Africa. Noteworthy in this variation was the presence of tool types that were then only known from 'advanced' Upper rather than Middle Palaeolithic contexts in Europe. The Howiesons Poort was termed a variation and evidence was needed before the Howiesons Poort variation could be elevated to the status of industry like at Pietersburg or Stillbay. The Howiesons Poort took its name from a small cave high on the side of a poort near Grahamstown, in the Eastern Cape Province. ..... Goodwin's reasoning was that the Howiesons Poort with its advanced elements was the final phase of the Middle Stone Age. The stratigraphic position of the Howiesons Poort was finally clarified in 1967 with the Singer and Wymer (1982) excavation of the Klasies River main site"* (Wurz 1999)

In Middle Stone Age (MSA) South Africa, Still Bay (SB) and Howiesons Poort (HP) constitute two outstanding Neolithic industries. The starting and ending ages for SB were estimated as 71.9 and 71.0 ka and, for HP 64.8 ka to 59.5 ka. (Jacob 2008, Table-3, Table-4) SB and HP emerged in the time series along the southern coastline of the African continent. The representative cave for SB is Blombos Cave, and those for HP are the Klasies River Mouth Caves.

Still Bay area is on a shallow beach. Klasies River Mouth Caves are located at a few hundred kilometers east to Still Bay (Figure-4), where waves are high and strong enough to erode extremely large caves at the merging area of the Atlantic and Indian Oceans. It is remarkable that the HP artefacts contain engraved ostrich eggshell containers. (Figure-5, Texier 2010) This sudden augmentation in the precision and

sophistication of artefacts at HP indicates that there wasa critical technological breakthrough at the beginning of HP period, which probably was language. Precisely speaking, this time series development of Neolithic industries should correspond to the two stage development of logical properties in voice or speech sound waveforms: phonemes to generatean infinite number of word signs and morae/accents to modulate adjacent concepts grammatically and to transmit conceptual and grammatical syllables together.

Acquisition of Phonemes

Phonemes and morae are two logical properties contained in the modern human speech sound stream. Phonemes can be defined as "a set of sound signals that are mutually distinctive in frequency domain, are shared by members of a linguistic community and can compose unique phonetic signs by repeated permutation."

Consonants and vowels are phonemes. Members belonging to a language group share phonemes during the period of infant care. Tiny differences in phonemic sounds can be used to identify friend-or-foe. Phonemes are logical because they can be mathematically permutated.

The period of SB coincided with the modern human population bottleneck following the Mt. Toba volcanic winter. (Ambrose 1998) (Table-3)The environmental stress of a volcanic winter, such as cold weather, less sunny days and less food, forced Hunter-Gatherers on the coastal zone of South Africa to spend more time than usual inside their caves, which functioned as sound shelters: they could sing as loudly and as long as they liked without being recognized by enemies or predators. It is probable that, through singing together, modern humans, aseusocial animals, autopoietically acquired click phonemes inside caves.

A South African natural scientist, Marais (1969) spent a couple of years with wild chacma baboons and reported that chacma baboons were singing together in the evening and night. Why not modern humans?

In few phases of behavior did our troop of baboons appear to us more human-like than in the unquestionable expression of this 'evening melancholy'. They generally reached their sleeping place sometime before sunset, to spread over the banks and rocks of the gorge-stream. Groups would collect in several shady spots and one could hear the animated 'talking' of the elders above the sound of the perturbed waters. Among the younger members of the troop this was the favourite time for mating, for shutting and boastful calling, and very frequently for romping games. It was especially the hour of the little ones. The favourite playground was a shallow rock-pool with an earth-slide on one side and a huge branch-swing that must have been used by their ancestors for generations, to judge from the mirror-like polish imparted to the bark. It was during the hour before sunset that games were indulged in with the utmost joyousness. Incessantly their happy 'laughter' and shrieks of excitement and delight awoke the echoes of the great shadowy gorge, while the older fathers and mothers sat watching the activity.

With the setting of the sun and the first deepening of the shadows a singular transformation came over the entire scene. Silence fell upon them gradually. The 'talking' ceased. The little ones crept cuddlingly into the protecting arms of their mothers. The romping young folk joined different groups, generally on the higher flat rocks from which a view could be had of the western horizon. The older ones assumed attitudes of profound dejection, and for long intervals the silence would be unbroken except for the soft whimpering complaints of the little ones and the consoling gurgling of the mothers. And then from all sides would come the sound of mourning, a sound never uttered otherwise than on occasions of great sorrow – of death or parting. I do not think there is any possibility of mistaking the state of mind which determines this behavior – even by one not well acquainted with the character and ways of the animal. One need only compare them with a native village under the same conditions to realize beyond any shadow of doubt that you have here a representation of the same inherent pain of consciousness at the height of its diurnal rhythm. In the case of the chacma the condition also disappears with the settling darkness. When the troop finally moved on to the krans or to the entrance of the sleeping-cave, the games were resumed and sometimes on moonlight nights continued for several hours.(Marais 1969)

Acquisition of Morae thanks to Laryngeal Descent and Vowel Resonant Vocal Tract

Vowels are generated by vibrating exhaling lung airflow over vocal chords and resonating it inside the modern human Supralaryngeal Vocal Tract (Lieberman & McCarthy 2007). The multiplexed intensity and frequency components in speech waveform are the accents. (Chiba 1935)(Figure-8, 9 and 10) Therefore accents are products of vowels. The accents contained in the speech sound stream can make rhythm, or mora. Mora is logical because the rhythm punctuates the speech sound stream into time slots, which predict the existence of a syllable in each time slot.

Thanks to mora, each syllable contained in the speech sound stream becomes distinctive, and two different types of syllables, namely conceptual and grammatical, can be vocalized alternatively without any indication or remark.

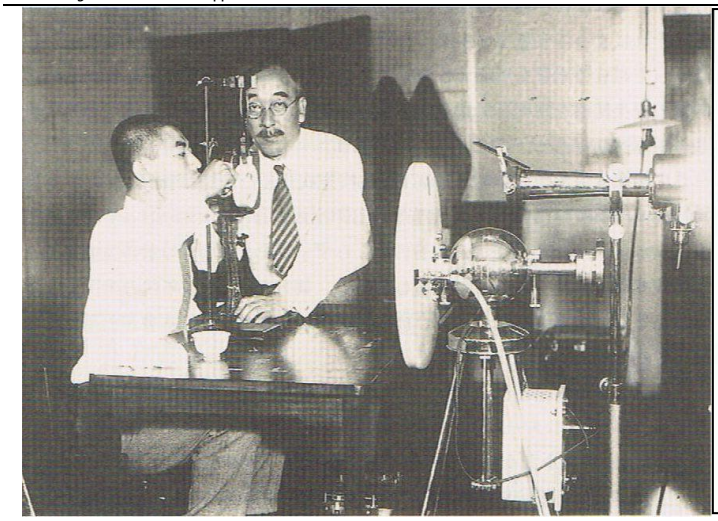


Figure 8 Dr. Chiba experimenting Vowels (Chiba 2003)

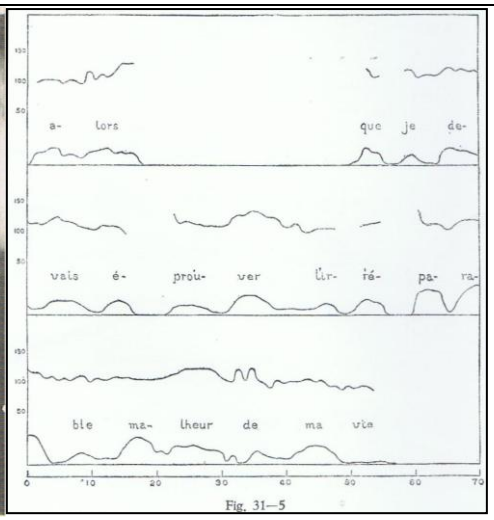


Figure 9 Accents (Chiba 1935)
Frequency (above) & Intensity (below)

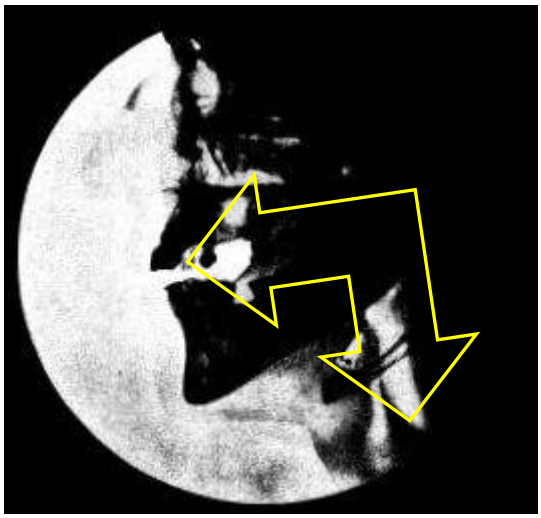


Figure 10 Vocal Tract with Laryngeal Descent (Chiba 1942)

Two Stage Evolution of Clicks at SB and Vowel Accented Syllables at HP

It is plausible that, grammatical modulation/demodulation started with the logic of mora. Moraic rhythm enables us to predict syllabic distribution aligned in time slots, and grammatical syllables should reach listeners without fail. The significance of digital communication using vowel accented syllables is error-free communication by just-once transmission. When this "just-once" transmission is established, grammatical modulation became possible and modern humans became able to create stories, i.e. legends and myths to thank and praise nature.

There are moraic or rhythmic language such as Japanese, where all the syllables end with vowels. There are only 112 syllables in Japanese, while in Chinese 1700 and in English 3400, and they are easily countable. Short poems with 5-7-5 morae (Haiku / Senryu) and 5-7-5-7-7 (Waka / Tanka) have been flourishing in Japan among ordinary people since at least the 8th century.

Thanks to phonemes, modern humans can generate an infinite number of word signs. Thanks to vowels and morae, the attainability of syllables in the speech sound stream to audiences increased and grammatical modulation of multiple concepts started. But, to date, there is not a single hypothesis to explain how modern humans obtained these logical properties in their speech sound.

The author surmises that click consonants and vowel accented syllables are time-series evolutions. Modern humans at first obtained clicks, and then became able to vocalize vowels when the supra-laryngeal vocal tract, a unique anatomical feature of modern humans, developed.

Deagling (2012) found that "no consensus exists that there is a diagnostic anatomical indicator for articulate speech in human evolution." Evidently the laryngeal descent seems to be critical for articulation of logical speech properties, mora.

He continued, "even though the chin is recognized as diagnostic of our species, its evolutionary and functional significance remain incompletely understood." He made extensive analyses to get clearer images of the evolution of the unique mandible of modern human, and he concluded that "high-frequency, low-magnitude loads associated with articulate speech are hypothesized to explain the apparent paradox of hypertrophied mandibular bone in contrast to the reduced bone thickness that typifies the remainder of the modern human skull." It is plausible that the frequent use of the tongue to produce click sounds had contributed to the modern human unique mandible and provided enough space to house the supralaryngeal vocal tract.

Some evidences for Click-Syllable Two-Stage Evolution

Nakagawa (2007) reported that "clicks are known as consonants involving a velaric ingressive airstream mechanism, whose geographic and linguistic distribution is restricted to Khoisan and a small number of other languages in Africa". Clicks are the phonemes which can be produced without lung airflow, before laryngeal descent and before vowels. "Existing analyses of clicks and non-clicks are seldom integrated into a single coherent phonological system..." (Traill 1997) This incoherency can be an evidence for clicks then syllables time series evolution. Once syllables are obtained, those who are surrounded by things named by click based concepts, Khoisan, kept clicks, while those who left Southern Africa abandoned clicks as they had enough phonemes with syllables.

Westphal (1971) concluded that, in "some of the Khoisan languages, most content words begin with clicks, but very few function words do." This indicates that there are grammatical phonemes and non-grammatical ones. Content words are concepts such as nouns, verbs and adjectives. With phonemic permutations, sound symbolic conceptual words could be generated as much as they liked. Probably clicks were the first phonemes without any grammatical modulation capability.

Table-6 is a summary for Early and Modern human evolution in South Africa.

Erect Bipedalism	**Early Stone Age and Early Human 3MA**
Opposum Thumb	**Bone Hunting Hypothesis (Shima 2003)**
Hard Enamel and Flat Teeth	
Frontal Lobe Development	**Australopithecus**
Cave Dwelling and Use of Fire in MSA S Africa	**Middle Stone Age and Anatomically Modern Human 300KA**
Secondary Altriciality (Menopose Female Intervention to Baby Care)	**Helpless Baby with rapid brain growth rate.**
Eusociality (Menopose Female Intervention to Baby Care)	**Altruism, Division of Labor, Xenophobia**
Click Consonants (Phonemes)	**Proto Language with Click consonants (SB72 ka)**
Mandible Development & Laryngeal Descent (Vowel Accented Syllables)	**Modern Human with Grammatical Language (HP65 ka)**
Naked (Thin Skin & Thin Hair)	

Table 6. Early Human and Modern Human Evolutions

The Birth of Modern Human and Language in South Africa

It can be concluded that the development of logical language and anatomical evolution of modern human unique vocal tract structure corresponds well with archaeological and anthropological evidences in South African MSA. It is plausible that the emergence of Howiesons Poort industry, following the pre-linguistic Still

Bay industry, should be connected to the birth of language, which seems to be the principal contributor to HP Neolithic industry. (Table-7)

Euro-centric prejudice still exists and hides the origins of modern human and language. It is necessary for us to convert our way of thinking with the Copernican way, from Euro-centric to Afro-centric (or Afro-origin) to understand correctly who we are and how language functions.

	Still Bay	Howiesons Poort
Period	72-71 ka	65- 59ka
Principal Location	Blombos Cave, etc.	Klasies River Mouth Caves& others in South Africa
Climate	Sudden Global Cooling by Mt. Toba eruption	Gradual Warming (Better nutritious conditions)
Evolutionary Process	Start of Evolution (Software adaptation)	Completion of Physical Evolution (Laryngeal Descent / Mandibular Development)
Acquisition	Click Consonants	Vowel Accented Syllables withSupra-Laryngeal Vocal Tract
Linguistic Development	**Concepts but no grammar**	**Concepts &Grammar**
Nomenclature by the author	**Proto-Modern Human**	**Modern Human**

Table 7 Comparison between Still Bay (SB) and HowiesonsPoort (HP) – Proto Language and Language

Speech Sound Stream in the Ambient Environment

Speech Sound Stream Consisting of Minimum Semantic Unit of a Concept & a Grammar

Speech sound stream in the ambient environment links the mouth cavity of a speaker and the ear of a listener. (Figure-2, Table-1)Whenthe speech sound stream consists of phonemes, it can be recognized by all the same linguistic community members as instantly distinctive, which is digital. On the other hand, written texts can be properly uttered when the reader knows how to pronounce the texts, which is analog.

Speech sound stream is a mono-dimensional (or linear) alignment of syllables. In human adult speech, there are two types of syllables: conceptual syllables and grammatical ones. Conceptual syllables are nouns, verb trunks, adjectives, adverb, etc. i.e. content words, while grammatical syllables are prepositions, articles, numerals, conjugation terminals of verbs/adjectives, etc. i.e. function words.The difference between "word (conceptual) sign" and "non-word signs" is the use of syllables. Conceptual signs consist of a syllable or a permutation of syllables, while signs can just be any audiovisual stimuli.

Chomsky (1964) defines that "Grammar is a device that specifies the infinite set of well-formed sentences and assigns to each of these one or more structural descriptions." As his definition has no physical or microphysical element, I modified the definition in order to maximize the representation of physical and semantic features. Grammar is defined by myself to be "Mainly a mono-syllabic addition or modification to a conceptual word in order to indicate semantic connectivity as well as semantic modulation. When one acquires grammar, he can compose and deconstruct the meaning of information that he sends and receives unconsciously."

(Note1: My definition of grammar, does not cover word order and pronoun. I would appreciate any recommendation to improve it.)

(Note2: There are some arguments that birds have grammar. (Okanoya 2010) But they do not provide adefinition of grammar. As their "grammar" are combinations or switching of contents or phrases, presumably it is not appropriate to call it ~~as~~grammar.)

Thanks to grammar, the complexity of messages significantly increases. The difference is evident between children's two/three-words sentences and grammatically modulated complex sentences. Without grammar, it is not easy to indicate the relationship between two or among multiple concepts, neither tense nor number.

With this definition, we now see conceptual and grammatical syllables alternately aligned in the speech sound stream.The unconscious and automatic mechanism of grammatical processing is the most enigmatic part of Chomsky's conundrum: Why humans can compose an appropriate new sentence in a particular situation, and, why, with hearing it only once, others can understand it immediately? (Chomsky 1964)

By careful observation, it becomes clear that grammatical syllables are modulating adjacent concepts,

and minimum semantic units of "concept + grammar complex" become visible. Our speech is composed of linked "concept + grammar complexes". Martinet (1965) named this mechanism as "double articulation".

In Japanese grammar, this unit is called "Bunsetsu", and, in French, this style is called ~~as~~"langage articulé", which has an opposite grammar + concept structure. (Figure-11/-12)As far as I understand, not all languages have an equivalent to Langage Articulé or Bunsetsu,standardized structures for a minimum semantic unit of a concept and a grammatical syllable in the speech sound stream. However, in any language, grammatical modulations are implemented against a concept either just before or immediately after.

It is plausible that this agglutinative structure is optimized to transmit linguistic information mono-dimensionally, as an alignment of "Concept + Grammar" Complexes. Howdoes our brain process a concept dualistically withadjacent grammatical modulation?

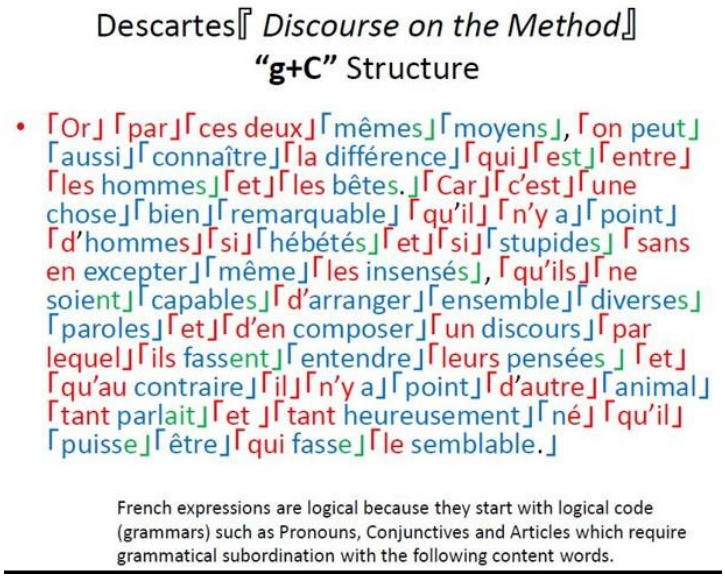


Figure-11 langage articulé (expression with articles)

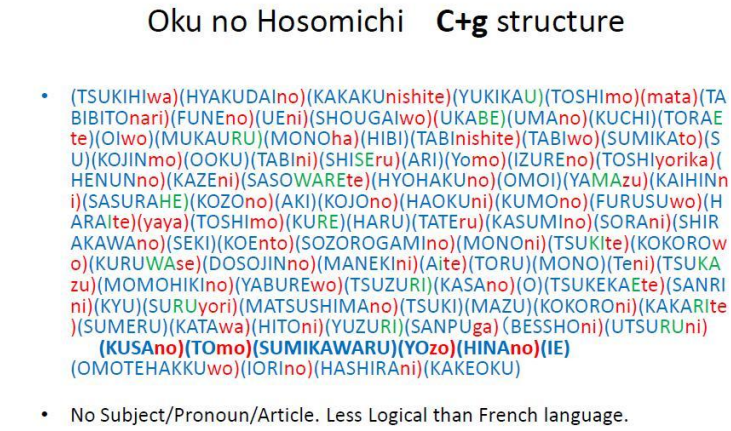


Figure-12 Bunsetsu, minimum semantic unit of a Concept and a Grammar

Evolution of Information Signal Transmission in the Noisy Ambient Channel

"Information" is here defined as "a linear grammatical composition of multiple concepts". Information can only be composed with functional grammatical rules and regulations as well as conceptual signs generated by the permutation of digital signals.

In mammal vocal communications, non-human animal signs are not information. Also, here single-word, two-word or even three-word non-grammatical messages of human children are not regarded as information.

In civilization, the speech sound stream transmissionin a physical ambient environment has evolved significantly from the acoustic voice by the invention of character sets, which code speech sound into two dimensional drawing signs. Then, paper, ink and brush enabled hand writing and later printing.

Telecommunications and broadcasting should also be regarded as a physical layer phenomena, a technical advancement of unilateral speech sound transduction. On the contrary, the linguistic processing mechanism in the logical layers inside our brain has never changed or evolved at all. The current technology of computer networks allows interactive search and error corrections, which should be regarded as a new phase of linguistic communication.

In Japan, the number of syllables is 112 and they are moraic. Since the 5th century, at least, Japanese syllables were represented by Chinese characters for their sound. These Chinese characters are called Manyo-Gana. In the 7th century, they were replaced by Katakana, which represented a type of Chinese characters.

Two sets of syllabaries, Katakana and Hiragana, were in use by the 10th century. As kana was designed based on the shapes and phonetics of Chinese characters, it greatly contributed to the historically high literacy rate of quasi 100% and to the large pool of Haiku & Waka poets of Japan. It is not that Japanese people have a genome of diligence, but that two sets of syllabaries make them diligent. If syllabary is effective for literacy, it is plausible that our logical layer processing is based on the phonetics of words.

Evolution of Physical Speech Transduction and Constant Logical Sign Coding in Human Brain

Timing A (Years Ago)	Physical Signal Transduction	Analog/Logical Sign Encoding	Biological Sign Receptors	Logic to be Used for Decoding as Signs	Results / Achievement
60MA (Million)	Mammalian Vocal Chirps (Sound)	Analog Emotional Coding (Repetitious)	Brainstem Reticular System + B-Lymphocytes in CSF	Dualism of Sign and Movement Vector	Alert / Mating /etc. Signs to Excite Reflex (10 or 20)
77KA (K= thousand)	Click Consonants (Sound)	Logical Phonemes (Distinctive)	Fab of B-Lymphocytes	Dchotomy (Ag/Ab Responses)	Infinite Number of Signs by Phonemic Permutation for Analytical Thoughts
66KA	Laryngeal Descent and Vowels / Syllables (Sound)	Logical Phonemes with Accents	Fab --> Fc Signal Transduction in Ig	Dualism of Sign and Logical Vector (Grammars/Throught)	Grammatical composition for Complex Informational Message (= Speech)
6KA	Character Set	Analog Coding of Syllables	Human Speech Voices are stored using Analog Character Sets.		Externalization of Knowledge in Archives, Genesis of Complex Logical Concepts
3 KA	Paper, Ink and Brush	Analog Hand Writing	Realtime Coding of Speech into Characters		Easy to Transport / Store
1KA	Syllabary in Japan (Katakana / Hiragana)	1 Syllable = 1 Character	46 Characters can represent all (= 112) syllables in Japanese		Aid for Learning (Easy to retrieve speech sound from literature)
500A	Printing	Analog Printing	Massive Distribution		Easy to Share Massively
100A	Telecommunication and Broadcasting	Analog Modulation of Audio-Visual Stimuli	Beyond Space		Realtime Telecommunication
50A	Electric Recoding with Magnetic Media	Analog Recording (Coding)	Beyond Time		Audio Voice and Visual Images are Recorded and Stored
NOW	Computer Networks	Logical Electronic Binary Signal Processing	Human Speech Voices are interactively searched and retrieved using Digital Computer Networks and Search Engines.		Interactive/Realtime Query and Sharing of Human Intellectual Genomes

Table- 8 Evolution of Speech Sound Transmission and Constant Logical Signs inside Brain (Tokumaru 2014A)
The external signals for speech sound transmission evolved significantly, while the in-brain biological sign mechanism remain sidentical since 66ka.

Physical to Logical Conversion

Are Speech Production and Listening Processed by the Same Organ?

To date, most scientists have tried to explain human linguistic activities with neurons, synaptic connectivity, neo-cortex (Broca and Wernicke areas) and electric pulses. Measuring instruments such as fMRI and PET provide images of neo-cortex activated during linguistic activities, but there is not a single hypothesis for the exact mechanism and cellular/molecular structures for word memories as well as episodic sensory memories at the neocortex.

So-called motor-theory and gesture theory are based on the lateralization to the left cerebral hemisphere for both spoken and gestural human language. As the sensor and motor areas are located in the same hemisphere, they suppose in-brain communications without any evidence. "*Though we cannot exclude the possibility that a purely auditory decoder exists, we find it more plausible to assume that speech is perceived by processes that are also involved in its production.*" And "*we are tempted to suppose that one hears the same /d/ because perception is mediated by the neuromotor correlates of gestures that are the same*." (Liberman et al 1967)

The critical difference between analog and digital communication is that the former sends physical values and the latter logical signals. The modulating/demodulating mechanism for analog communication is opposite, addition and subtraction of physical values. Physical values deteriorate and accumulate physical entropic distortion over the noisy channel. However, even though signals are distorted to a certain extent, such distortion should not fully damage or destroy the message.

On the other hand, the modulating/demodulating mechanism for digital communications is different and regenerative. Thus the digital values or logical signals are not distorted by physical noises. With Error Correction/Prevention Mechanism exploiting redundancy, the original logical signals can be regenerated by the receiver. Entropic increase or distortion of carrier wave under threshold, can be nullified in the regenerative process of logical values. As human communication is digital (Figure-3), it is probable that there is a dedicated auditory decoder.

My breakthrough was in Pavlov (1927), in contradictive and unsolved phenomena. He also had supposed that Conditioned Reflexes are established as synaptic connections between Sensory Area and Motor Area in the Brain Neocortex. However, Differential Inhibition (Lecture-7) and Mutual Induction (Lecture-11) are unexplainable with hissupposition.

Pavlov's Unsolved Phenomena: Differential Inhibition and Mutual Induction

In Lecture VII, Differential Inhibition, Pavlov reported. "*It was noticed that when, after a conditioned reflex to a definite stimulus (e.g. a definite musical tone) had been firmly established, the effect of another closely allied stimulus (a neighboring musical tone) was tried for the first time, the conditioned reflex which resulted from the new stimulus was frequently much weaker than that obtained with the original conditioned stimuli. On repetition of the stimulus of the neighboring tone, always, of course, without reinforcement, the secretory effect increased until it became equal to that given by the originally established stimulus, but subsequently on further repetition began to diminish, falling finally to a permanent zero.*" (Page 118) (Table-9/10)

Pavlov described it in a matter-of-fact way as if readers should not pay attention to this unexplainable phenomenon. Pavlov did not give or even try to give any explanation to the sequential rise and fall of secretion ("much weaker" to "increased until it became equal" then "a permanent zero"). It is not possible to explain this phenomenon, if conditioned reflex is based on a newly synaptic connection between sensor-motor areas on the neo-cortex.

Time	Stimulus applied during 30 secs.	Amount of Saliva recorded by divisions of scale (5 div. = 0·1 c.c.) during 30 secs.	Remarks
Experiment of 12th October, 1917.			
12.28 p.m.	Tone	30	Reinforced.
1.0 ,,	Tone	35	Reinforced.
1.10 ,,	Semitone	9	Not reinforced.
Experiment of 13th October, 1917.			
12.54 p.m.	Tone	36	Reinforced.
1.5 ,,	Tone	36	Reinforced.
1.12 ,,	Semitone	32	Not reinforced.
2.1 ,,	Semitone	16	Not reinforced.
2.18 ,,	Tone	29	Reinforced.

The reflex to the semitone continues to fluctuate, gradually diminishing in strength until at the thirteenth repetition it has fallen to zero.

Time	Stimulus applied during 30 seconds	Salivary Secretion in drops during 30 secs.	Remarks
Experiment of 8th June, 1911.			
2.5 p.m.	Tone	10	Reinforced.
2.35 ,,	Semitone	0	Not reinforced.
2.38 ,,	Semitone	0	Not reinforced.
2.39 ,,	Tone	7	Reinforced.
2.50 ,,	Tone	12	Reinforced.
Experiment of 14th June, 1911.			
1.45 p.m.	Tone	12	Reinforced.
2.0 ,,	Semitone	0	Not reinforced.
2.2 ,,	Semitone	0	Not reinforced.
2.4 ,,	Semitone	0	Not reinforced.
2.6 ,,	Semitone	0	Not reinforced.
2.7 ,,	Tone	1·5	Reinforced.
2.30 ,,	Tone	13	Reinforced.

半音ズレた音を聞かせて餌のない状況を作ると、
"半音/餌なし" : 9 → 32 → 16 → 0 (安定)

Table-9 and 10: Pavlov divided the sequential experiment of Differential Inhibition into two tables so that readers should not easily recognize this mysteriousexperimental results.

Pavlov, in his Lecture XI, introduced Positive and Negative Mutual Induction. These are cyclic experiments to combine positive and negative signs. (figure-13)

Positive induction test cycle is: (No-Food sign) → [No Food] → (Food sign) → [Food]

It was confirmed that, with (Food sign), saliva secretion started earlier than usual and with 30 – 50 % more volume.

Negative induction test cycle is: (Food sign) → [Food] → (No-Food sign) → [Food]

Although this cycle was repeated many times, i.e. 30 times, dogs did not secrete saliva at all after (No-Food sign).

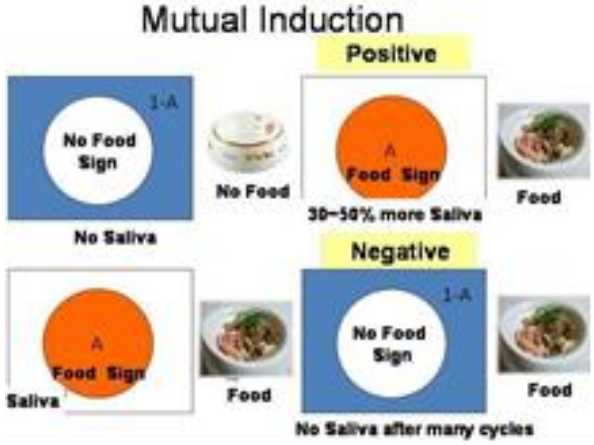


Figure- 13 Mutual Induction Cycles (above Positive, below Negative)

With the assumption of synaptic connection between sensor-motor cortices, the differential inhibition and mutual induction cannot be explained. It is plausible that food and no-food signs network freely each other.

Hypothesized Mechanism of Regenerative Auditory Decoder

Now I hypothesize "a purely auditory decoder" (Liberman 1967) for sign reflex as well as physical→logical conversion in human digital linguistic communication. In my hypotheses, human digital linguistic audition exploits sign reflex mechanism, inspired by Pavlov (1927) and Tinbergen (1951). I also referred to studies on cerebrospinal fluid (CSF) Contacting Neurons (CSF-CN) (Vigh et al 2004), Brain Stem Reticular Formation (Moruzzi Magoun 1949)(Penfield Jasper1954) (Allen 1932),B Lymphocytes inside CSF (Jerne 1974, 1984), etc. My hypotheses are as follows:

1) Linguistic activities are operated as spinal reflexes, which are not operated atthe neocortex level but at brainstem reticular formation (BSRF) inside the CSF intra-ventricular system immune networks.
2) CSF-CNs connect the cochlea in the inner ear with BSRF and display antigen-like terminals at the CSF side of ventricle system. The shapes of antigens should simulate the amplitude envelop fluctuations of conceptual word wave forms or audio-signs. (Phillips 2001)(Chiba 1935) (Figure-17)
3) Inside CSF, B-lymphocytes equipped with antibodies with specific antigens of CSF-CNs at BSRF are floating.
4) On the neocortex, Glial cells store sensory memories related to the word or audio-signals, displaying the exact same antigens with CSF-CN.
5) According to Jerne (1974), neurons and immune cells have a logic of dichotomy, which operates as antigen-antibody responses between antigen presented by CSF-CN at BSRF and antibody presented at the membrane surface of B-lymphocytes inside CSF. This logic of dichotomy enables also immune networks inside CSF between B-lymphocytes and glial cells at neocortex.(Jerne (1974) indicated that immune cells are neurons which do not need synaptic connections for networking, namely Mobile Ad-Hoc Networking (MANet) Neurons.)

6) It is plausible that instinctive signs are coded in DNA. Then a set of CSF-CN and B-lymphocytes equipped with antigens/antibodies (as key and keyhole) for instinctive signs are automatically generated.

7) It is reported that following the same procedures with Pavlov's Differential Inhibition, animals can learn new signs. (Kuhl Miller 1975) (Kluender Randy Killeen 1987)
If the learning process is a maturation of neuroblast cell to B-lymphocyte, the enigma of Differential Inhibition may be explained as the Primary Response and Secondary Response of Immune Cell activities.(Figure-14, Tonegawa 1987)

Against an unusual feature, a stem cell with antibodies having proximity to a new sign start to divide into plasma cells with identical antibody structure, which is the Primary Response. Then a signal to adjust the inadequate combination with the new stimuli is transferred to lymphocytes under maturation, by some Signal Transduction, and orders to rearrange DNA sequence for Fab to increase affinity. This is the Secondary Response. When the affinity to a new sign is confirmed, plasma cells start to generate a lymphocyte with affinity to a new sign. It is plausible that the overall processes of Primary/Secondary Responses correspond to "much weaker" to "became equal" then "a permanent zero" transition of saliva secretion.

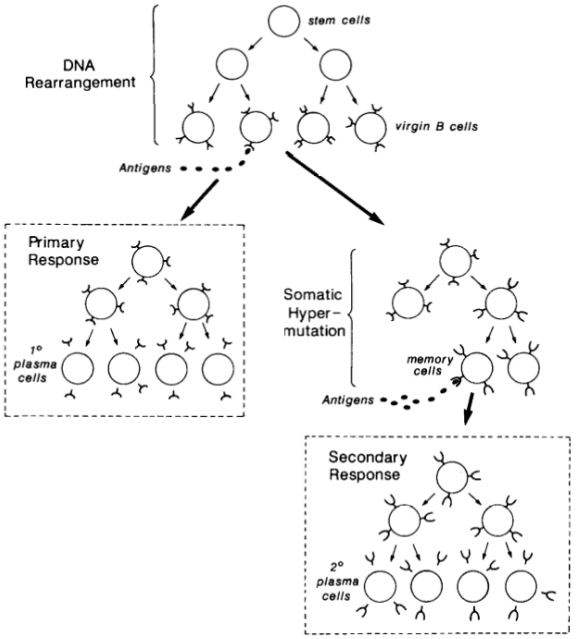


Figure-14 (Tonegawa 1987)

8) Human learning of a new word should follow the same procedure with 7) as a post-natal acquisition of signs. Normally, it takes several days for a person to generate the necessary memory cells (CNS-CN, B-Lymphocyte and, for sensory memories, Glia) for a new word. If one lives only inside the mother tongue community, it is not easy to become aware of this memory generation mechanism and time requirement. In my experience, in a foreign culture or country, one can be aware of the moment when a new word memory is generated in ones CNS and starts to network with existing word and sensory memories.
The names of God / Goddess in a foreign culture should be good to implement such experiments, as their names are quite new to us. At the beginning, it seems impossible to memorize their names. But if we recognize it as essential, in my case I stayed at the hotel with the name of Goddess, after several days when I was told to visit a temple of the same Goddess, I had the memory of her name. Then I started to network sensory memories (hotel, college, Professor's given name, temple, etc) with the same name. That was in 2012, yet I have keptthis memory for over 5 years.

9) Immune Cells (or Mobile Neurons) display a logic of dualism, which can integrate two different input stimuli into a single output. This logic enables (i) spinal reflex behavior (If A then do B), (ii) thought or comparison (A and B = ○, ×, △ , ◎ , ≡ , ≠ , < , etc.) and (iii) grammatical modulation/demodulation (C + g =).

In summary, conceptual segments in physical speech sound waves are recognized by antigens of CSF-CN at BSRF, which stimulate the antibodies of B-lymphocytes floating inside the CSF. Then, immune cell networks inside CSF constitute the logical layers of linguistic comprehension and consciousness.

As the above hypotheses have not yet been verified, theyneed to be experimented and proven. Hereunder, I would like to further hypothesize inside the logical layer phenomena, based on these hypotheses, referring to some logical background literature which inspired the above hypotheses.

Logical Layers Operated by Neuro-Immune Cells Networks

Not Neocortex, but Reticular Formation

The questions are (i) what is the mechanism to cope with scores of thousand words, and (ii) how we learn a new word and its meaning.

Using an electrode, Penfield stimulated directly the brain cortex of more than 1000 patients and recorded what they recalled. And he concluded that "Stimulation of the cortex has never caused the patient to speak or to become aware of individual words, although he may hear people talking and be able to understand what they say."(Penfield Jasper 1954,p146, underlined by the author) It is plausible that word memories are not stored in the cortex.

He also investigated "Subcortical Interretationships", inter alia, the integral role and location of the reticular formation."*The reticular system of midbrain and diencephalons receives collateral connections from the ascending afferent systems before they reach the thalamus, as illustrated diagrammatically in Figure IV-2. Impulses are also received into the integrating network from various subcortical structures, …*" (Penfield Jasper 1954 p163, Figure-15)

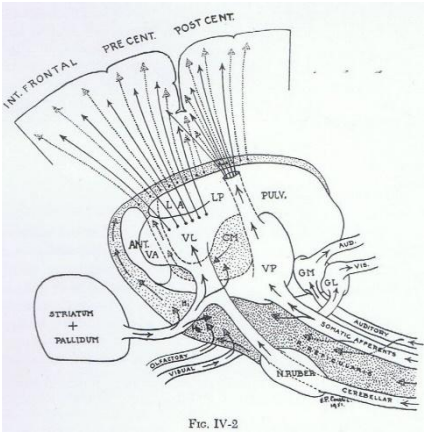


FIG. IV-2

Figure-15 Principal subcortical afferent pathways. Nucleus ventralis lateralis (VL) and Reticular system (strippled area) (Penfield Jaspter 1954)

"Along this course are to be found specialized portions, centers, or nuclei, for the control of respiration, cardiovascular, and gastrointestinal functions, and for the control of posture and tone of the body as a whole (particularly the vestibular, pontine, and red nuclei, and the substantia nigra). A large portion of the lower brain stem, however, cannot be assigned any such specific function, and has been thought to subserve an important integrative function, correlating the activities of the specific systems…" (Penfield Jasper 1954, underlined by the author)

Reticular formation is located at the center of our CNS. It "is known from embryology that most of the left over cells of the brain stem and spinal cord which are not concerned in the formation of motor root nuclei and purely sensory relay nuclei are utilized in the production of the formatio reticularis." (Allen 1932)

Immune Cells are Mobile Neurons with Ad-Hoc Networking Capability

To date, the brain mechanisms for linguistic processing have never been clarified nor hypothesized at the cellular or molecular levels. A Language Acquisition Device (LAD) has not ever been identified or discovered. There is no hypothesis for the brain mechanisms of spinal sign reflexes either.

The idea that the human language is digital and non-human animals' (including human babies) vocal communication is analog was inspired unexpectedly. The Naked-Mole Rats (Heterocephalus glaber) are eusocial and altruistic. (Shima 2004) They live underground tunnel in tropical savanna of East Africa. (Wilson 2012) They are also naked like modern humans with thin skin and thin hair, and are highly vocal known for

their eusocially structured and altruistic society. "It is not surprising that naked mole-rats have a large, complicated vocal repertoire," (Pepper, Braude, Lacey, Sherman 1991) but surprisingly they have just a total of 17 different sound patterns in their communication, 11 tonal and 6 atonal, or 12 for adults and 5 for juveniles.

What makes the difference of "vocabulary" of more than 100,000 in a human language and 17 in Naked-Mole Rat? From sound spectrogram of their chirps, Naked-Mole Rats produce the same tonal patterns (upsweep, downsweep, "V", inverted "V", atonal, etc.) repeatedly, i.e. "at a rate of about 3/s, in bouts lasting 1-3 s." or "twice per second in repeated bouts separated by pauses of 0.5 - 10s; each bout contained an average of 17 or 18 chirps." On the other hand, human words can be made as many as possible as the permutation of phonemes. It was inspired to me that human communication might be digital.

After 8 years of interdisciplinary research, I came to the conclusion that logical elements of phonemes and morae contained in the speech sound stream interact with sign (=word) memory represented by mobile neurons (= memory B-lymphocytes) inside the cerebrospinal fluid (CSF) in the ventricular system. Phonemes and accents in speech (sound) are modern human unique logical properties in vocal sound. The transmitter for logical speech (sound) coincidently developed within two distinctive Neolithic cultures, Still Bay (72-71 Ka: thousand years ago) and Howiesons Poort (65-58 ka) both techno-complexes in the Middle Stone Age (MSA) in South Africa along its southern coastline.

Digital linguistics owe quite a lot to a synthetic paper of Noll (2003), "The Digital Origin of Human Language – A Synthesis", which I encounteredvia Google search with "human, language, digital" as keywords. His extensive interdisciplinary references not only in linguistics but also information/automata theories, molecular biology, ethnology and immunology were very helpful to understand molecular biology and immunology. Among all, he cited Jerne the most, probably because he had been most inspired by Jerne most through direct personal acquaintance, who seems to have an idea of immune (=idiotype) network inside CSF hypothesis for human language. Noll seems to have played the role of an evangelist for Jerne.

According to Noll, "Jerne, in his classical paper 'Towards a network theory of the Immune system' was also the first to point out the close analogy between the immune and the nervous system; (the) immune system, when viewed as a functional network dominated by a mainly suppressive Eigen-behavior, but open to stimuli from the outside, bears a striking resemblance to the nervous system." (Jerne 1974)

"Both systems display dichotomies and dualisms. The cells of both systems can receive as well as transmit signals. In both systems the signals can be either excitatory or inhibitory." (Jerne 1974) Dichotomy divides the world into two, A or not-A, and executes pattern recognition. Dualism allows one to formulate a logic which receives any arbitrary two signals and producesan output. It is not easy to understand such logical mechanism without following Tinbergen's experimental results, which display logics in instinctive behaviors. (Tinbergen 1951)

The following sentences in Jerne (1974), which were not cited in Noll (2003), are also very important to understand what immune cells are. "The two systems penetrate most other tissues of our body, but they seem to be kept separate from each other by the so-called blood-brain-barrier. The nervous system is a network of neurons in which the axon and the dendrites of one nerve cell form synaptic connections with sets of other nerve cells. In the human body there are about 10^{12} lymphocytes as compared to 10^{10} nerve cells. Lymphocytes are thus a hundred times more numerous than nerve cells. They do not need connections by fibres in order to form a network. As lymphocytes can move about freely, they can interact either by direct encounters or through the antibody molecules they release. The network resides in the ability of these elements to recognize as well as to be recognized."

According to Jerne (1974), we should rename immune cells "Mobile Ad-hoc Networking (MANet) Neurons" or simply "Mobile Neurons". In 1974, Jerne deliberately chose the expression of "seem to be kept separate", but it is now confirmed that there are lymphocytes inside CSF/VS and they perform active immune responses. Some scientists suppose that immune cells are working inside CSF for pathogen patrol, but I suppose they function as mobile neurons for reflexive behavior as well as sign communications, in low noise environment of CSF where the amount of proteins are only 1/200 compared to blood regulated by barriers of chroid plexus at each ventricle (Left, Right, 3^{rd} and 4^{th}).

This indicates that there is an unexplored research field of neuro-immune interactions inside VS/CSF operating among CSF-Contacting Neurons presenting antigen (epitope) type terminals on the ventriclewall, freely moving lymphocytes, and glia cells on neocortex.

Lymphocytes are advanced type of neurons with mobile networking function. Jerne concluded his speech by saying, "both systems thereby learn from experience and build up a memory that is sustained by reinforcement and that is deposited in persistent network modifications, which cannot be transmitted to our offspring."

This neuro-immune network should be the intelligence of a person.If it is uninheritable, each person make efforts to build up memory networks through learning and thinking. There is no center, no language center

or language acquisition device in our brain, asthe network is a distributed system, operated by individual neurons and immune cells (=mobile neurons). It seems to work for linguistic processing. It is expected that future studies on neuro-immune cell interactions inside the ventricle system can validate this hypothesis.

Logics of Neurons and Immune Cells (1): Dichotomyfor Physical→Logical Transduction

Neural logic of dichotomies and dualism are omnipotent and can flexibly construct variety of reflex circuits. Our emotion seems to be generated by good/bad memories and approaching/disappearing vector. (Table-11) Linguistic processing, thought and complication can all be implemented by combining dichotomy and dualism. (Table 12)

Memory ⇒ Movement Direction ↓	*Good*	*Bad*
Approaching	**JOY**	**ANGER**
Separating	**SAD**	**HOPE**

Table 11. Emotions are generated as dualistic integration of Signs and its vector element.

Versatile Applications of Dualism			
Application	Input-1(sign)	Input-2 Sign or Vector	Output
Reflexes	Audiovisual Sign	Movement Vector	Reflexive Action
Emotion	Audiovisual Sign	Movement Vector	Catalyzer of Action
Grammar	Concept	Grammatical Modulation	Semantic Modulation
Thought	Concept-1	Concept-2	Judgment
Observation	Audiovisual Stimulus	Concept	Judgment
Selection	Concept-1	Concept-2	Decision
Operation	Concept-1	Concept-2	Logical Concept
Complication	Concept-1	Concept-2 or Grammar	Complicated Concept

Table 12 Versatile Applications of Dualism

Dichotomies divide the world into two, A or not-A. This logic can achieve non-linear (= all or none) pattern recognition. It can be described as excluded middle: A * (1-A) = 0. (There is no entity which is A and at the same time not-A.) Recognition is a memory based operation and, without memory, we cannot recognize anything. The antigen-antibody responses can perform logic of dichotomies by biochemical contacts between epitope/idiotope (antigen) and paratope (antibody), both 3-D structures of polypeptides.

Logic of dichotomy issues a signal when input is recognized as A. (i.e. This sound is for 'food'. Let's go.) Or, a mismatch signal of 'Not-A' is issued when the entire situation is determined so. (i.e. This is NOT Miso soup, because it does not contain fish bouillon soup. Stop eating.)

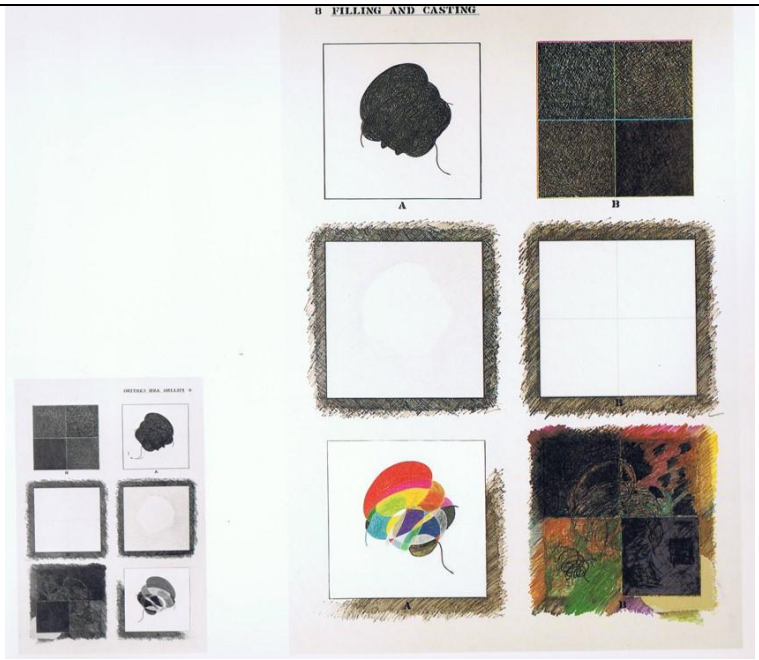


Fig.16 Logic of Dichotomy - Arakawa+Gins 1988

According to Phillips (2001), "the representation in the cortex of speech sounds is acoustic rather than phonetic, and is independent of voice pitch." This cortical behavior indicates that speech signals are not processed at the auditory cortex (A1). Phillips also stated, "Insofar as human speech sounds are concerned, it is unlikely that cortical neurons are able to entrain spikes to the glottal pulses that set the voice pitch, but there is no doubt that they can indicate the timing of the phonetically important components of the speech signal. In this regard, there is recent evidence that the most important temporal components of the speech signal are the slower, amplitude envelope fluctuations, rather than the waveform's fine time structure." Chiba (1935) displayed such "amplitude envelope" in his study of accents. (Figure 17)

Recently, I confirmed a critical role of an amplitude envelope:When I said the word"Pakistan", Ms. "Takeshita" reacted as she felt that her name was called.

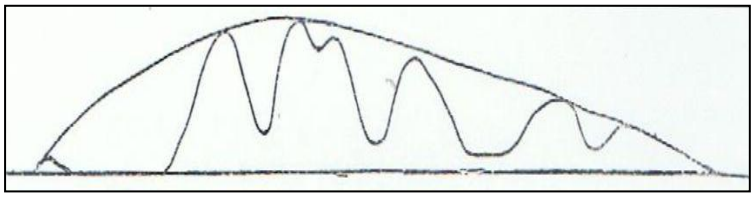


Figure 17 The shape of Epitope should be amplitude envelope of speech. The slower, amplitude envelope fluctuations (above line) and the waveform's fine time structure(below line) (Chiba 1935)

Knowing a particular phonetic word sign is an all-or-none phenomenon. If one wants to study something, before everything, we have to generate CSF-CN antigen terminals at BSRF and concept devices, which is biologically speaking B-lymphocyte inside the CSF. The meaning should accompany and be normalized in accordance with thought operations using the concept device.

Logics of Neurons and Immune Cells (2): Dualism

Combined with Dichotomy, dualisms can create versatile circuits of A+B=C (A+Bi=C, A and B=C, A or B=C or If A, Then do B, etc.) and serve for various applications.

While the logic of dichotomy recognizes the incoming stimuli, the logic of dualism serves to send a signal or issue a decision in response to one or two incoming signal(s). By combining dichotomy and dualism, logics for sign reflex can be established. For example, chained reactions for reproductive activity of fish can be pattern recognition, "If A", and then dualistic connection to indicate the next action, "Then do B". (Table 12)

Not only modern humans but also mammals display emotions. Emotions seems to have a catalytic function to accelerate sign-reflex invoked behaviors. It is plausible that emotions of joy, anger, sadness and hope are instinctively generated by simple life logic mechanism. (Table 11) indicates the author's interpretation on the logical mechanism of emotions. They are produced by memory based operations of a 2 x 2 matrix: good or bad memory pattern recognition and their movement vector. In other words, emotions are for known threats/situations but not for unknowns.

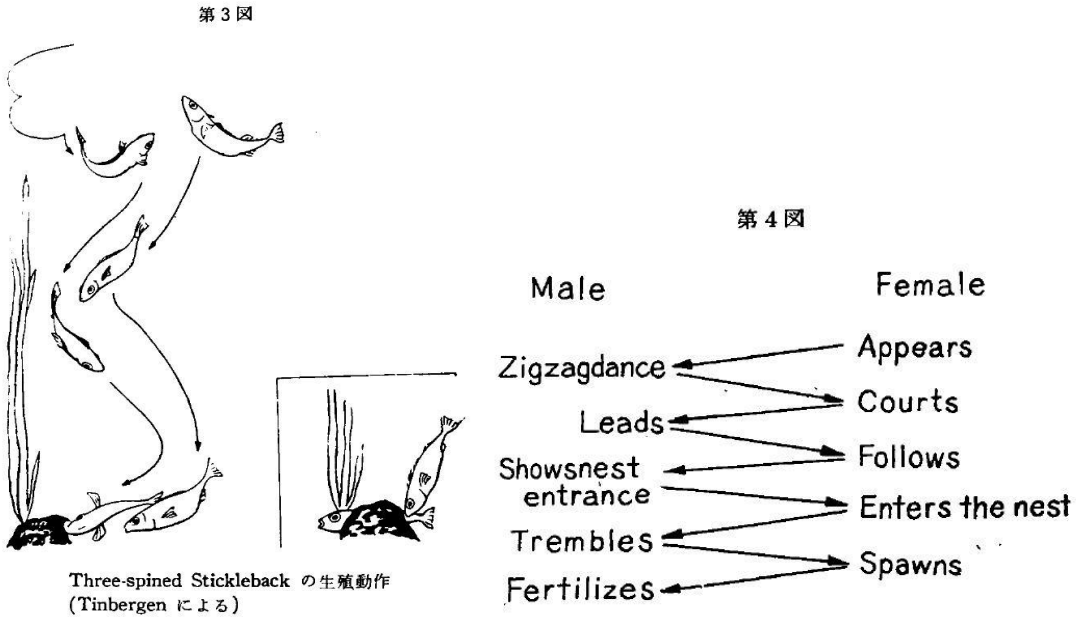


Figure 18/19 Logical Structure for Fish Reproductive Activity IF A Then Do B (Tinbergen 1956)

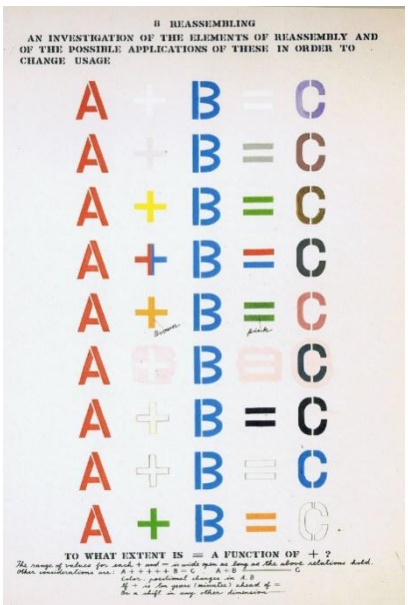


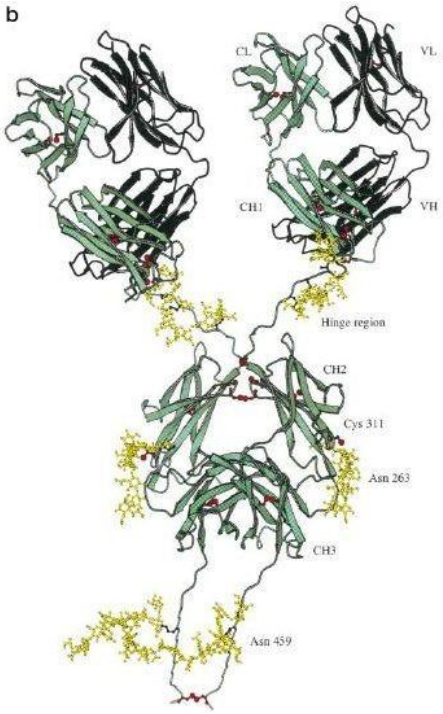
Figure 20 "A" and "B" are signal input parameters, while "+, =, C" constitute versatile dualistic logical circuits. (ARAKAWA+GINS 1988)

Antibody Structure

The antibody molecule has a "Y" like structure. It consists of variable regions at the top sides of "Y" and a constant region at the bottom of "Y". An amino acid sequence is a constant part in any antibody molecule. There are two identical antigencombining regions in one antibody, whose "specificity" is determined by 3 idiotopes. Each idiotope works as antigen and networks with other antibodies. (Jerne 1984)

The immune system is capable of generating more than ten million pairs of specificity combinations (key and key hole pairs), and "the immune system will then produce antibodies that specifically recognize these

molecules, even if they have been synthesized in a chemical laboratory without ever before having existed in the world. How is this possible? For example, the immune system of a mouse possesses no more than about 10^8 B lymphocytes, which would be the maximal available repertoire of variable regions on its antibody molecules. We realize that "recognition" need not be perfect, and that the same "combining site" might recognize, with more or less precision, a number of similar antigens." (Jerne 1984)



Variable region of antibody consists of paratope, which networks with epitope (antigen) and idiotope (one of three segments of paratope) .

Constant region of antibody has Fc ligand, whichpossibly stores logical networkmemories.

Figure 21 Antibody Molecular Structure for Variable & Constant Regions (Mattu 1998)

CSF Contacting Neurons

There are not-well-recognized neurons inside the ventricle system named as Cerebrospinal Fluid Contacting Neurons (CSF-CN). Neither neurologists nor immunologists study the CSF-CN, but they are reported in the journal of Histology. (Vigh 1983, Vigh 2004)

CSF-CN are neurons connecting the retina/cochlea and ventricle wall, and their terminals at ventricle wall constitute epitopes (= antigens) with cilium of motor protein on the top. It is plausible that CSF-CN has functions to generate a new antigen terminal at the Brainstem Ascending Reticular Activating System (ARAS) corresponding to a new external sign stimulus.

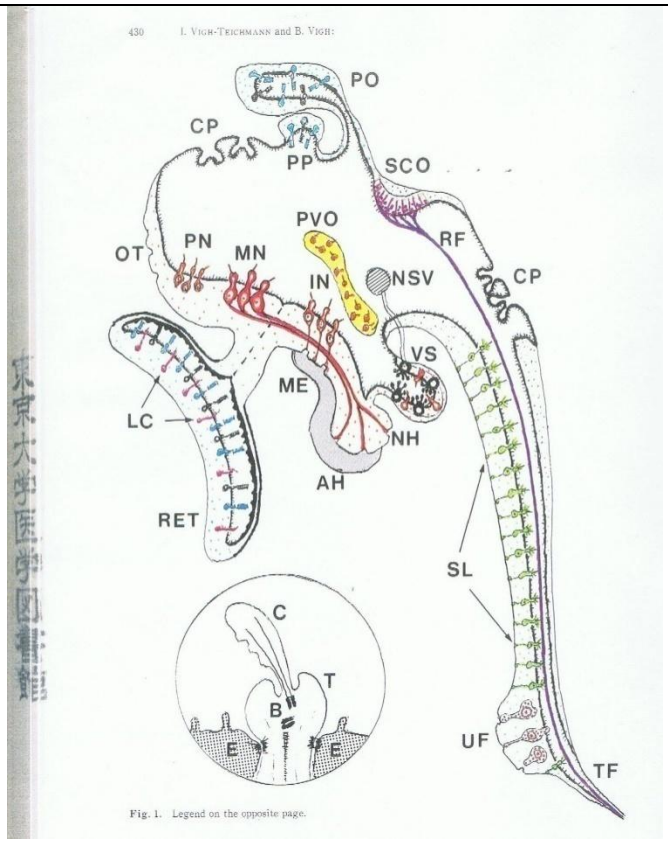


Figure 22 Distribution and Terminal Structure at Ventricle Wall of CSF-CN, in Inset Epitope like terminal (T) and Cilium (C) on its top (Vigh 1983)

Glia cells are Macrophage like immune cells and represent Antigens

About 90 % of brain cells are immune cells. Gray material which covers the surface of neocortex is glia, or more precisely microglia, which are very similar to macrophages which present antigen molecules on the surface of the cell membrane.

Language and Intelligence are inside Ventricle System Neuro-Immune Networks

I would like to propose a series of hypotheses. Lymphocytes move freely and form mobile ad-hoc networks inside CSF in VS. They network brain stem reticular formation for word stimuli, and provide physiological mechanism for language as spinal reflexes. Word memories supposedly have 3-D structures representing their sound waveform.

Jerne (1984) demonstrated, in his Nobel lecture, "The Generative Grammar of the Immune System", that B-lymphocyte have all the necessary properties required for linguistic processing. (Table-13) After reviewing the versatility of its logics and the fulfilment of network requirements, I implemented the Network Requirement Analysis among CSF-CN, B-lymphocytes and Glia cells, and I am more convinced than before that linguistic activities and intelligence are inside the ventricular system neuro-immune networks. (Table-14)

Table 13. Linguistic Requirements and Immune Cell Logical/Physical Properties (re Jerne 1984)

	Linguistic Requirements	Immune System
Number of Specificity Pairs	**About 100 K**	**More than 10 M**
Plasticity to New Stimuli	**Memorize New Words**	**Create Antibody to New Antigen**
Dualism of Phy / Log		

Logical Structure	**Phonemic Permutation**	**3 CDR (Complementarity Defining Regions)**
Physical Structure	**Waveform of Accent**	**3-Dimensional Protein**
Physical Stimuli	**Speech Sound Stream**	**Pathogens, Virus, Toxics, etc.**
Network among Antibodies	**Word - Word Network**	**Antibody networks each other**

Immune Network Requirement Analysis for Language and Intelligence
(Logic of Dichotomy : Antigen-Antibody Responses)

Memory Type	*Active/Passive*	*Ag / Ab Structure*	*Location*	*Biology*	*Mobility*
Sensed Stimuli	Passive (to Activate)	Epitope 凸	Brainstem Reticular Formation	CSF-CN	Fixed
Word Memory	Passive/Active	Paratope 凹 /Idiotope 凸	Floating in CSF/VS	Mobile Neuron (B-lymphocyte)	Mobile
Sensory Memory	Passive	Epitope 凸	Temporal Lobe (Neocortex)	Microglia	Fixed

Table 14 Network Requirement Analysis for Sign Reflex and Language inside Ventricle System

Mechanisms for Automatic Grammatical Processing

Incoming Signals

Speech sound stream is a linear (or mono-dimensional) compilation/alignment of phonemic and vowel accented moraic syllables. There come conceptual and grammatical syllables one after the other without any remarks or identification. Speech receiver/decoder of the listeners must by themselves identify conceptual and grammatical syllables on a real-time basis, i.e. without thinking unconsciously. This is one of the reasons why grammaris difficult.

Conceptual syllables are stems of “nouns”, “verbs”, “adjectives”, and “adverbs”, and grammatical syllables are variable parts of “nouns”, “verbs”, “adjectives”, and “adverbs” as well as independent grammatical words such as “pronouns”, “prepositions”, “articles”, “negatives”, “numerals” and “conjunctives”.

Functions and Logic of Grammatical Demodulation

Grammatical demodulation defines the relationships among conceptual words in the speech as well as provides the attributes of anadjacent word. As we observed in the Chapter “Speech Sound Stream in the Ambient Environment”, SSS is made as a concatenation of minimum semantic unit of a concept and a grammar. Therefore, in general, each conceptual word accompanies a grammatical syllable.

In French, this structure is called as “langage articulé”, a grammatical syllable always comes prior to conceptual order. In English this expression is usually translated as “articulated language”, but “expression with articles” seems to be more an appropriate translation. (Figure-11)

A similar unit of a conceptual and a grammatical syllables exists in Japanese. It is called as “bunsetsu”, grammatical syllables always come after conceptual ones. “Bunsetsu” is an expression which recalls sections of bamboo. A sentence is sectioned by “Bunsetsu”, like bamboo is sectioned. (Figure-12)

It is interesting that the Japanese translation of “langage articulé” was given as “bunsetsu” by an anonymous translator. Both “langage articulé” and “bunsetsu” consist of a minimum semantic unit of conceptual syllable(s) and a grammatical syllable which modulates to an adjacent concept.

The terms for such a minimum semantic unit, langage articulé and bunsetsu, provided me with an idea that grammatical syllables are processed simultaneously and dualistically with adjacent concepts.

As neurons and immune cells are equipped with a logic of dualism, it is not difficult, after identification of a word by dichotomy, to deal with its vector segment of a grammatical syllable by dualistic operation.

An example of a reflexive action isthe evasive activity of birds. It is a dualistic integration of pattern recognition of a sign and its vector element. According to Tinbergen (Figure 23/24), birds issue a call for evasive behavior when they see a shadow with short neck, as birds of prey have short necks, and the direction of its movement when it is approaching. This seems to be "A + Bi = C" type dualistic integration.

Pattern Recognition of a Sign and Dualistic Integration of its Movement Vector

Tinbergen (1951) confirmed that gallinaceous birds issue a danger signal against short neck shadows (+ marked in Figure-23). Only the simple short neck shadow shape is important, other details didn't matter at all. This is pattern recognition, operated by dichotomy (A or not-A).

He further observed and confirmed that, in addition to the shadow pattern, the moving direction vector (approaching + / receding –)(Figure-24) is also important to invoke a danger signal. This indicates that a pattern recognition of sign (short neck shadow) is integrated with movement vector analysis (approaching) to generate an action (danger signal). This can be formulated as: A+Bi=C. (i indicates that A and B are alien.) Interdisciplinary consolidation of Jerne's theory and Tinbergen's experiment allows us to interpret that sign reflexes are operated by logics of dichotomy and dualism. Immune cells have a logic of dichotomy as antigen-antibody responses as well as logic of dualism to issue an order for alert signal.

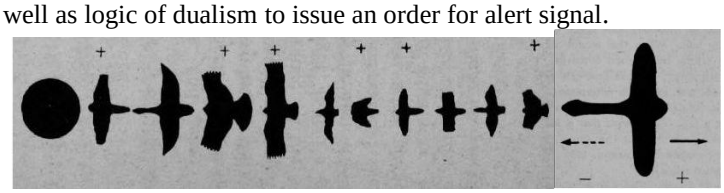


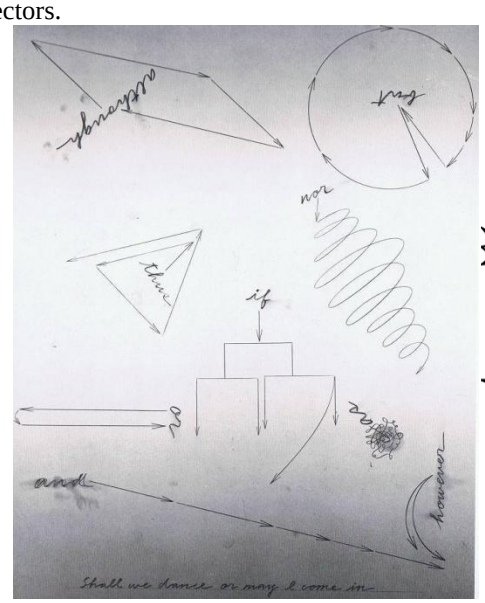
Fig.-23 Sign Patterns (+) activated danger signals. Fig.-24 Movement Vectors (+)
(Birds reacted against shadows with short necks which were approaching (Tinbergen 1956)

Onomatopoietic (= Sound Symbolic) Character of Grammatical Syllables

We talk of onomatopoie or sound symbolism of conceptual words such as nouns, adjectives, verbs, but seldom of grammatical words. But, most of the grammatical words including conjugative suffixes of adjectives and verbs are sound symbolic.

For example, sound of French verbs in present: *j'ai*, imparfait: *j'avais*, passé simple: *j'eus*, future simple: *j'aurai,* passé compose: *j'ai eu*, conditional: *j'aurais,* impératif: *(tu) aie*, subjonctif present: *j'aie*, subjonctif passé: *j'aie eu*, sound onomatopoieticly. English adjective comparative and superlative: *big*, *bigger* and *biggest* are also sound symbolic.

Figure-25 shows vector image of English conjunctives and Figure-26 of Japanese particlesportrayed by the author using Microsoft Power Point. They indicate that grammatical syllables can be treated as sound vectors.



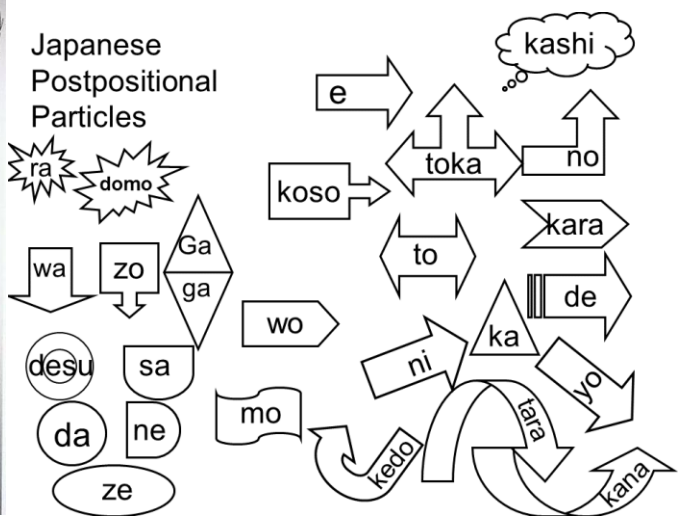


Figure-25 Vector Images of English ConjunctivesFigure-26Sound Vector Images of Japanese Particles
Arakawa + Gins 1988by the author

Biological Mechanism to Integrate Sound Vector of Grammatical Syllables

CSF-CN has a cilium on top of antigen type molecules, which is a motor protein and supposedly changes its shape to indicate a direction.(Figure-27/28) It is possible that vector element is displayed by the motor protein on top of the antigen type molecule of particular word.

It is plausible that this mechanism integrates a movement vector and a sign in animal sign reflex. The dualistic unit of a concept and a grammar in speech sound stream can be physically presented with this structure: a concept sound waveform like antigen molecular and a cilium on the top to indicate grammatical modulation as a vector. In this case, it is necessary to translate the phonetic vector of grammatical modulation into the physical direction of cilium.

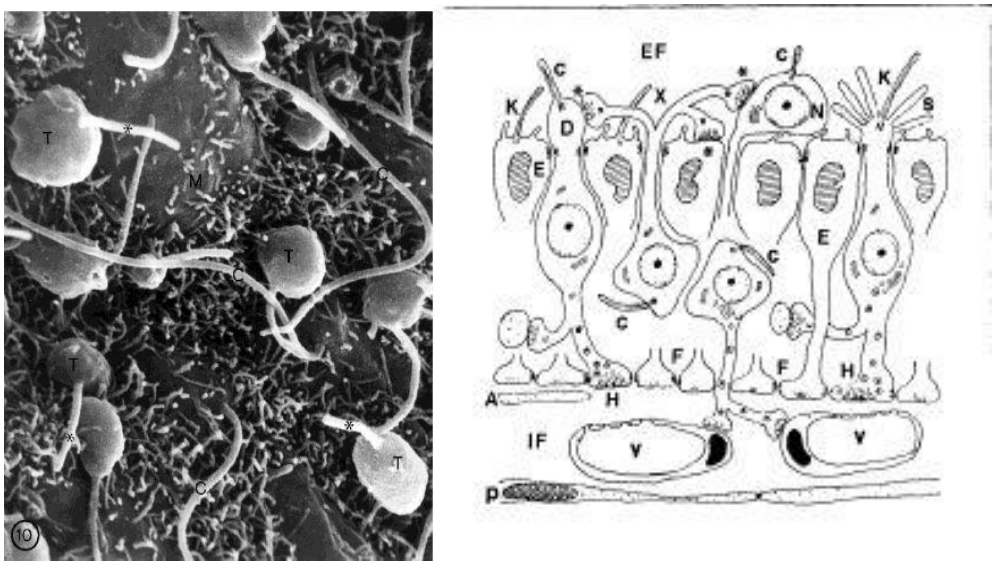
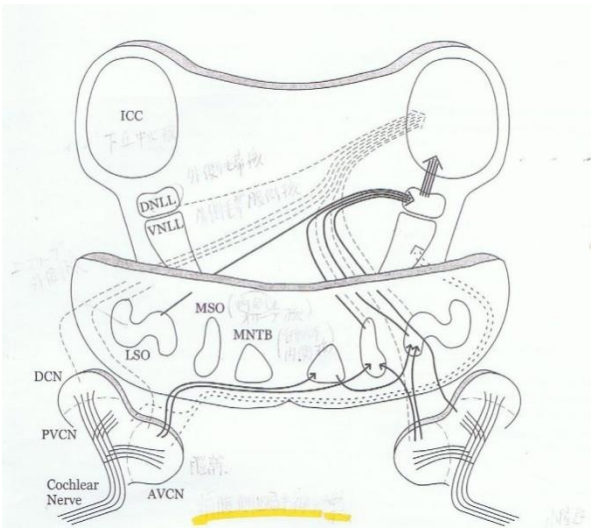


Figure 27/28 CSF-CN and cilium (C) on top of epitope structure (T) (Vigh 2004)

Vectorization of Grammatical Syllables



Auditory Nuclei in Brainstem
MSO:Medial Superior OlivaryNucleus
LSO: Lateral Superior Olivary Nucleus
ICC:Inferior Colliculus Nucleus
DCN:Dorsal Cochlear Nucleus
PVCN:PosteroVentral Cochlear Nucleus
AVCN:Antero Ventral Cochlear Nucleus
MNTB:Medial nucleus of the trapezoid body
DNLL:Dorsal Nucleus of Lateral Lemniscus
VNLL: Ventral Nucleus of Lateral Lemniscus

Figure 29 Brainstem Auditory Nuclei and Binaural Signal Input
(Phillips 2001)

If our brain processes a grammatical syllable as a vector, to be integrated with a conceptual memory represented by an antigen molecule at BSRF, vectorization function must be provided by a competent organ or brain region. Pattern recognition of individual concepts and vectorization of grammatical syllables must be simultaneous to be integrated at real time basis to reconstruct the semantics of speech message. The question is where and how grammatical processing should be implemented automatically.

To localize sounds in space, humans heavily depend on minute interaural time differences (ITDs) and/or interaural phase differences (IPD) generated by path-length differences to the two ears. “Single neurons

in the Medial Superior Olivary (MSO) receive these inputs from both sides and are thus able to execute a coincidence detection on the timing of phase-locked spikes in the pathways from the 2 cochlear nuclei."(Phillips 2001)(Figure-29)

However, for mother tongue speech sound, "A voice to one side of the head will be significantly attenuated at the more distant ear, and listeners can improve their processing of the other voice simply by attending to that ear." (Darwin & Carlyon 1995). When some individuals with asymmetrical hearing losses are fitted with two hearing aids, their binaural performance is worse than their better ear alone. This is termed as "Binaural interference" or "a principle of degradation." (Harris 1965)

It is probable that, by attenuating significantly at the distant ear and hearing mother tongue speech monaurally, the binaural sound localization function is converted to process grammatical syllables as sound vectors, to be transmitted to CSF-CN at BSRF to activate the cilium. This can be the core mechanism for automatic and unconscious grammatical processing. (Tokumaru 2014B)

In conclusion of the hypothesis, the grammatical processing in our brain decodes the input speech sound stream into concatenated concepts with indication of vectors. For example, sentences in Figure-12 are presented by corresponding concepts (= antigen terminals) and their motor-protein based vector indicators (=cilia) at the CSF contacting wall of BSRF, by translating sound of grammatical syllables into vectors (Figure 26) as follows:(Figure-30)

(Tsukihi)↓(Hyakudai)→(Kakaku)⇗(Yukikau)↓(Toshi)→(Mata⇔)(Tabibito)↰
Figure-30

In this hypothesis, grammatical vectors don't modulate the original conceptual meanings, but just they indicate vectors attached to concepts to indicate the relationship with adjacent concepts or grammatical semantic modulations such as "none", "half", "twice", etc. In other words, to clarify and understand the meaning of concepts, we have to investigate the mechanism of conceptual meanings.

Language without Grammatical Modulation but with Binaural Hearing

Piraha (Everett 2008) is a language spoken by a very small population group living in the Amazonian jungle. (Figure-31/32) This language is unique as it has no counting numbers, no phatic communication, no tense, no plurals for nouns, no fixed terms for color, no tense, no comparatives in adjectives, no disjunction, no recursion,.

It can be concluded that Piraha is a language without grammaror logical concepts. (In my definition, "Grammar except syntaxes and pronouns" can be defined as "(i) Onomatopoietic logical switches. (ii) mainly mono-syllabic addition or modulation to indicate semantic connectivity and modification of adjacent concepts. (iii) When acquired, one can compose and decompose grammatically modulated sentences automatically and unconsciously".)

The question is why such strange language exists and how it developed in the family tree of modern human languages born about 70 thousand years ago in Southern Africa? Piraha use an expression when they leave at night: "Don't sleep, there are snakes." As "they know that danger is all around them in the jungle and that sound sleep can leave someone defenseless against attacks by various predators around the village." (Everett 2008) In this extremely wild environment with possible attacks by predators at any moment from any direction, binaural sound localization function should be fully alert and dedicated to determine the direction of evacuation. Probably those who had converted spinal sign reflexes for grammatical modulation should all had been killed by predators, or children before the acquisition of grammar fled into the jungle, like the final scene of the film "the Mission" (Directed by Roland Joffe, 1986), and survived to develop a unique language without grammatical modulation.

In order to confirm the appropriateness of the above inference, the author asked Dr. Everett directly when his lecture was organized in Japan, and his answer was "Yes, Piraha use binaural audition during speech." The author respects this exceptional language of binaural audition without grammar as evidence of the above hypothesis of grammatical processing at brainstem auditory nuclei at the expense of sound localization function.

Figure 31/32 Residential Area of Piraha (Slide in Dr. Everett's lecture) and Dr. Everett's book (Japanese edition)

Mechanisms of Conceptual Meaning and Concept System

Generation of Sign/Word Memory Device and Development of Conceptual Meaning

In case of instinctive sign reflexes, the sign invoke actions. Some words such as "tsunami", "fire", or "wolf (wolves)" are used as emergency reflexive signs to automatically invoke immediate actions like non-human animals' sign reflexes, although we need trainingfor each word and relevant action. We are accustomed to conceptual word signs. In language, meanings of conceptual signs are reminders of sensory memories, word memories and logical memories.

According to my understanding semiology studies on "sign" and "meaning" here, in order to avoid confusion, I tentatively define "signs" as "audio-visual stimuli which trigger spinal sign reflexesor invoke wordsigns", and "meaning" as "outcome of linguistic sign reflex which includes reminiscence of sensory and linguistic memories".

A word becomes a sign, when a person gets a concept device equipped with a specific antibody structure for the sound waveform of a word, biologically a newly matured B-lymphocyte inside CSF. When a concept device is newly born, it is not yet related to any sensory and conceptual memories, and thus has no meaning.

Then theconcept device starts to network with sensory, word and logical memories to develop its meaning.

Pavlov (1927) called signs,such as sound of the metronome and buzzer,as "the conditioned stimulus" and meanings,such as meat powder and acid,as "unconditioned stimulus". He reported that signs should be given in prior to meanings to establish the reflex successfully: "it is also and equally necessary that the conditioned stimulus should begin to operate before the unconditioned stimulus comes into action. If this order is reversed, the unconditioned stimulus being applied first and the neutral stimulus second, the conditioned reflex cannot be established at all. (Lecture 2)

It is possible that, when a memory cell (Microglia) is newly matured in the Hippocampus with the memory of meat powder or acid (to be coded in DNA double helix in the nuclei), antigen 3-dimensional structure with specificity to an antibody of concept device is presented on the cell membrane surface.(Guo-li et al. 2012)(Neuberger 2000)This is probably true for memorization of words.

Binary Tree type Concept System to be Created with Logic of Dichotomy

A concept system or binary tree can be established with the logic of dichotomy and creation of new names for sub-divided categories. (Figure-33) Spontaneous and intentional dualistic conceptual operations yield logical memories such as = (equal), ≠ (not equal), ≦ (larger than), << (much larger than), ∽ (similar), ≡ (congruence), ○ (good), × (bad), ∆ (half good), ∩ (and), ∪ (or), ≒ (almost), ⊂ (inclusion), ¼ (a quarter), ½ (a half), ◎(very good), etc., and construct concept system autopoietically. (Piaget 1947)

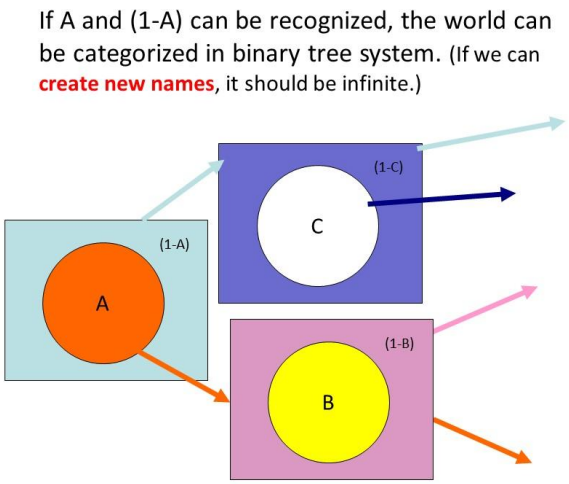


Figure 33 Dichotomies can create as many binary differentiation as possible

Dualistic Operations for Complication and Subdivision

If a new name can be assigned to the result of dualistic integration of two concepts, we can generate a higher order concept. A + B = C (C, a new concept) Using this type of simple dualistic complication, we can define any complex logical concept with multi-order and/or simultaneous equation of simple concepts. In this way, science become logic. (Table-12, Complication)

"True", "scientific" or "complex logical" concepts are dedicated for invisible complex phenomena, and must be defined with a logical expression of other subordinate concepts with step-by-step complication/simplification.

Definition is a logical expression of a concept, in other words, an equation(s) to determine rigorous and precise meaning of a complex logical concept. Equations can be single order, quadratic, multi-order and simultaneous.

Biologically, memories of dualistic operation are stored in B lymphocytes. Based on these logical thought operational memories and network memories of entire mobile neurons, the intelligence of individual people with systematized scientific perspective and in-depth knowledge shall be established as networks.

It is not easy to establish necessary and sufficient definition for such complex logical concepts. It should be established with an ad-hoc definition at first, then little by little be elaborated and ameliorated for perfection through incessant thoughts, discussions, reading and writing.

Logical Memory and Logical Concepts

The meaning of concepts "daily" or "spontaneous" are sensory memories of individuals through individual experiences connected to a particular word stimulus. As conceptualization itself is a generalization, we can share generalized memories by using spontaneous concepts. However, to be precise, the meaning of a daily concept varies and differs by time, place, personal experience and evaluation. It is not easy to define or to establish a unified definition for a spontaneous concept. On the contrary, all logical concepts go through logical operations, and it is easier to have clear and transparent definitions.

Vygotsky (1935), a psychologist under the Soviet regime, and a pioneer of the conceptual formation of scientific and spontaneousconcepts stated that"scientific concepts, like spontaneous concepts, just start their development, rather than finish it, at a moment when the child learns the term or word meaning denoting the new concept."Both concepts develop through maturity and learning. "Scientific concepts grow downward through spontaneous concepts; spontaneous concepts grow upward through scientific concepts."

"The development of concepts, or word meanings, presupposes the development of many intellectual functions: deliberate attention, logical memory, abstraction, the ability to compare and to differentiate. These complex psychological processes cannot be mastered through the initial learning alone." (P149-150, underlined by the author)

Logical memories are obtained through thought operations. Piaget showed some examples of logical operations and the resultsin his comments to Vygotsky. It is plausible that a concept device stores logical memories somewhere in itself. (Table-12 thought, observation)

A (rose) + A' (flowers other than rose) = B (flowers),

A = B – A'

Consequently A < B

Dualistic thought operations of AND and OR yield "logical concepts" of 'Relationship' and 'Class', respectively.

I.e. "offspring AND boy" = "Son", "Son AND Son" = "Grandson", concepts of relationship

"Lemon OR Orange" = "Citrus", "Chimpanzee OR Modern Human" = "Primate", "Early Human OR Modern Human" = "Hominidae", concepts of class.

The definition of concepts gained through logical operations can be obtained through the same logical operation of two definitions. These concepts were generated in order to signify invisible logical relationships or classes.

These logical concepts can be operated further to generate one-step more complicated concepts. And by continuing these logical operations, we can generate "logical complex concepts" with transparent procedures of logical operations. Complex logical concepts are not abstract and can be verified or proven by a step-by-step logical operation of complication / subdivision.

Thus we can make and use complex concepts. "Every new stage in the development of generalization is built on generalizations of the preceding level; the products of the intellectual activity of the earlier phases are not lost. The inner bond between the consecutive phases could not be uncovered in our experiments because the subject had to discard, after each wrong solution, the generalizations he had formed and start all over again. Also, the nature of the experimental objects did not permit their conceptualization in hierarchical terms." (Vygotsky 1935, P202, underlined by the author)

Logical Concepts: Complexity Orders and Indispensable Definitions

Although Vygotsky did not specify the difference of stagesin the development of generalization, the author tried to classify these concepts by logical order. Level-0 is not conceptual. The words invoke physical actions such as emergencies, incantations, consumption signs etc. Level-1 is for spontaneous and daily concepts, which accumulate meanings through sensory experiences. For sensory perception, words are generally onomatopoietic. Level-2 is for concepts representing 1st order thoughts and grammatically composed information. First order thought operations are, for example, AND, OR and NOT. They are concepts of Class (OR), Relationship (AND) and Negative (NOT). Multiple concepts can be connected by AND, OR and NOT, and conceptualized as Concept of Information. Level-3 is for scientific terms with transparent definitions and open access in their respective disciplines. At this level, words are memorized and used with correct spelling, and other conventions. Third order concepts are no more spontaneous. They are not always associated with sensory memories. They are generated through multiple thought operations and/or as a compilation of other 3rd order concepts. We don't have many 4th order concepts yet.As a definition, they are usable interdisciplinary general concepts, whose definitions should be transparent. They are generated by step-by-step logical processes. Therefore, although they are highly abstract, they are endorsed by reality. When we establish common human intellectual genomes, 4th order concepts should be used.

One of the difficulties in our language lies in the fact that we use the same biological mechanism, B-lymphocytes inside CSF, for reflexive signs, spontaneous concepts, primary logical concepts and complex logical concepts. In our future dictionary it would be recommended that, in addition to the parts of speech, such as "noun", "adjective", "verb", etc., a logical order or maximum logical order of these conceptsshould also be indicated as follows: Noun0, Noun1, Noun2, Noun3, Noun4.(Tokumaru 2012 A/B, 2014C)

Logical Order of Concept and Memories

	Order	Type of Concept	Types of Memory
	0	Sign Only No Memory	Magical Words; Consumption Code; Empty Memory
Spontaneous --- Scientific	1st	Spontaneous Association	Onomatopoetic Etymology; Non-rigorous
	2nd	Thought Result, Information	Class; Relationship; Grammatical Composition of Multiple Memories
	3rd	With Transparent and Shared Definition & Orthography	Logical Etymology; With System and Conformity in a Linguistic Community or a Professional Discipline
	4th	Interdisciplinary Usable General Concept	Clearly defined with Materials and Phenomena; Reducible to Reality with step-by-step logical process; To Contribute to Human Intellectual Genome

Table-15 Logical Order of Concepts (Tokumaru 2012 A/B, 2014 C)

For example, some words from the OED are classified and indexed with complexity orders. "damn: **exclamation0** informal expressing anger or frustration *Damn! I completely forgot!*", "gossip: **noun1** [mass noun] casual or unconstrained conversation or reports about other people, typically involving details which are not confirmed as true: *he became the subject of much local gossip*.", "grandfather: **noun2** the father of one's father or mother", "DNA **noun3** [mass noun] Biochemistry deoxyribonucleic acid, a self-replicating material which is present in nearly all living organisms as the main constituent of chromosomes. It is the carrier of genetic information."

Noun2 is a good example of definitions. A definition displays the logical structure of a concept. It is a formula of a concept using lower level simple concepts. The users of logical concepts had better construct their own definitions to the concept above level2. One cannot use logical concepts correctly without understanding their definitions.

Constructing the most appropriate definitions of logical concepts by oneself through trial-and-error requires a lot of thought operations and generates memories inside individual concept devices, the B-lymphocytes, as well as harmonized networking memories in one's CNS system. As a professional baseball player swingshis bata million times in his life, and the fingers of a professional pianist tap the piano keyboard a hundred million or billion times in their life, we need to think thousands or millions of times to become good at defining and using complex concepts.

Complex Logical Concepts Require Very Low Noise Environment

In traditional communication theory, there is a theory of "Signal to Noise Ratio". This is a very simple idea on the trade-off relationship between the environmental Noise (or Entropy) element and Signal intensity. (Figure-34)In a low noise environment, channel efficiency is big and communication becomes dynamic. And, in a high noise environment, channel efficiency decreases and communication becomes difficult.

The phonetic property of science is very similar to that of silence. Probably science started in silence, for example, at some monasteries in Europe. In very quiet low noise environment, one can perceive subtle things and think them repeatedly. "Writing requires a double abstraction: abstraction from the sound of speech and abstraction from the interlocutor." (Vygotsky 1935) A low noise environment is an incubator for dynamic ideas and new scientific concepts. When we compare Table 15 and Figure 34, they correspond to each other, and indicate the importance of a low noise environment to higher order concepts.

The modern human is an ape with language. We have to know how to use language correctly and efficiently. Not many people are aware of the difference between daily concepts connecting to sensory memories and logical concepts not directly connecting to any sensory memory. It is recommendable that, in school education, complex logical concepts should be taught. A complex logical concept is not directly connected to any sensory memory, but its meaning should be constructed and maturated through a lot of purely-logical conceptual thought operations.

A very quiet environment is needed for us to learn and think interdisciplinary complex logical concepts. Then we will be at the final stage of our evolution to become "*Homo Sapiens*" in its true sense: Incessantly Studying Apes.

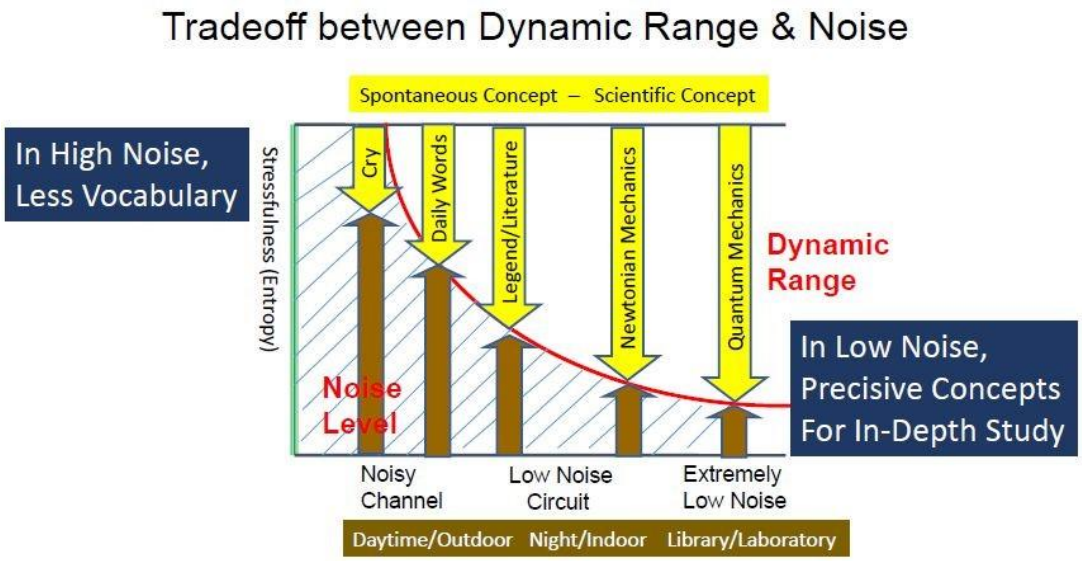


Figure 34 Silence yielded Science: Dynamism of Thought and Noise (Tokumaru 2014C)

Be a Master of Concepts

When we use concepts, we must be the Master of Concepts, and not their slave. This is important when we acquire and learn scientific (complex logical) concepts.

The appropriateness, preciseness, correctness and transparent/rigorous definitions of concepts are the key to efficient and productive studying and learning. Whenever we encounter a new concept, we have to verify when, how (in which occasion), by whom and for what purpose it was invented. We should not forget that a new concept is invented by someone who encounters a new situation or a new phenomenon that has never been conceptualized. Without understanding the background of its birth, we cannot tell whether the concept and its definition is correct and appropriate.

'When I use a word,' Humpty Dumpty said in rather a scornful tone, 'it means just what I choose it to mean — neither more nor less.' 'The question is,' said Alice, 'whether you can make words mean so many different things.' 'The question is,' said Humpty Dumpty, 'which is to be master — that's all." ----- Lewis Carroll, "Through the Looking Glass"

Forward Error Correction of the Existing Concepts

It is necessary to spend many years to fully understand the meaning of complex logical concepts which require axiomatic thinking; to verify facts and concepts and discover the author's prejudice/misunderstanding; to reconstitute truth beyond the texts; to investigate the origin of an ambiguous and confusing concept; to determine appropriate definition and rectify the concept.

We have to implement Forward Error Correction (FEC) of such concepts. FEC is an error correction mechanism by the information receiver without having to contact the information sender.

Long-term, extensive and in-depth learning and thought are necessary to understand extensive and highly sophisticated concepts. In order not to make erroneous comments and not to confuse listeners/readers, we should be well aware of definitions of complex concepts. And, when necessary, we should propose the correction of a concept and its definition.

(a) The splitting of a concept is necessary, if one concept is related to multiple independent objects or phenomena. For example, "human" concept is not appropriate when we think of its origin, because the early human of 3 ma and the modern human of 65 ka are totally different. Therefore we should stop using "human origin" and instead use "modern human origin" and "early human origin" as separate concepts.

(b) The reconstitution of facts and reconfiguration of definitions are necessary to deal with not-fully-refined and erroneous concepts. For a mystic, ambiguous, and confusing concept, it's better to go back to its origin to discover how it was born and for what purpose.

For example, a thermodynamic concept of "entropy" has been used by many scientists without a clear definition. In Information Theories, the meaning of "entropy" is "information quantity" and the bigger the entropy, the more efficient. This is in contradiction to the thermodynamic "entropy" concept.

Dr. Eri Yagi investigated the original papers of Rudolf Clausius on thermodynamics and came to the definition of "amount of displacement of component". (Clausius 2013), (Yagi et al 2014) If it is a displacement value, there exists no negative value for entropy.

On the other hand, the author discovered John von Neumann's manuscript for the third lecture at the University of Illinois in December 1949 at the US Library of Congress, Manuscript center. (Figure-1) There he introduced the "entropy" notion of Maxwell, the bigger the better. But he did not allow this lecture to published. It is possible that he had realized the wrong usage of "entropy" notion, but had no time to correct it. (Tokumaru 2015)

It is probable that the thermodynamic way of thinking is effective when we analyze information and communication phenomena. We had better reexamine the "entropy" concept in the Information Theories and establish a general concept which can be used as an interdisciplinary concept.

Concepts are our tools for thought. They are like the scissors of a barber, and knives of a chef. We have to keep our concepts accurate and sharpened so that we can think correctly. As thought is probably a cellular networking between B-lymphocytes, they think, not us.

Source Coding Errors and Channel Coding Errors make a law of excluded middle

Channel Coding Errors are errors in the physical layers (bottom three layers of Figure- 3) and defined to be "any signal loss or replacement taking place during thetransmission/propagation/reception". In short, they are errors not made by the author. It is a matter of identicalness of the information in accordance with the will of sender. When the information (or message) at the receiving side is completely identical with the one sent by a sender, there is no Channel Coding Error.

In communication via human speech, mishearing in a noisy environment is regarded as a Channel Coding Error.In inter-cultural speech communication, there exist many errors, and it demonstrates how sophisticated and delicate our language is. Some are Channel Coding and others are Source Coding related. For example, a Japanese lady pronounced the French sentence "C'est tout" (That's all) with flat intonation, and a French grocery clerk received it as "Sept oeufs" (seven eggs.) This is achannel coding error of inappropriate intonation. Another Example is an American tourist in Paris spoke to a taxi driver in French but using the English word order, "Eiffel tour". The taxi driver received this as "Et fais le tour" (And make a circle) and drove his car to make a circle. The tourist should have told the driver "Le Tour Eiffel". This is a syntactic error, which is regarded as a source coding error.

In written documents, Channel Coding Errors are determined based on the author's original manuscripts. Books posthumously-published do not go through proofreading by the original authors, such as von Neumann (1987) and Confucius's Analects, which may contain Channel Coding Errors from the first edition.

Source Coding Errors are errors in logical layers (top three layers in Figure-3) and defined as "errors in information or in a concept presented by the author."In short, they are errors made by authors.

It is not easy for information receivers, such as readers, to determine whether the received information is right or wrong, because the authors of books and papers are more knowledgeable than their readers, and because most of the authors don't provide definitions and acquisition processes of concepts.

However, we have to choose correct information, and to reject errant information. We should not blindly accept any information or concept even from textbooks or books written by famous scientists otherwise we import the wrong information into our consciousness and dilute our knowledge.

It is important that the channel coding errors and source coding errors consist of a law of the excluded middle. When these two types of errors are eliminated from information, it is right and correct.

C**onclusion: Towards Logical– Physical Dualism**

In this paper, I briefly touched on my hypotheses on the human digital language or linguistic communications: its overall network architecture, a plausible evolution of our vocal tract, the speech sound stream with logical properties of phonemes and morae, the physical/logical converter at the brainstem reticular formation, a mechanism for grammatical demodulation, and the mechanism of conceptual meanings.Although they are not yet verified yet with appropriate and dedicated experiments, they are based on the words of prominent scientists.

If our consciousness and intelligence are built up with neuro-immune cellular logics of dichotomy and dualism, non-human-animals can also build up their intelligence and understand human language. The results of my investigation implies that the essential mechanisms that control humans and non-human animals are the same in the physical layer except only for the human unique Supralaryngeal Vocal Tract (Lieberman & McCarthy 2007) to vocalize vowel accented syllables.

Humans have culture thanks to logics of"Language" that no other social animal (e.g. elephants, wolves, apes) have in their communities. Culture is a qualititively new order of reality that is constitutive of human conscious system in its logical layer constructed by "Language". The reasoning of human beings does not exist as itself, but it must be carefully built up with full respect and the enthusiastic learning of "Language". Language is a common intellectual genomes of the modern human species, which individuals should learn and improve on. Language is culture. "Culture is stable, but it is never static: it is, on the contrary, dynamic and ever-changing." (Merriam 1964)

In conclusion, I would like to propose "Logical – Physical Dualism" to replace the Cartesian "Body – Mind Dualism". One problem of "Body – Mind Dualism" is in the absence of a definition of "mind". So-called mind phenomena are immuno-neural interactions inside the ventricle system, which are physical and microphysical phenomena. Body and mind are both made of amino acid and nucleotide sequences. Thus the modern human is not a special animal, and we have to admit non-human animals also have their own minds with emotions and feelings.

Body-Mind Dualists would ask "How can you explain our mental activities in literature and science without a mind?" Literature and science were achieved not because of the human mind but because of a logical language. Intelligence is not the property of any individual human, but that of literature or language. Among human-beings, those who only respect language successfully left sophisticated and splendid additions to literature and science.

The future development of the modern human depends on how we correctly use language. The Cartesian expression "Cogito ergo sum" is a superstition and should be modified, because "I think" is not yet analyzed as a molecular level biochemical phenomena. In reality it is concept devices (or words) which network to each other and think. Thought is a networking phenomenon of individual word memories represented by mobile neurons inside the CSF. If we want to think correctly, we have to rectify word memories through incessant learning and thinking. Then we will become "true human beings" with the correct and appropriate usage of the logical language.

Words think: Concept devices representing individual word signs network inside the brain cerebrospinal fluid, which is thought. The more correct, accurate and appropriate words we use, the more correct our thoughts are and the further we advance.

We should say farewell to our egocentric and human centric way of thinking, and live peacefully with all the living creatures on this planet as *homo sapiens*.

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Appendix-A : Ad-hoc and trial definition of several important concepts.

(a) The definition of "logic" should be common among computer software/hardware engineers, molecular biologists and linguists. It can be defined as "an automatic device that recognizes an input signal as a sign and transmit a predetermined signal with regularity".

(b) Grammar except syntaxes and pronouns can be defined as "(i) Onomatopoietic logical switches. (ii) mainly mono-syllabic addition or modulation to indicate semantic connectivity and modification of adjacent concepts. (iii) When acquired, one can compose and decompose grammatically modulated sentences automatically and unconsciously".

At the beginning, the definition of grammar was (ii) mono-syllabic logical switches. I later added (i) "onomatopoietic" as this is commonly shared characteristic of grammar, and (iii) "automatically and unconsciously" as I understood that this is also common feature of grammar.

(c) Concepts can be defined as "a device containing a sound waveform receptor for a word sign. It networks with relevant sensory memories as well as other word signs. At each networking, the evaluation is made and its results such as=,≠, ≦, <<, ∽, ≡, ◎, ○, ×, ∆, ∩, ∪, ≒, ⊂, ¼, ½, etc. are memorized."

Through daily experiences, one can acquire a new concept sign and a relevant sensory memory. In accordance with the accumulation of experiences, concepts are classified and categorized through mutual networks into a non-hereditary concept system of an individual and independent person.

There are special concepts, which Vygotsky (1935) named as "true concepts" or "scientific concepts", which are differentiated from daily concepts. As they do not connect directly to any sensory memories, but only to memories of logical thought operations, they can be called as "purely logical concepts" or "complex logical concepts".

The difficulty and confusion lies in the fact that daily concepts and scientific ones use the same biological cells, namely mobile neurons, B-lymphocytes, floating in Cerebrospinal Fluid (CSF). In order to use correctly scientific concepts, they should not be connected to any sensory memories, but they should be defined by words as clear and as objective as possible.

(d) Information should be defined as "logically composed multiple signs" The difference between adult humans and infants is in the use of grammar that can compose complex and profound linguistic information. Non-human animals such as Nim (Terrace 1979) and human infants before learning grammar can operate two-words or three-words sentences with ease.

The above definitions should be discussed, investigated, evaluated and ameliorated so that an interdisciplinary and transparent definitions can be established.