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Towards The Completion of the Modern Human Linguistic Evolution – The Restrictions of Vertebrate Spinal Sign Reflexes Should Be Overcome – The Digital Linguistics

Abstract: Digital Linguistics identifies that modern human linguistic evolution is a digital evolution of the analog vocal sign communications of mammals, which are operated by the spinal sign reflex mechanisminside the ventricle system immune cell networks. There are three breakthroughs in physical layer human speech sound: (1) the acquisition of phonemes and morae, which allow the generation ofan infinite number of word signs and to modulate concepts with grammatical syllables, (2) character set and literacy, to record and retrieve speech sounds based on orthography, and (3) search engines and electronic transfer of linguistic information, to locate and obtain necessary information.The second breakthrough, i.e. writing, allowed the accumulation and transfer of knowledge over generations, which lead to rapid and serial technological innovations known as civilization. Pakistan is one of the places where civilization was born. The author traveled to the Panjab region in 2016 and visited Mohenjo Daroin 2017 to investigate the Indus civilization. He came to a hypothesis that the Indus civilization collapsed because of insufficient literary education and documentation as the job of clerks had been monopolized by a special caste. In the 21st century, we can make keyword searches and download any relevant linguistic information via our mobile phones.It is necessary to understand and overcome restrictions of vertebrate sign reflex mechanism, which we use for linguistic processing in the brain, and enhance our learning and thinking capability to cope with the flood of information.As20th century science expanded into quantum and molecular level way beyond our senses, we have had toestablish methods to correctly learn and think about these invisible phenomena. Otherwise ourcontemporary civilization might collapse like MohenjoDaro.

Keywords: Sign Reflex Mechanism, Immune Cell Networks, Digital Evolution, Axiomatic Thinking, Scientific Concepts

1. Introduction: Brief Overview ofthe ICLAP 2016 Lahore Lecture

1.1 A Bricolage and Three Breakthroughs for Digital Linguistic Evolutions

The author delivered a plenary lecture at the ICLAP 2016in Lahore, Pakistan with the title, "The Logical Linguistics: Bricolage and Breakthroughs in Human Digital Linguistic Communications." It was an interdisciplinary integrationto hypothesize that the digital linguistic evolution of modern human'sspeech sound stream as well as the in-brain molecular and cellular mechanism for linguistic memories and processing, which is based on the sign reflex mechanism of vertebrates.As there are no hypothesis for the acquisition process of syllables or laryngeal descent, this is a new and unique hypothesis.

The digital linguistic evolution took place when modern human acquired phonemes and morae, logical distinctive properties in frequency and time domain respectively. It is plausible that these logical properties

came about with the unique event of the laryngeal descent of modern humans, and that laryngeal descent became possible with the development of the unique mandibular bone of modern humans which reduced the risk of choking.

The archaeological excavation at the Klasies River Mouth (KRM) Caves, South Africa, in 1967-68 (Singer Wymer 1982) confirmed that (anatomically) modern humans had lived inside the caves during the period 120 – 60 Ka (Ka: thousand years ago), and Royer et al (2009) stated that '(T)his 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.' This dimorphism indicates that the evolution of the mandibular bone should have taken place in KRM Caves.

Deagling (2012) found that "no consensus exists that there is a diagnostic anatomical indicator for articulate speech in human evolution" and made extensive analyses to get clearer images of the evolution of the unique mandible of modern human. 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 laryngeal descent took place in a two-stage time-series evolution of logical properties, namely click consonants then vowel accented syllables, and that frequent use of the tongue to produce click sounds had contributed to the unique mandible of modern humans and provided enough space to house the vocal tract with its descended larynx. The location and timing of these events should be 72KA at Still Bay for clicks and 66KA at KRM Caves in HowiesonsPoort technocomplex for laryngeal descent and vowels.

Bricolage & 3 Breakthroughs	**Logical Phenomena**	**Results & Achievement**
Spinal Sign Reflex Mechanism (Vertebrates and Mammals)	Inside Ventricle Immune Cell Networking (Ag-Ab response)	Audio Sign Processing
Laryngeal Descent for Vowel (72-66KA)	Phonemes and Morae (*the birth of linguistic humans*)	Infinite number of word signs, Grammatical Modulation
Character Set (phonogram /ideogram)	Externalized and Shared brain memories	Abstract concept, Collective Intelligence, Civilization
Computer Networks & Keyword Search (Now)	Interactive Keyword Search & Download at handy terminals	Birth of Linguistic Human

Table-1 A Bricolage and Three Breakthroughs for Digital Evolution of Linguistic Humans

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-2 South African Middle Stone Age and Still Bay / HowiesonsPoort Technocomplexes (Lombard et at 2012)

1.2 Cellular and Molecular Biological Mechanism for Linguistic Processing

There is no hypothesis for the cellular and molecular biological mechanism for linguistic processing. Scientists discuss "Language Acquisition Device" or "Linguistic Brain" without identifying the organ and cellular/molecular level memory and interaction mechanisms. As speech impediments in the 19th century were associated with neocortex anomalies in the Broca / Wernicke areas, it has been taken for granted that linguistic processing takes place on the neocortex by establishing sensor-motor synaptic connections. But Penfield concluded, in his unique experiment to stimulate neocortex of patients with an electrode, 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 1954).

Pavlov (1927) had supposed that conditioned reflexes are established as synaptic connections between sensory and motor areas on the cortex. To demonstrate that "*(A) decerebrate dog would never have responded by salivary secretion to any stimulus of the kind,*" he removed the sensory areas or cerebral cortex entirely (Lecture-2, Page 22, Lecture-19 to 21 are the cases of decerebrate dogs.) However his writings in Lecture-19 contradicts his statement in Lecture-2. "*The first change which follows the extirpation of some part of the cortex is the almost invariable disappearance of conditioned reflexes; but in the majority of cases it is only the " artificial " conditioned reflexes which disappear, i.e. those which were established in the laboratory, being therefore relatively recent and little practiced. If the " natural " conditioned reflexes have also disappeared, they are always the first to reappear; but usually no disappearance of the natural conditioned reflexes could be observed even though tested immediately after the recovery from the anaesthetic administered during the*

operation. Examples of the greater resistance of conditioned reflexes to " natural " stimuli as compared with those established to " artificial " stimuli occur in every research upon partial extirpation of the cortex and there is therefore no need to give any special examples."

"*As a rule the conditioned reflexes disappear after the operation, whether it is performed on one or both of the hemispheres and on whatever portion of them it is carried out. The absence of " artificial" reflexes persists for different lengths of time, varying from a single day to several months*." (Lecture-19)

Digital Linguistics (DL) owes a lot to Noll (2003), in particular for his extensive interdisciplinary references not only in linguistics but also information theories, quantum mechanics, brain sciences, molecular biology, primatology, archaeology, mathematics, immunology, genetics, etc. It seems that Noll inherited the idea of digital language from Jerne, who identified that immune cells are neurons with mobile ad-hoc networking functions, and verified that B-lymphocytes have all the necessary functions to behave as concept devices. (Jerne 1974)(Jerne 1984)

There are neurons inside the ventricle system called Cerebrospinal Fluid Contacting Neurons (CSF-CN). Neither neurologists nor immunologists study the CSF-CN, and the papers of Vigh were published in the journal of Histology. (Vigh 1983), (Vigh 2004) CSF-CN are neurons connecting the retina/cochlea and ventricle wall, and their terminals at the ventricle wall constitute epitopes (= antigen terminals) with cilium of motor protein on top. 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.

About 90 % of brain cells are immune cells. The grey material which covers the surface of the neocortex is microglia, very similar to macrophages which present antigen molecules on the surface of the cell membrane. Pavlov (1927) reported that signs should be given prior to meanings to successfully establish the reflex: "*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 amicroglia is newly matured in the Hippocampus with the memory of food to be coded in the DNA double helix in the nuclei, antigen 3-dimensional structure representing sign waveform is presented on the cell membrane surface as an index. (Ming Guo-li et al. 2012)(Neuberger 2000)

Linguistic Entity/Processing	**Cellular Structure & Location**	**Molecular Structure**
Conceptual Device	Mobile-Neuron B lymphocytes floating inside Cerebrospinal Fluid	Antibody structure on the membrane surface
Word sign receptor / activator	CSF Contacting Neuron at Brainstem Reticular Formation	Antigen terminals and cilia (motor protein) on top
Sensory Memories (Daily Concepts'	Microglia cells on the surface of brain neocortex	Antigen terminals on the membrane surface as an index

Meanings)		
Logical Memories (Abstract Concepts)	Antibody networking among B lymphocytes in CSF	Fc ligand inconstant region of antibody
Unconscious & Automatic Grammatical Processing	Monaural audition of mother tongue at the expense of sound localization function in brainstem auditory nuclei	Sound vector analysis at Brainstem and dualistic integration at CSF-CN antigen terminal and direction of cilia

Table-3 Molecular and Cellular Mechanism for Linguistic Phenomena

Network Requirement Analysis for Inside Ventricle System Immune Cell Networks for Word Sign Reflex

Nomenclature	Memory Type	Activation	Molecular Struture	Locaation	Mobility
CSF (Cerebro-spinal Fluid) Contacting Neuron	Sound Waveform of word phonetics (& Instinctive Reflex)	Activation	Antigen terminal with cilial vector	Brainstem Reticular Formation	Fixed
B lymphocyte (= Concept Device)	Word Networking Results and Waveform Receptors	Active / Passive	Antibody (= 3 Antigen CDRs)	Floating inside CSF (Cerebro-spinal Fluid)	Mobile
Microglia Cell (= Meaning of Daily Concept)	Sensory Memories with Sound Waveform as indexes	Passive	Antigen terminal to be recognized	Neocortex	Fixed

Table-4 Network Requirement Analysis for inside VS Immune Cell Networks for the Word Sign Reflex.

Table-4 is the result of Network Requirement Analysis inside VS immune cell networks for the word sign reflex. Antigen terminals of CSF-Contacting Neuron and microglia cell represent "amplitude envelope fluctuations" of individual phonetic stimuli of words. The antibody of B lymphocyte constitutes a specificity pair with the antigen terminal. Word phonetic stimulator (= CSF-CN) and sensory memories related to that word (=microglia cell) are mediated by concept device (= freely moving B lymphocytes inside CSF) for daily spontaneous concepts. The meaning of scientific concepts is to establish a network of dualistic thought operations among B lymphocytes inside the CSF. This is a brief overview on the meanings of daily and scientific concepts. (Vygotsky 1935)

The table shows that sensory memories stored in the microglia cells are passive and need to be recognized by B lymphocytes. For example, when we happen to see our old friend on the street, we can recognize their face, but we cannot recover their name. It is because sensory memories are fixed in the neocortex and need to be recognized by mobile concept devices.

1.3 Grammatical Demodulation using Sound Localization Function at Brainstem Auditory Nuclei

Mora is logical because the rhythm or beat of vowel accents punctuates the speech sound stream into time slots, where listeners can predict the existence of a syllable in each time slot. Thanks to the logical property of mora, each syllable contained in the speech sound stream becomes distinctive in the time domain, and two different types of syllables, namely conceptual and grammatical, can be vocalized alternatively without any indication or mark.

It is interesting that some moraic (=syllabic) language such as French (g+C) and Japanese (C+g) have unique grammatical structures "*langagearticulé*" and "*bunsetsu*", the minimum semantic units with standardized order of a grammatical and conceptual syllables. They indicate that grammatical syllables modulate adjacent concepts.

The onomatopoiec feature of grammatical syllables indicates that they are analyzed as sound vectors. We hear mother tongue monaurally and convert sound localization function of brainstem auditory nuclei for vector analysis of sound waveform of grammatical syllables. The fact that the language of the Piraha has no grammatical modulation, but that the Piraha keep binaural audition for speech sound (Everett 2008), and the fact in other languages mother tongue speech sound audition is monaural, indicate the mechanism of grammatical processing by the brain. The author surmises that this monaural audition of the mother tongue and sound vector analysis at the brainstem auditory nuclei is the answer to the 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)The sound localization function of brainstem auditory nuclei is converted to analyze the sound vector of grammatical syllables and the results of vector analysis are sent to the celia (= motor protein) at the top of CSF-CN antigen terminals of relevant concepts as vector information.

2. Character Set and Literacy Gave Birth to Civilization

2.1 Civilization is a linguistic phenomenon

If the laryngeal descent had taken place 66 ka, linguistic humans had spent more than 60 thousand years without any external recording system. Then the first character set, cuneiform, was invented 5ka in Mesopotamia, a very vast flat land, where earth and sand sediment filled the sea, between the Eurasia andGondwana continents. The size of land was beyond the perception of humans at that time and some form of recording system was needed.

It can be concluded that the character set was not autopoietically invented like grammar. And, it was not the brain mechanism of linguistic humans which required or needed to have an external memory system. It was invented to correspond to the administrative requirements to govern unimaginably vast areas, and only those who had gone throughspecial training could read and write. Probably they had not foreseen that a character set should help develop a civilization.

A civilization is a linguistic phenomenon of linguistic humans. At the end of their biological life, they can write their accumulated knowledge with a character set, so that subsequent generations can share their thoughts and experiences. This linguistic phenomenon enabled rapid and serial innovations which we call

Civilization.

The character set and knowledge of orthography provided linguistic humans with an extended external memory system which could be shared and passed on. Civilization can be defined as the "time and space where members can share linguistic information such as law, literature, technology, etc. thanks to a character set and literacy, and improve on this through the generations", which is a *synchronic* definition. Or, another definition can be as follows, "in a civilization, a person is expected to learn what the precedent generations have written down and go beyond them", a *diachronic* definition. (Saussure 1959) In our civilizations, modern humans became immortal by inheriting and improving on common intelligence.

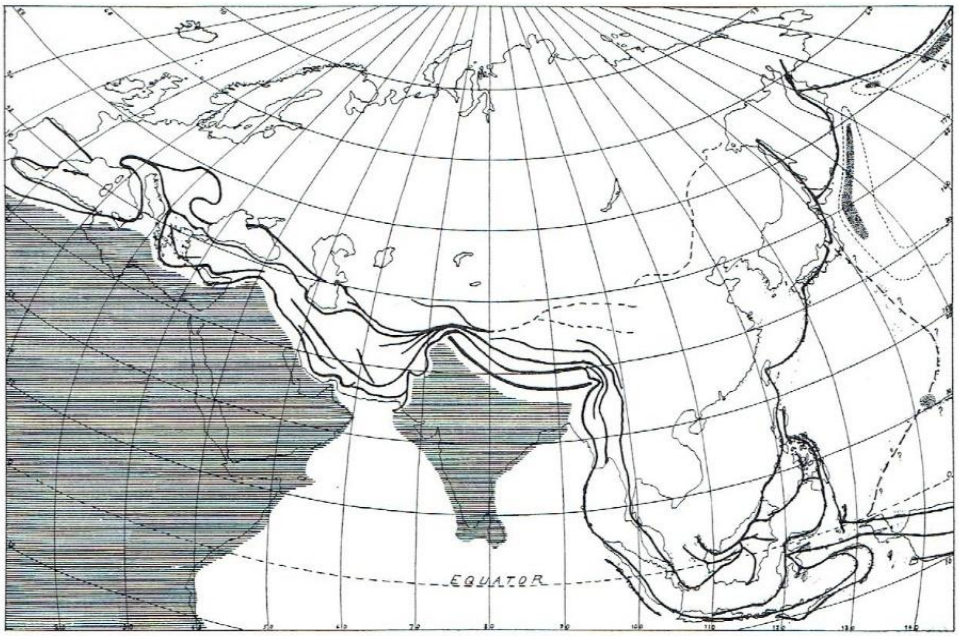


FIGURE 2.—*Eurasia*

Showing the extent and general relations of the Tertiary ranges of fold-mountains which form the peripheral system. Shows also the irregular trends of the European ranges, the Iranian and Malay earth-lobes, the Himalaya re-entrant, the island arcs of eastern Asia, the Ladrone arc, the Tuscarora and part of the Aleutian frontal deeps, and the meeting place of the Australian and Asiatic fold-lines in Borneo, Celebes, and Halmahera.

Figure-1 Civilization started at the continental gaps between Eurasia/Gondwana (Taylor 1910)

It is important that linguistic humans spent more than 60 thousand years without a characterset, and thatcharacters were invented around 5Ka in Mesopotamia. Characters were not generative like grammars:every language has grammar which is to a certain extent similar tothat of other language and so grammar was generated autopoietically. In the case of characters, there are languages which don't have writing system with established and functional orthography. The unimaginably huge river deltas of the Nile and Yellow River, and the gaps between the Gondwana and Eurasia continents filled up, i.e. Mesopotamia and Indus/Ganges regions needed an external recording system, namely a character set. And we cannot learn reading and writing without some form ofeducation, which requires discipline and diligence of behalf of children.

While grammar is natural in its development in any language as well as in individual generative acquisition, characters are unnatural in their creation in some languages and in individual learning. In linguistics, there are many linguists who study grammar, but only a few geniuses such as F. de Saussure discuss characters.

(Saussure 1959) Therefore the critical importance of characters, literacy, dictionaries, orthography and civilization have been overlooked: civilization is a linguistic phenomena.

Civilization started around 5 Ka in vast river valley regions such as the Tigris-Euphrates, Nile, Indus-Ghanga and Yellow River. To date, it has been universally assumed that such civilizations invented their own character sets. But precisely speaking it was opposite: the invention of such characters gave birth to separate civilizations, by enabling the sharing and handing down of knowledge. Although the life of the individual is limited to around 100 years, thanks to documentation and the dissemination of knowledge through reading, linguistic humans acquired logical immortality: this is the accumulation of knowledge over generations. In this way, civilizations transformed a dugout into a luxury ocean liner and a fire to signal into electronic mail. This critical function of a writing system in rapid technological innovations has not been fully investigated.

2.2 Why did the Indus Civilization Collapse?

Among the four character sets from ancient civilizations, Indus characters have not yet been deciphered. The author made a visit to MohenjoDaro in Pakistan and its museum on the 9th October 2017, and learned that, theonly artefacts using Indus characters that had been discovered in archaeological sites throughout the Indus river area had been seals. It is obvious that the written characters in seals are irregular and amateurish.

Fig.-2 A swimming pool? At MohenjoDaro

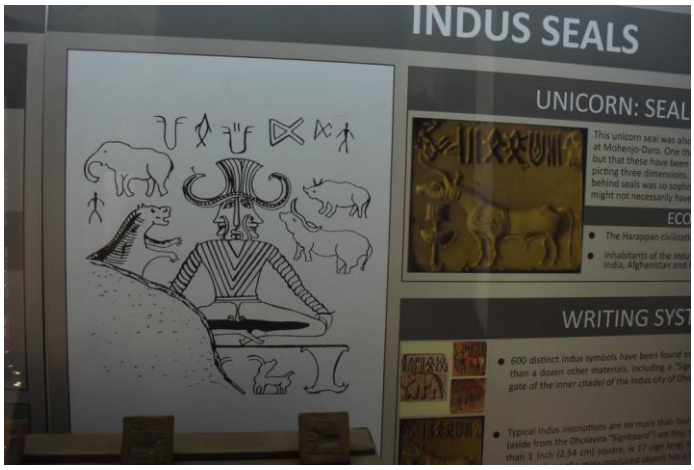


Fig.-3Indus Characters on the Seals

It is plausible that the caste or family of clerks monopolized literacy and did not encourage others to learn reading and writing. Consequently, the Indus civilization could not have had sufficient numbers of literate people who could write down information to be passed on and could read what the precedent generations had written, and thus this civilization stalled.

2.3 The orthography

Character sets and literacy are recent phenomena and not generativefor linguistic humans, This means several things. In the brain, linguistic processing is phonetically operated. A biological mancan live happily and self-sufficiently without literacy. To learn reading and writing, education is compulsory.

Reading is hearing. Reading is an autonomous regeneration of speech sound inside the brain of readers from written text. In order to become able to replicate speech sound from written text, it is necessary to master the orthography.

"Reading is another issue. We read in two ways: a new or unknown word is spelled out letter by letter; but a common, ordinary word is embraced by a single glance, independently of its letters, so that the image of the whole word acquires an ideographic value.

Here traditional orthography takes revenge. It is useful to distinguish between French tant 'so much' and temps 'weather'; et 'and' est 'is' ait 'have'; du 'of the' and dû 'had to'; ildevait 'he owed' and ilsdevaient 'they owed', etc. Let us hope only that the most flagrant absurdities of writing will be eliminated. Although a phonological alphabet is helpful in the teaching of languages, its use should not be generalized." (de Saussure, 1959, p34)

According to the definition of "English orthography" from Wikipedia, the free encyclopedia, "Like the orthography of most world languages, English orthography has a broad degree of standardization. However, unlike with most languages, there are multiple ways to spell nearly every phoneme (sound), and most letters also have multiple pronunciations depending on their position in a word and the context".

The following table- indicates how spelling "ei" and "ey" should be pronounced. It shows a regulated irregularity, which make individual words distinctive like ideograms and remind us of the words of Saussure. "Reading is another issue. We read in two ways: a new or unknown word is spelled out letter by letter; but a common, ordinary word is embraced by a single glance, independently of its letters, so that the image of the whole word acquires an ideographic value. Here traditional orthography takes revenge." (Saussure 1959) English orthography is a product of civilization, or the cultural tradition of reading. The solemn view of decorrelation between spelling and phonemes reminds us of other words of Saussure: Although a phonological alphabet is helpful in the teaching of languages, its use should not be generalized. (Saussure 1959)

ei, ey	usually	/eɪ/	v**ei**l, w**ei**ght, h**ei**nous, ob**ey**	caff**ein**e, s**ei**ze, k**ey**, /iː/ g**ey**ser /aɪ/ **ei**ther, h**ei**ght, h**ei**st, /iːɪ/ h**ei**nie, **ey**e alb**ei**t, b**ei**ng,	/ɛ/ h**ei**fer, l**ei**sure, s**ei**gneur /æ/ rev**ei**lle, ser**ei**n /eɪɪ/ fid**ei**st, /iˈaɪ/ d**ei**ce

				cyst**ei**ne, d**ei**st	
after c	/iː/	dec**ei**ve, c**ei**ling, conc**ei**t			/æ/ c**ei**nture, enc**ei**nte /eɪ/ glac**ei**ng /iːɪ/ haecc**ei**ty
before r	/ɛə/	h**ei**r, mad**ei**ra, th**ei**r	/ɪə/	w**ei**rd, w**ei**r, **ey**rie	/aɪ/ on**ei**ric, **ei**renic
unstressed	/ɪ, ə/	for**ei**gn, counterf**ei**t, forf**ei**t	/ə/ /i/	mull**ei**n, vill**ei**n voll**ey**ed	/ɪ/ ag**ei**st, her**ei**n, ogr**ei**sh /aɪ/ wall**ey**ed
unstressed, word-final	/i/	monk**ey**, curts**ey**, jers**ey**			/eɪ/ surv**ey** (n)

The following table- indicates how spelling "g" should be pronounced.

before e, i, y, ae, or oe	/dʒ/	**g**el, pa**g**er, **g**in, al**g**ae (GA) **g**entle, ra**g**e, **g**igantic, re**g**imen	/ɡ/ /ʒ/	**g**et, ea**g**er, **g**ig, al**g**ae (RP) **g**enre, barra**g**e, **g**igue, re**g**ime
g in gm or gn	Ø	phle**g**my, diaphra**g**m **g**nome, si**g**ned, poi**g**nant, rei**g**n	/ɡ/ /ʒ/	pi**g**my, si**g**net, indi**g**nant jud**g**ment
Elsewhere	/ɡ/	**g**o, **g**reat, **g**uest, le**g**, mar**g**aric	/dʒ/	mar**g**arine, **g**aol

And the following indicates how IPA/uː/ can be spelled out in many different way.

/uː/	u, u...e, oo, eew, eu, ew, ieu, ioux, o, o…e, oe, oeu, ooe, ou, ough, ougha, oup, ue, ui, uo, w, wo	t**u**t**u**, fl**u**t**e**, t**oo**, sl**eu**th, l**eew**ard, y**ew**, l**ieu**, S**ioux**, t**o**, l**o**s**e**, sh**oe**, man**oeu**vre, c**ooe**d, s**ou**p, thr**ough**, br**ough**am, c**oup**, tr**ue**, fr**ui**t, b**uo**y (GA), c**w**m, t**wo**

The above English orthography is an example of regulated irregularity. Orthography is the art of writing words with proper letters according to standard usage. But why? It is an art to coordinate written form and style of text so that skilled readers can easily, accurately and rapidly grasp its sound and meaning. The extensive literature in English Orthography indicates its significant importance. If orthography does not generalisethe correspondence between pronunciation and spelling, it is not easy to establish orthography for any language. (To understand the difficulty and complexity of establishing an orthography for a language, some introductory literature is available on www. (Karan 2013) (Tung 2015))

2.4 Four levels in book reading

It takes many years to acquire the ability to read and write correctly those expressions required for

daily life, and probably twenty or thirty years are required to become a master of reading books.Adler (1972) stated in his book, "How to Read a Book", that the major difference between homo sapiens and the other animals is the human mind. "*The body is limited in ways that the mind is not. … There is no limit to the amount of growth and development that the mind can sustain. The mind does not stop growing at any particular age.*" For the growth and development of mind, he wrote the book and indicated four levels of reading Elementary, Inspectional, Analytical reading, all required to read and understand good books, and finally, Syntopical reading to develop new and synthetic ideas based on study of the past. (Table-5)

These four are cumulative and one must master each level from Elementary upwards. The general rule is: "the more effort the better, at least in the case of books that are initially beyond our powers as readers and are therefore capable of raising us from a condition of understanding less to one of understanding more." A good reader is created through intensive reading. Reading is learning from an absent teacher. It is like voyage of discovery.

Level of Reading	Objective of Reading	What to Read	Quality of Reading
Elementary Reading	Entertainment	Books for Children	Rudimentary, Basic
Inspectional Reading	Information	Informative Books	Skimming, Surface
Analytical Reading	Understanding	Good Books	Thorough, Complete
Syntopical Reading	Growth of Intelligence	Interdisciplinary Intellectual heritage	Comparative, Synthetic (Rigorous Definition)

Table-5 Four levels to get the art of reading good books (based on Adler 1972)

It is plausible that at each level, readers obtain appropriate conceptual devices to think. As Vygotsky (1935) differentiates concepts into spontaneous/daily and scientific/true concepts, the author tentatively differentiates concepts into four with Concept Logical Order (CLO) 1, 2, 3 and 4. (Table-6): Spontaneous Concepts (CLO 1: Spontaneous Association / with Sensory Memories), Primary Logical Concepts (CLO 2: Thought Result, Information, Logical Memories), Complex Logical Concepts (CLO 3: With Transparent and Shared Definition) and Interdisciplinary Concepts (CLO 4: Interdisciplinary Usable General Concept).

Signs and concepts are different. In short, concepts are thinking signs. Or, they are signs thinking with words andmemorizing thought results. Therefore, at each conceptualization, the order of complexity steps up.

Concept Logical Order and Memory Types

Order	Concept Type	Memory Type	Reading Level
0	Reflexive Signs	Reflexive Action	Not applicable
1st	Spontaneous	Episode Memories (subjective)	Elementary Reading
2nd	Thought Result (Primary logical)	Class, Relation, Multiple Grammatical Composition	Inspectional Reading
3rd	With Shared Rule & Definition	Abstract in a professional or society (not universal)	Analytical Reading
4th	Interdisciplinary & Complex	Definable at molecular and phenomenon level (universal)	Syntopical Reading

Table-6 Complexity of concepts corresponding to each reading level

3. Overcoming the Restrictions of Vertebrate Sign Reflex Mechanism

3.1 The Benefit of Interactive Keyword Search using Computer Networks

Maynard Smith and Szathmary (1999) predicted, "*The last transition, through which we are living today, is the use of electric means for storing and transmitting information. We think that the effects of this will be as profound as were those after the origin of the genetic code, or of language*." In the 21st century, much linguistic information is available in electronic form. If we put some keyword into Google or other search engines, within seconds they list the relevant linguistic information, which can be immediately accessed or downloaded. The Open Public Access Catalog (OPAC) of libraries indicates which libraries hold the books we need (even down to the exact shelf location) and we can find new and secondhand books on the web to be paid with by credit card.

A lot of copyright free books, scientific papers and useful linguistic information provided by public organizations as well as private companies and individuals can be downloaded as PDF or text files free of charge. We can access them with our smartphone or laptops from anywhere in the world. It is necessary to enhance our brain capability to learn more words and to think more to advance human collective intelligence.

3.2 Beyond the restriction of memory based reflex

As our linguistic processing mechanisms are based on the vertebrate sign reflex, it is a memory based system. When we have a word memory receptor in our brain from before, we reflexively react to that word without confirming if the word is used within its ordinary meaning or not, which causes misunderstanding in our everyday life. We misshear words we don't know, regardless of their importance. We should pay attention to all words and spot which are new to us or which are used in unfamiliar context.

Against a new word, a specific new receptor and a concept device must be generated to recognize it. Probably it is a maturation of the neuroblast cell, triggered by an order to do so issued by our bodily immune system. (Immune cells develop from neuroblast cells.) Then, to acquire the general meaning for a daily spontaneous concept, it is necessary to normalize and standardize one's peculiar episode memory in time and space. To establish a transparent and appropriate definition for a scientific concept, intellectual enthusiasm with continuous learning and countless thought is required.

3.3 Ego-centric and equilibrium oriented nature of our consciousness

Piaget (1947) pointed out that our intelligence is ego-centric and once it reaches the stage of equilibrium, it easily assimilates a few exceptions. We determine what is right or wrong based on what we already know. It is an egocentric mechanism, which prioritizes a quick response rather than the right answer, and we cannot assume its validity.

Sign reflex is self-sufficient mechanism, and not open to a new field. It is envisaged that we have to keep being curious against what we don't know and always be open to and take time in new situations. Zen and contemporary art have been struggling to overcome the restrictions of reflex. Zen quest for meditation, *koan*, refuses any commonsense answer. Nonsense *objet* (not *pièce*) in contemporary art are presenting opportunities to open our eyes to a new world: we stop reflexes, just gaze at an *objet* liberated from prejudice and try to be acquainted with its world. To cope with a new word and new meaning, we had better follow the way which *koan* of Zen and contemporary art are presented.

3.4 Forward Error Corrections (FEC) of Linguistic Information

Like scientists, human babies are keen to know everything. They have an innate intellectual enthusiasm and curiosity. However, we lose such intellectual curiosity when we become adult. It is probably because sign reflex is a self-satisfactory recognition mechanism. Or, are we too contaminated, confused and exhausted to look for something new and interesting. We tend to look for what we already know, but we don't look for what we don't know.

S/N		Delivery Date	Place	Clean Copy	Place
1	GenjoKoan	1233.8.15		1252	
2	MakaHannyaHaramita	1233.4	Koshoji	1244.3.21	Kippoji
3	Bussho	1241.10.14	Koshoji	1258.4.25	
4	ShinshinGakudo	1242.9.9	Koshoji	1243.1.2	
5	SokushinZebutsu	1239.5.25	Koshoji	1245.7.12	Daibutsuji
6	Gyobutsulgi	1241 Oct	Koshoji		
7	IkkaMeiju	1238.4.18	Koshoji	1243.7.23	Kippoji
8	ShinFukatoku	1241.4	Koshoji		
9	Kobutsushin	1243.4.29	Rokuhara	1244.5.12	Kippoji
10	Taigo	1242.1.28	Koshoji	1244.3.20	Kippoji
11	Zazengi	1243 Winter	Kippoji		
12	Zazenshin	1242.3.18	Koshoji		
13	KaiinZanmai	1242.8.20	Koshoji	1243	
14	Kuuge	1243.3.10	Koshoji	1244.1.27	Kippoji
15	Komyo	1242.6.2	Koshoji	1244.12.13	Daibutsuji

Table-7Postscripts in Shobogenzo (Vol.1 – 15)

When we put keywords into internet search engines, thousands of relevant references are listed. We are flooded with linguistic information of an uncertain quality and reliability.

Forward Error Correction (FEC) is a technology in digital communications to correct errors without

contacting the information sender or original authors. It differentiates errors in two; first, channel coding errors, for which authors are not responsible, and second, source coding errors for which they are responsible. They constitute excluded middle, and after channel and source coding error corrections, we should get error-free information.

At the time of receiving information, receivers should verify if it is authentically presented as the original author desired. Biography and other works by the authorare auxiliary information which confirm the reliability of the author.

Manipulation and apocryphal information are channel coding errors, which should be eliminated. The author can protect his text from forgery by adding additional analytical data as error correction codes. For example, Dogen (1200-1253) protected his texts Shobogenzo (75 volume version) by stating the serial number, volume title, lecture date and place for each volume as a post script at the end of each volume. He also protected another text, DogenOshoKoroku (Sozan-bon, volume 1-10), by counting the number of lectures and poems contained in each volume, written at the end of each volume. (Tokumaru 2017) Readers can verify the authenticity of the texts by these post script codes and disregard incorrect copies.

Readers should verify the accuracy of an author's idea by following a step-by-step learning and thinking process, i.e. unifying themselves with the authors. Without fully understanding the author's knowledge and way of thinking, readers cannot detect the authors' errors and correct them.

Through continuous efforts to correct errors in texts, human intellectual genomes should be established for linguistic humans to inherit, share and improve the human collective intelligence.

3.5 Reference Models to Overview the Complex System

Communication and information theories provided us with tools, named as "schematic diagrams" or "reference models", to get an overview of complex system. When we think of invisible and interdisciplinary phenomena, reference models allow us to display everything in one chart and to interrelate subsystems.

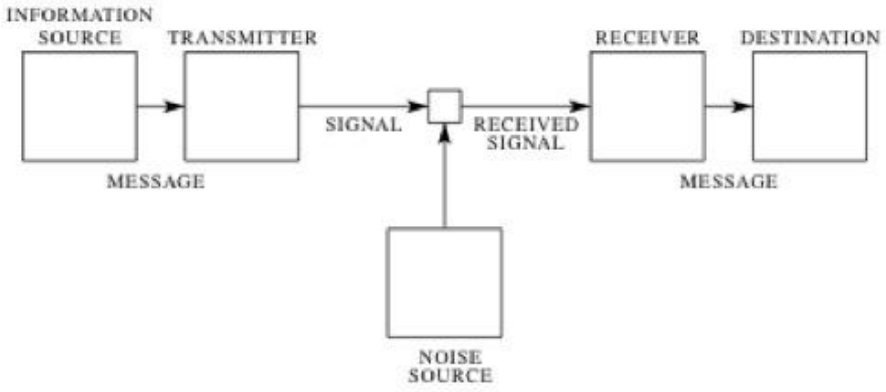
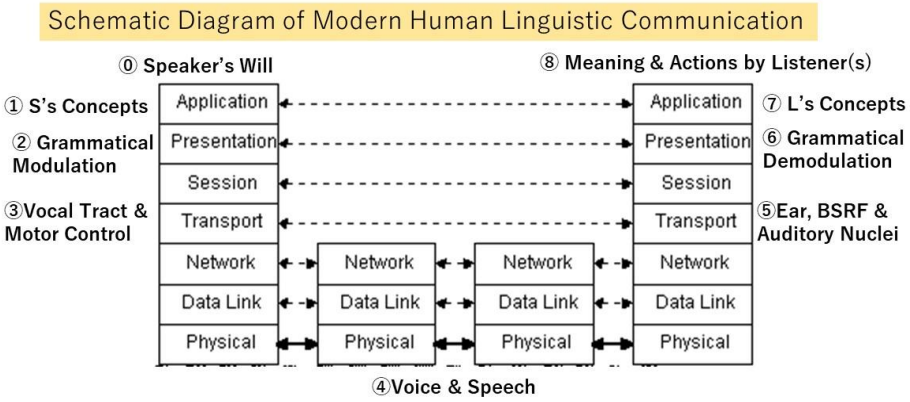


Fig. 1 — Schematic diagram of a general communication system.

Figure-4 is Schematic Diagram of a general communication system (Shannon 1948) invented at the

very beginning of the information theories. Figure-5 is OSI (Open System Interconnection) reference model, which is used for computer networks. It is not so obvious but the OSI reference model is a logical layer development of a general communication model. Although noise source is not indicated in Figure-5, it exists in physical layers.



3.6 Behave as Cosmopolitans and Live in Reversible Destiny

Modern humans are altruistic and eusocial, probably because we had to take care of altricial babies inside safe caves under the supervision of elder females. This is a legacy of the middle stone age (300 – 25ka) in South African caves, but it is not an ideal situation for linguistic humans, who should be cosmopolitan and only seek the development of the human collective intelligence for the benefit of all living creatures.

Dogen said, "Small mountain and depression basin bring you in the stage of *KOKU*, immersion." (Jodo 414) With immersion, we can learn and discover a lot of new things. ARAKAWA's "Reversible Destiny" is an environment with artificial mountains and hollows, where we can recover innate intellectual curiosity and learning capability.

Fig.-4 Shusaku ARAKAWA (1936-2010)

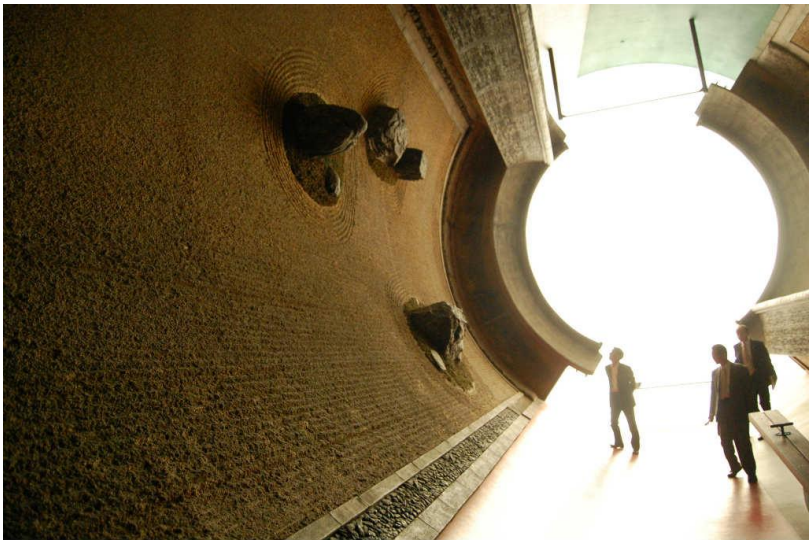


Fig.-5 Ubiquitous Site - Architectural Body Ryoanji Temple (1994) - Nagi MOCA

Fig.-6 Yoro – the Site of Reversible Destiny - Office (1996)

Fig.-7 Yoro – the Site of Reversible Destiny – Elliptical Field (1995)

Conclusion: To Live as an Intellectual Wild Animal

When the brain mechanism for linguistic processing is identified in the vertebrate sign reflex mechanism operating inside the ventricle system immune cell networks, we linguistic humans are wild animals with digital language. We have an innate intellectual curiosity and we know how joyful it is to learn new things. With the world wide web, anybody with a smartphone or laptop can access the accumulation of all intellectual activities of linguistic humans.

If adult humans can rediscover the intellectual curiosity of infants and immerse themselves in study, what kind of intellectual evolution could happen?

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