Japanese Virtual Infant as created by Dr. Suga

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Professor Tetsuo Suga, born in 1940 in Japan, is a prominent Japanese linguist and professor of Psychology (Japan Women's University) who specializes in Cognitive Linguistics and Visual Perception. In 1963 he graduated from Tokyo University (Psychology), and 4 years later, in 1967, started as a lecturer of Psychology at Gunma University. Since 1975 Tetsuo Suga has been an assistant professor of Psychology at Ochanomizu University, professor of Psychology at Ochanomizu University (1986), and professor of Cognitive Psychology at Japan Women's University (1991). In 1980 his name became known all over the world in the linguistic institutions, as he constructed the Japanese Word Processor - JW1, perhaps the first, or at least one of the first, word processors with Kanji. In 1990 Suga's publication titled "Rapid jigsaw-puzzle-solving model" appeared in visual motion perception and in 1995 publication of the project to construct a "Multiple language acquisition system" in a conference of the Japanese Psychological Association. At last in 2000 he presented his

publication of the “Multiple language acquisition system - MLAS” in a conference of the Japanese Psychological Association.

After that MLAS (Multi-Language Acquisition System) has become the significance of his life, the purpose that avoids any other, as it provokes one to think more and more about how does the language work, how it is constructed, and what are the basic elements that could be reconstructed in MLAS. The interview with Dr. Suga is beneficial as it expounds the outlook to the contemporary Japanese linguistics, as it gives the information about the contemporary projects; it also helps to understand the role of linguistics as a segment of science in Japan, its role and functions, new trends and successes.

Interview with Dr. Suga took place from July 27, to August 1, 2007.

Drozdovskyi - ***Dear Professor Suga, to start with, could you emphasize what way language could be represented and defined in the modern theory of sign?***

Suga - I have not been conscious of the position of language in relation to the modern theory of sign. My usual concern has been to understand how infants can acquire their native language. The implication of MLAS is open to elucidate to any researcher. Though language seems to me a peculiar sign system, I am afraid that my answer to this question remains at best at the level of average students. The distinctiveness of language is its descriptive comprehensiveness. Language is a system to describe all objects of the world, all relations among objects, all human affairs including sentiments, cognitions, and all phenomena of signs and language itself. Another distinct property is its explicitness, whereas

representative functions of symbols or signs other than language seem to me connotative. A picture can describe almost all that language can, but its descriptive meaning remains connotative. An analytic and explicit nature is the distinctive property of language.

D - ***And how could you define the Multi-Language Acquisition System (MLAS)?***

S - It is defined as a computer-simulation of an infant's first language learning. In fact MLAS teaches language based upon the speech information about virtual life experiences entered through a keyboard. MLAS performance was demonstrated at two conferences of psychologists and language scientists by using two languages (English and Japanese). It can be estimated as capable of attaining the level of 4-5 years-old children.

D - ***Professor Suga, could you please tell me, what was the first step in your desire 'to create' the Multi-Language Acquisition System (MLAS)? How did the idea appear? Is it the part of the University research program?***

S - The idea is my own and not the subject of a group research program. In fact my research was not supported by any grant but by encouragements given by several acquaintances.

As for the emergence of MLAS-idea itself, the impact given by Chomsky is worthy of special mention. Chomsky's studies of the universal grammar have interested me for a long time, but at the same time worried me on the following points:

Principles and parameters Chomsky proposed seem persuasive in relation to his assumption of the poverty of experience but not easily conceivable in relation to what we know about mechanical or brain mechanisms. For example, in the psychophysiology of vision, the Fourier transform of spatial

frequency extracted from any visual scene may be represented through two systems of a high-pass filter and a low-pass filter in the brain. The two-channel model seems probable by taking into account the stochastic nature of visual processing. However, principles of phrase-structure, government and binding, or subjacency are hard to represent in mechanical terms when we consider the discrete nature of sentences. Chomsky's proposition seems simply to replace the problems with another set of problems.

Chomsky has seemingly avoided studying semantics. He has simply pointed out that the concepts of meaning proposed by several theories of semantics are so naïve that they do not distinguish the concrete meaning of "book" from the abstract one as shown below:

concrete case - "Look at the book on the table."

abstract case - "He wrote a book."

Chomsky himself has neglected semantics except by simply referring to the LF formula represented by predicate-logic. He has concentrated on studying syntax for a long time. His study of syntax, however, seems to me not to be successful. For example, he has distinguished the core of language from the periphery. He excludes sentences like "The sooner the better" which lack a verb and are in discord with the formula "S -> NP VP".

Let me explain my idea of MLAS by distinguishing two approaches from which to study humanity. One is studying adult's mental operations from an adult's point of view (I would like to call this *FromAdultApproach*) and the other is studying to construct an adult's mental affairs from an infant's zero-state (I would like to call this *FromInfantApproach*). It is noteworthy that several

metaphysical problems of esthetics or ethics have been studied for more than two thousand years and have not been uniquely solved. No philosopher could propose a final definition about what is beauty or what is justice. Everyone can imagine a finite set of instances, features and conditions that characterize beauty or justice. If the finite set imagined were admitted to be sufficient to define the concept, then the definition would be complete. Everyone, however, knows that the imagined set is not exhaustive and others could be imagined which would hardly conform to one another. *FromAdultApproach* cannot avoid falling into a sort of frame problem, because if an instance is added to the finite set by another proposition, then one could not conjecture what sort of influence this added instance would have on the ready-made finite set. This difficulty might exist in studying language in the same way. A brief example is shown below.

The abstract grammatical rule “S -> NP VP” may incorporate the following sentences (1) and (2) which are Chomsky’s famous examples utilized in order to propose his classical notion of the deep structure.

(1) “John is easy to please.” (2) “John is eager to please.”

The finite set Chomsky cited contains only two members. One can take into consideration other sentences, which are likely to be adequate from the standpoint of the abstract formula as follows.

(3) “The book is easy to read” (4) “The book is eager to read.”

(5) “John is easy to read” (6) “The book is eager to please.”

It should be noted that these sentences are usually taken up as isolated sentences without any contextual constraints, and they are regarded as members of a single sentence pattern. If we neglect meanings of sentences, so many examples as one likes can be added.

Is it guaranteed that any combination of NP and VP will necessarily produce a valid sentence? It seems probable to me that linguists would not agree with one another about the validity of these sentences. The probable conflict may be attributed to *FromAdultApproach*, which is processed on the basis of a finite set of context-free sentences.

By contrast, in MLAS (by F*romInfantApproach*) the sentences (1), (2) and (3) may be integrated into a single sentence pattern, and be split into two different meaning patterns. The reason is that MLAS experiences such sentences in the different types of life context and MLAS acquires meaning depending on life context. Moreover MLAS may not integrate (4), (5) and (6) into the same sentence pattern. The reason is that MLAS may not experience such sentences in its life context. Such sentences may be interpreted as fictitious by MLAS. Thus, *FromInfantApproach* by MLAS could avoid falling into a frame problem in contrast with *FromAdultApproach*. Children in the early learning stage might resemble MLAS in these respects.

So far as I know, the discrepancy between *FromAdultApproach* and *FromInfantApproach* is general in grammatical studies of individual languages such as English, Japanese or others. A complete generative rule system of individual language seems not to be attained as yet. I wonder why it is so hard to construct a complete grammatical theory, and when it would be attained. I suspect that an object of scientific study could not be influenced by a completion of scientific theory about the

object. I mean that native speakers of a certain language have not necessarily common knowledge of the language with respect to its syntactic aspects and semantic aspects as well. So it might be an illusory expectation of linguists that a complete theory about common knowledge of individual language can be attained. So far linguists have mainly studied adults' knowledge of language, and have not succeeded yet in forming a complete theory. It may be another viable approach to simulate infants' learning from zero-state by using only simple cognitive skills without any linguistic resources. This was my first step of the idea to construct MLAS.

D - ***Could you explain once more, how the system could be able to extract phrase structures from the sentences with no available rule-base?***

S - The algorithm used in MLAS is simple: 1) to compare two or more speeches given by others and to extract common components, and/or 2) to distinguish variant components among them.

Let me assume an MLAS that obtained the following two sentences:

1) "Look at the toy." 2) "Look at the toy on the table."

The MLAS may extract phrases "Look at the toy" as common, and "on the table" as variant.

From two speeches "Look at the toy" and "Look at the picture" it extracts phrase "Look at the" as common, and "toy" and "picture" as variant.

From two speeches "Look at the toy" and "Look at a toy" it extracts phrase "Look at ~ toy" as common, and "the" and "a" as variant. It may often extract phrase structures which lack validity from the viewpoint of an adult's linguistic intuition, but the more speeches it obtains, the more the validity of the phrase structures it extracts increases. MLAS learns phrase-structures depending upon its

experiences, and, assuming several systems of MLAS learning by different sets of experiences, it is not assured that they have common knowledge of phrase structures. The degree of the commonality of their shared phrase-structures can be determined by the commonality of their ordered set of experiences. It is noted that the knowledge of MLAS will not attain a formally complete grammatical system. Please reconsider the discussion on the discrepancy between two approaches in the answer to question (3).

Infants start talking with one word after a silent (except babbling) period of about one year. The first words they use are nouns (like “mama”, etc.) in infants, and the case is the same in MLAS. The one word used by MLAS is abstracted through several speeches given by others. MLAS emits speeches made of only one word in its earliest stage for the reason that the word is the unique one whose meaning is known. (For example, MLAS simply uses the one word “Book” in place of “That is a book” emitted by adults. This is not because it does not know the ordered sequence of words but because it does not know the meanings of “this”, “is” and “a”.)

MLAS learns many speeches adults emit before it starts one-word-talking. I would like to assume that infants resemble MLAS. The important acquisition might be almost completed before one-word-talking.

MLAS acquires language on the basis of experiences. When common experiences contain the word phrases like “stand up”, “let’s go”, “wait here”, “red shoes”, “pocket monster”, etc., then it will store repertoire of talking in the similar way. When the full sentences are common, it will store repertoire of using full sentences. However, even in the latter case, MLAS would not attain the

abstract rule to generate all of sentences. MLAS would have many bundles of specific rules. The specific rules contain many fixed chained words (Slovosochetanie). It is possible to consider that many specific rules for MLAS to generate full sentences might be regarded as consisting of a series of chained words. The traditional triad (S -> Word-Phrases -> words) seems to be in accordance with MLAS learning.

D - Could ***you define the sentence as the linguistic term that is closer to your theory?***

S - In my paper (2003) I described all speeches emitted by virtual men as sentences. MLAS classifies parts of speech by their locations in the speech. The early stage of learning in MLAS is in accordance with that in children. Names of objects (”mama”, “book”, “clock”, etc.) are the first, and then names of attributes (“red”, “blue”, etc.), assigning names (“this”,” there”, etc.), and “I”,”you”,”he”. Then come relational concepts such as “yes”, “no”, “who”, “is”, etc. Thus MLAS stores concrete formulas of sentences such as “(this that) (is) (a) (book box clock)”, “(who what) (is) (this that)”, and so on. The concrete formulas of these sentences may be regarded as similar to the orthodox formula “S -> NP VP” except that each category consists of a set of concrete specific words. Note that the more speeches MLAS experiences, the more the set of concrete words enlarges. After all, the sentences MLAS acquires are not contrary to the ordinary grammar but they comprise a set of sentence-patterns which may be more specific than the general formulas such as “S -> NP VP”.

D - ***Is it important for MLAS that we have in the language system the quantity of the lexical-grammatical parts (categories) of language (I mean nouns, adjectives, verbs…)?***

S - As suggested above in the answer to question 5, MLAS does not attain the generally comprehensive formula defined by ordinary grammar as “S -> NP VP”, but constructs a set of specific formulas such as “S1 -> NP1 VP1”, “S2 -> NP2 VP2”, and so on. NPi and VPi in the specific formula contain only specific sets of words, and in the earliest stage of learning, only one word. In the extreme case, it may be probable that even in the advanced stage of learning; an NPi may contain only one word. For an English example, MLAS may distinguish the VPi, which contains only one phrase “had better” from VPj, which contains several words such as “have-had, get-got, take-took, etc.” It does not exclude such sentence as “had better do something” as an exceptional periphery. MLAS might generate many sentences on the basis of this formula.

MLAS does not generate such generally comprehensive grammatical categories as expressed in the formula as “S -> NP VP”, but it stores many formulas “Si -> NPi VPi” as stated above. To sum up, MLAS will be in accordance with the classification adopted by traditional linguistics as for the lexical-grammatical parts to describe sentences, and its distinction will lie in the degree of comprehensiveness of the word set comprised by a category. MLAS will give up the completeness of its rule-system and will describe many specific bundles of sequences made up of word sets; the traditional grammar aims at a general and complete rule-system, which seems to me to miss reality.

D - ***Does your investigation undermine the basic statements of the classic linguistic theory?***

S - What you mean by the term “classic linguistic theory” seems to me a little troublesome, for I cannot exactly discriminate between before and after Chomsky. I am afraid that I might miss your aim. Excuse me, but for simplicity, let me return to the grammatical aspect of language. Almost all

linguistic theories, classic or not, try to establish a complete explanatory system of an individual language such as English, Japanese, or Russian. However no individual language has been completely explained by a fixed generative rule-system. Let me repeat the question of why any individual language has not been generatively explained yet. MLAS starts from the state without any data/rule-base. The data/rule-base MLAS produces step by step can contain rules that orthodox grammatical systems may reject. For example, let me assume the following three sets of data:

(1) A boy (2) A boy on a stage (3) A boy who is on a stage

MLAS can pick up the possible phrases such as “a boy” and “on a stage” as common, and “who is on a stage” and “who is” as variant.

It is noted that the selection of “a boy”, “on a stage” and “who is on a stage” is adequate from the standpoint of orthodox theories. However, please think about whether or not the phrase “who is” is an adequate selection. MLAS cannot abandon the recognition that “who is” is an adequate phrase. This is a selection, which is not in accordance with orthodox linguistics. Should I judge that MLAS extracts an erroneous structure? Then I wonder why the selection of a structure, which can be freely abbreviated and added, is inadequate. Occasionally the opposite verdicts arise from the different approaches I have described, the one starting from adult knowledge and the other, as with MLAS, starting from zero-state. With such subtle structures as “who is” aside, MLAS will be able to coexist with orthodox linguistics in almost all fundamental respects.

D - ***Do you think that the processes of constructing language (as sentences) are the same in different types of languages (agglutinative, flexive, polysynthetic etc.)?***

S - MLAS was designed as a system for learning any human language, but it was tested only through a few languages (English, Japanese, and French for experience-based learning process; Turkish, Swahili, and Tagalog only for syntactic and morphological aspects). So the answer to this question is not more than in theoretical principle. The languages tested included no polysynthetic type, and the system, as it is at present, does not produce adequate morphological rules, which require infix transformation. The affix transformational rules MLAS generates are at present limited to prefix and suffix. Secondly, any affix system contains transformation of not only objective meaning such as of number, gender, location, and so on but also transformation of more subtle and complex meaning such as tense and mode. These latter transformations need to be based on long stories to determine their meanings. MLAS cannot process story-data longer than only four unit stories, and cannot process such subtle details of meaning as those kinds cited above. As far as morphological treatment is concerned, however, there is no problem. The distinctive point of MLAS is that it has several modules of program-generating programs. The morphological transformations such as inflection (in English, etc.) and agglutination (in Japanese, etc.) are processed by producing self-generated programs, which serve as the transformational rule. The transformational rule produces morphological changes conforming to the given data as illustrated below.

English inflection:

(1) (like likely) (fortunate fortunately) -> Fn-Suffix-ly

By applying this Fn to the new word “equal” MLAS gets “equally”

If the data (1) is not antecedent

(2) (like unlikely) (fortunate unfortunately) -> Fn-Prefix-un-Suffix-ly

By applying this Fn to the new word “fair” MLAS gets “unfairly”

Japanese agglutination

(1) (ketugou ketugoukanou) (ryoukai ryoukaikanou)

*ketugou=connection ryoukai=agreement kanou=probable

-> Fn-Suffix-kanou

By applying this Fn to the new word “keiyaku” MLAS gets “keiyakukanou”

* keiyaku=contract

(2) (ketugou ketugoufunou) (ryoukai ryoukaifunou)

* funou=not probable

-> Fn-Suffix-funou

By applying this Fn to the new word “keisan” MLAS gets “keisanfunou”

* keisan=computation

(2) (ketugou ketugoufunousei) (ryoukai ryoukaifunousei)

* sei=nature/property

=> (1. Fn-Suffix-funou) (2. Fn-Suffix-sei)

By applying these Fns to the new word “reiji” MLAS gets “reijifunousei”

*reiji=exemplification

The morphological transformation has been successfully tested by using two languages illustrated above and sentential transformation as well. In addition, I have personally tested it in other

languages such as French, German, and Swahili with fairly good results. In polysynthetic type of language, however, I cannot make any positive comments. I have no knowledge about Inuit or others such. This is an unknown area concerning MLAS.

So far as I have tested MLAS, I would like to say that the processes of constructing sentences are similar to one another in the different types of languages cited above.

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