1. INTRODUCTION

Human language is innate and biologically determined, insofar as chimpanzees and other primates cannot be taught to use human language (Wallman 1992). The issue at stake in contemporary linguistic and psychological theories is whether there is a language-specific faculty in our brain/mind that is modularized and independent of other cognitive abilities of human beings. Or, can language faculty be derived from human’s perceptual and general cognitive categories, memory capacity, processing strategies, and conversational structures between hearer and speaker? In other words, the issue centers around whether or to what extent Chomsky’s ‘innateness hypothesis’ is necessary for explaining patterns of human language.

For nativists, Chomsky’s innateness hypothesis is necessary in order to explain language universals and learnability in child language acquisition. In Chomsky’s theory of Universal Grammar (UG), both principles of universals (formal as well as substantive), which dictate forms of possible human language, and parameters, which permit variations intra-language or cross-linguistically, are genetically endowed by the language-specific faculty in the human brain/mind. Furthermore, the innateness of UG serves as a metatheory for child language acquisition, in explaining the remarkable rapidity with which the child acquires language despite impoverished input from the adult language. The input data for the child is impoverished because it contains only grammatical sentences of the adult language (the positive data), and little information about ungrammatical sentences (the negative data).

Alternative modes of explanations for language universals have been offered. These include semantic explanations, discourse-pragmatic explanations,
processing explanations, and perceptual and cognitive explanations (cf. Hawkins 1988). The negative evidence problem in child language acquisition has been re-examined by Arbib and Hill (1988) and Bowerman (1988), and the results suggest that the complexity in child language acquisition cannot be solved merely by reference to innate UG. Hence, with respect to language universals and learnability, UG does not have as great explanatory value as nativists claim.

The innateness hypothesis also hinges upon the observation that grammatical patterns are not random, and that grammatical rules are structure-dependent. From the point of view of information science, the non-randomness of linguistic structure is a fundamentally important property of human language so that there are possible and impossible patterns of linguistic structures. Chomsky attributes the non-randomness and structure-dependence of human language to the innate language-specific faculty, and excludes the possibility of deriving linguistic patterns from human’s conceptual structures of the physical world. The emphasis of the autonomy of grammar is to underscore the plausibility of the innateness hypothesis. The autonomy thesis maintains that linguistic structures are self-contained and cannot be shaped by human’s experience and conceptualization of the physical world. This autonomy thesis, as pointed out in Tai (1993), has roots in the arbitrariness principle initiated by Saussure and passed on to American structuralists, from Bloomfield to Harris, and on to Chomsky.

In this paper, it will be observed that Chinese grammar is, to a great extent, not arbitrary, and not autonomous from human’s conceptualization of the physical world. The paper focuses on three important cognitive bases of human language that play an important role in Chinese grammar, namely: (1) space and time, (2) categorization, and (3) iconicity. They will be highlighted in the following sections.

2. SPACE AND TIME

As space and time constitute the cornerstones of human cognition, they are explored in spatial and temporal expressions in Chinese grammar in Tai (1989, 1993b), where spatial expressions were treated as more basic, conceptually and grammatically, than non-spatial expressions of various kinds, including time expressions. Chinese observes certain universal functional principles in spatial expressions. First, Chinese uses a reference object to locate a focal object, as illustrated in (1).
(1) Shu zai xiangzi-de litou.
    book be-located box-PRT inside
    'The book is in the box.'

In (1), *shu* 'book' is the focal object and *xiangzi* 'box' the reference object. The focal object is the trajector and the reference object the landmark in humans' identification of the location of an object. Moreover, note that both focal and reference objects are schematized in terms of geometric relations, and that the geometry of a focal object is typically reduced to a geometric point, while some particularity of the geometry of the reference object is preserved (cf. Talmy 1983). In (1), the physical shape of the book is reduced to a geometric point, whereas that of the box is construed as a three-dimensional geometric enclosure.

Nonetheless, despite certain functional universalities, sentence (1) also shows that the syntax of Chinese spatial expressions differs from that of English. The English preposition *in* indicates the spatial relationship between the focal object and the reference object. In Chinese that same spatial relationship is accomplished by using the word, *zai* 'to exist, to be located', to indicate the existence of an object in some location, and then adding the place word *litou* 'inside' after the reference object, to pinpoint more precisely the nature of the spatial relationship between focal and reference object. It appears that Chinese employs a more transparent, two-step strategy in conceptualizing the spatial relationship between focal and reference objects. English, in contrast, employs a more opaque, one-step strategy, by lexicalizing that spatial relationship in the form of spatial prepositions ('in', 'on', 'at', etc.). Furthermore, as demonstrated in Tai (1993b), the relationship between the reference object and the place word is patterned after the whole-part relation. It is based on the whole-part schema wherein body-part terms are extended to indicate spatial relationships, as in (2).

(2) a. shan-tou  =  top of a mountain
    mountain-head
b. shan-yao =  halfway up a mountain
    mountain-waist
c. shan-jiao =  foot of a mountain
    mountain-foot

Parallel to spatial expressions, temporal expressions follow the principle of placing the whole before the part in word order. This is illustrated in (3) and (4).
(3) Ta jia zai Taiwan, Taipei, Luosifu lu, his home be-located Taiwan Taipei Roosevelt road san-duan, jiushi-jiu hao. 3-section 90 9 number 'His home is located at number 99, section 3 of Roosevelt Road, Taipei, Taiwan.'

(4) Ying'er chusheng-de shijian shi yi-jiu-jiu-si nian qi-yue ershi-liu hao, baby born-PRT time be 1 9 9 4 year 7th-mo. 20 6 number xiawu si-dian sanshi fen. p.m. 4-o'clock 30 min. 'The baby was born on July 26, 1994, at 4:30 p.m.'

In treating time as a spatial metaphor, one can account for the use of the locative word zai 'to be located' in temporal expressions indicating an action in progress, as in (5).

(5) Wo zai kan shu. I be-located read book 'I am reading books.'

There are similarities as well as differences in structuring temporal expressions in terms of spatial expression in Chinese and English. For instance, we can refer to a 'long time' in both languages, but not 'wide time' or 'tall time' in either language. This is because time is one dimensional, and can only be described by one-dimensional spatial terms such as 'long'. The concept of 'wide' involves two dimensions, while that of 'tall' three dimensions. Differences between the two languages can easily be exemplified by expressions such as qiantian 'day before yesterday', literally 'front + day', and houtian 'day after tomorrow', literally, 'back + day'. As discussed in detail in Tai (1989), these Chinese expressions can be accounted for by the moving time metaphor rather than the moving ego metaphor. In using the moving time metaphor, past time is placed before future time, since the former arrives before the latter does.

In contrast to English, Chinese systematically uses vertical spatial relations, 'above/top' and 'below', to refer to the past and future respectively; for example, 'last week' is shang xingqi, literally 'above + week', and 'next week' is xia xingqi, literally 'below + week'. This may have to do with the Chinese
tradition of writing from top to bottom, dating back at least to the oracle-bone inscriptions. In this top-to-bottom metaphor, time begins at the top and proceeds downwards. Thus, what is above represents earlier time and what is below later time.

The metaphorical extension from spatial domain to temporal and other semantic domains in Chinese grammar remains to be more fully explored in the future.

3. CATEGORIZATION

Categorization is one of the most important aspects of human cognition. Human language deeply involves categorizing objects and events in the physical world as well as linguistic structures. Lexical items in a language automatically classify objects and actions. In addition, we categorize these lexical items under various parts of speech, such as nouns or verbs. We can further subcategorize nouns into count nouns, mass nouns, and so forth, and verbs into action verbs, stative verbs, etc.

There are two different approaches to human categorization. In the classical approach to categorization, a category is formed by a set of discrete properties that serves as necessary and sufficient criterial conditions to define that category. Accordingly, an object is a member of a category if and only if it meets all the criterial conditions defining that category. This categorizational approach has played a central role in various formal theories of syntax and semantics, as it allows models of discrete mathematics to be implemented in those theories.

More recently, many psychologists and linguists are convinced that the alternative approach known as 'prototype theory' is more compatible with the facts of human categorization than the classical one. The prototype theory holds that categorization can be achieved through association with the prototype(s) or the central member(s), and that members of a category may be associated with one another in the fashion of 'family resemblance' (à la Wittgenstein). Categories are then formed through 'typicality' conditions rather than 'criterial' conditions. It is thus not necessary for all members of a category to possess a common objective property that criterially defines that category. Instead, the notions of 'centrality' and 'marginality', 'continuum' and 'gradation', as well as 'fuzziness' and 'borderline' are the essential aspects of human categorization in the theory. As a result, statistics is compatible with the prototype theory, whereas discrete mathematics is not.
Furthermore, as pointed out in Lakoff (1987), human categorization can be better understood from a non-objectivist experiential view, which regards human categorization as resulting primarily from the interaction between the human body and its physical environment in different socio-cultural contexts. In this experiential view of categorization, human experience and imagination play a crucial role.

Chinese grammar has a rich system of classifiers in which nouns are categorized into different classes. The Chinese classifier system thus provides fertile soil for applying prototype theory and the non-objectivist experiential view of linguistic categorization. The first study of this kind was conducted by Tai and Wang (1990). They show that the semantics of the classifier tiao is cognition-based, in that it is used to classify objects that are long-shaped, and not just to classify different types of nouns. For example, among objects designated as gua 'melon', only those gua that are long-shaped can be classified with tiao. Hence, included under the classifier tiao are huanggua 'cucumber', kugua 'bitter melon', and sigua 'towel melon', and excluded are those that are fatter and not so obviously long-shaped, such as xigua 'water melon' and donggua 'winter melon'. Tai and Wang also show the metaphorical extension of tiao to classify abstract entities, such as xinwen 'news item', falü 'legal article', and mingling 'order, command'. This metaphorical extension is built on native speakers' experience, wherein news items, legal articles, and so forth have traditionally been written vertically on the page in Chinese. A subsequent study of classifier systems across Chinese dialects by Tai (1992a) shows that these systems are also cognition-based in employing shape, size, consistency and whole-part relation, and that their pattern of distribution can be accounted for by the prototype theory. It is true that the use of classifiers in Chinese dialects is often based on the 'conventional' image of an object; nonetheless, the conventional image is not formed arbitrarily without experiential and cognitive bases.

Genuine classifiers, such as tiao for classifying long-shaped objects and zhang for classifying flat-surfaced objects (Tai and Chao 1994), should be distinguished from measure words, such as qun 'a group/flock (of)' and bang 'a pound (of)'. Functionally, while classifiers are used to 'categorize' objects in reference to their salient perceptual properties, measure words are used to 'measure' the quantity of objects or collections of objects. Cognitively, classifiers refer to relatively 'permanent' properties of entities, whereas measure words refer to 'temporary' properties. This cognition-based functional distinction between classifiers and measure words provides a semantic basis for their different
syntactic behavior. For example, the modifier marker, *de*, can be inserted between a measure word and the head noun, but not between a classifier and the head noun; to wit, *yi bang de yu* 'one pound of fish' versus *yi tiao de yu* 'one fish'.

The distinction between classifiers and measure words, like other prototype-based categorical distinctions, is a graded distinction with fuzzy boundaries. Thus, there exists a continuum from prototypical classifiers (such as *tiao* and *zhang*) at one end, to prototypical measure words (such as *bang* 'pound' and *jin* 'catty') at the other end. In this continuum, next to the prototypical classifiers are those classifiers that also function as measures, in the sense that they denote a portion of an object in addition to the shape of the object. Examples are *kuai* 'a piece' and *pian* 'a slice'. Next on this continuum are measure words which involve containers with a clear visible shape, such as *wan* 'a bowl (of)' and *bei* 'a glass (of)'. And towards the prototypical measure word end of the continuum are collective measure words such as *qun* 'a group/flock (of)' and *dui* 'a pile (of)'.

Categorization of nouns and verbs is the cornerstone of grammar, and it is cognition-based. Prototypical nouns denote physical, tangible objects such as books, houses, and trees, while prototypical verbs denote visible, dynamic actions such as jump, run, and hit. Nouns, in turn, can be subdivided into count nouns and mass nouns. This subcategorization is also cognition-based, in that count nouns denote objects with 'heterogeneous' structure, and mass nouns denote objects with 'homogeneous' structure. Count nouns correlate with concrete, individuated objects, and mass nouns with concrete, non-individuated objects. Prototypical, or central, members of nouns in Chinese are those nouns that refer to concrete and individuated objects. Included are *shu* 'book' and *zhuozi* 'table', which can co-occur with prototypical classifiers. Less prototypical then are tangible mass nouns, among which are liquids and solids. Liquids such as *shui* 'water' and *niunai* 'milk' can only occur with certain measure words, for example, *wan* 'bowl (of)' and *jialun* 'gallon (of)'. Solids such as *fan* 'rice' and *mianfen* 'flour' take such measure words as *wan* 'bowl of', as well as such measure words as *dui* 'pile (of)'. Observe that there is also a cognitive basis for the use of different measure words for liquids versus solids; solids can be piled up, for example, whereas liquids require some kind of container. Furthest from the prototypical nouns are those nouns that denote abstract concepts, such as *daode* 'virtue' and *fuqi* 'luck', which can only occur with a very restricted subset of measure words, namely those that are themselves abstract, such as *zhong* 'kind/type (of)' and *xie* 'some'. 
Parallel to the distinction between count and mass nouns, verbs can be subdivided into those that denote actions and those that denote states. Cognitively, actions have a 'heterogeneous' structure, and states a 'homogeneous' one. Action verbs correlate with processes that have inherent temporal structures, and stative verbs with states that indicate atemporal relationships. Prototypical members of verbs in Chinese are those action verbs that depict physical activities visible to the human eye, such as ti 'kick', and da 'hit'. In terms of temporal structure, these actions are durative, covering beginning and ending point. Therefore, these action verbs can take various aspect markers to indicate their internal, temporal structure. For example, chi 'to eat' can take the perfective aspect marker, le, as well as the imperfective aspect markers, zhe and zai. Furthermore, these action verbs can co-occur with verbal measures; for example, ti (ta) yi jiao 'give (him) a kick' (literally, 'kick (him) one foot'), da (ta) yi quan 'give (him) a punch' (literally, 'hit (him) one fist'). Less prototypical are verbs that depict non-physical activities and are thus not visible to the human eye. Examples include ai 'to love' and xiang 'to think'. Although they have temporal structure similar to prototypical verbs, these actions do not involve physical movement of body parts, and thus cannot co-occur with verbal measures (e.g., *xiang ta yi tou (literally, 'think (him) one head'), *ai (ta) yi xin (literally, 'love (him) one heart'). Even less wazzu prototypical are stative verbs whose temporal structure coincide with the resultative ending point and thus can only take perfective le and not imperfectives zai and zhe. Examples include si 'to die/be dead' and faxian 'to discover'. Then, furthest from the prototypical verbs are stative verbs, which indicate atemporal, abstract relations. These verbs do not have temporal structure and are thus incompatible aspect markers. An example is the stative verb, xiang 'to resemble', which cannot take any aspect markers.

From the above discussion, it can be observed that the more prototypical is the noun or verb, the more it exhibits the clusters of syntactic behaviors associated with its respective syntactic category of nouns or verbs. This observation, derived from a cognition-based approach, coincides with that made by Hopper and Thompson (1984) in their discourse approach to the study of nouns and verbs in universal grammar. Compared to English and some other languages, Chinese is notable in its paucity of denominal verbs (cf. Tai 1992b). This contrasts strikingly with English where denominal verbs occur in prolific abundance; for example, 'to water' from 'water', 'to skin' from 'skin', 'to carpet' from 'carpet', etc. The rarity of denominal verbs in modern Chinese can be
explained by the cognitive constraint in the language, which tends to prohibit concrete nouns from functioning as verbs, especially as transitive verbs.

4. ICONICITY

The simplest and most economical way for linguistic structures to reflect humans' conceptual structures of the physical world is through iconicity. The existence of iconic patterns mitigates not only the autonomy thesis that underlies various formal grammatical theories, but also Chomsky's view of innateness and modularization of language faculty.

It is obvious that the Chinese lexicon, including the classifier system, reflects Chinese conceptualization of the world within its cultural milieu. We have also seen, from the preceding two sections, that Chinese grammar is transparently conceptual-based, reflecting the structuring of space and time, as well as categorization, in the culture. In this sense, Chinese grammar is, to a great extent, iconically-motivated.

Iconicity is clearly exhibited in word order in Chinese (cf. Tai 1985, 1989, 1993a,b). In the language, word order often parallels the temporal sequence of events and situations in the conceptual world, as illustrated by the following pair of examples.

(6)  Ta zuo gonggong-qiche dao zher.
     he ride bus     arrive here
     'He came here by bus.'

(7)  Ta dao zher zuo gonggong-qiche.
     he     arrive here ride bus
     'He came here to ride the bus.'

In (6), riding in the bus precedes arrival at the destination ('here'). In contrast, the reverse temporal order in (7) is reflected in the word order, with arrival ('here') preceding riding the bus. Thus, in (6) and (7) word order cannot be changed without a change in meaning. Furthermore, there are many situations where there is only one temporal ordering, and hence only one word order is allowed, as shown in (8a), contrasting with the ungrammaticality of (8b). The principle of temporal order is so deeply entrenched in Chinese that it cannot be treated merely as a discourse-based principle, as argued by Newmeyer (1992).
a. Ta cong jiali zou dao gongyuan.
    he from home walk arrive park
    ‘He walked from home to the park.’

b. *Ta zou dao gongyuan cong jiali.’
    he walk arrive park from home
    ‘He walked to the park from home.’

Word order in basic sentence patterns is also constrained by the whole-before-part schema. These patterns include topic-comment, and ba and bei sentences. This can be illustrated by the following examples where the ‘whole’ is placed in bold, and the ‘part’ underlined.

9) Nei-ge juzi pi hen bao.
   that-CL orange skin very thin
   ‘That orange has thin skin.’

10) Wu-ge juzi lan-le san-ge.
    five-CL orange be-rotten-ASP three-CL
    ‘Three of the five oranges are rotten.’

11) a. Wo bo-le nei-ge juzi-de pi.
    I peel-ASP that-CL orange-’s skin
    ‘I peeled (the skin of) the orange.’

b. Wo ba nei-ge juzi bo-le pi.
    I BA that-CL orange peel-ASP skin
    ‘I peeled (the skin of) the orange.’

c. Nei-ge juzi bei wo bo-le pi.
    that-CL orange BEI I peel-ASP skin
    ‘The orange had its skin peeled (off) by me.’

Besides motivation for word order, other iconic motivations (viz., distance, separateness, juxtaposition, and reduplication) have been identified for various grammatical patterns in Chinese (Tai 1993a). Reduplication motivation, for instance, accounts for various reduplicative constructions and patterns of verb-
copying. Furthermore, as pointed out at the end of section 3, the syntactic
categories of nouns and verbs in Chinese correlate very closely with the
ontological categories of objects and actions respectively. It is this close
correlation that accounts for the paucity of denominal verbs in the language (Tai
1992b).

The whole-before-part schema and the temporal order principle also
underlie spatial expressions in Chinese. Positional spatial expressions are built on
the whole-and-part schema, as illustrated in (2). The temporal order principle
structures the action-before-result schema in directional spatial expressions, such
as zou-jin ‘to walk into’ and zou guo ‘to walk/pass through’.

The study of iconicity in Chinese grammar has thus far been limited to
iconic motivations. Two other areas of iconicity, isomorphism and automorphism
(cf. Haiman 1985), have not been well studied in Chinese grammar. Further study
of isomorphism will reveal additional conceptual structures of the Chinese
lexicon. The projection of spatial domain to other semantic domains is within the
realm of automorphism. Needed is further study of automorphism, along with
metaphorical structures of the Chinese language, to develop a more
comprehensive view of the conceptual structures in Chinese grammar.

5. CONCLUSION

We have seen that the grammar of natural language in general, and
Chinese in particular, can be understood and analyzed to a large extent in terms
of human cognition in conjunction with pragmatic and discourse principles in
human communication. Grammar can be viewed as a complex mapping function
from humans' conceptualization of the multiple-dimensional physical world to
the one-dimensional linearity of human speech. In this mapping, linguistic
structure is further shaped by humans' perceptual principles, memory capacity,
processing strategies, problem-solving strategies, and conversational structures
between hearer and speaker. Thus, word order and constituency in language can
be viewed as a function of this complex mapping, rather than having been derived
from innate and domain-specific language faculty, which is modularized and
isolated from other cognitive faculties of human beings. In other words, as aptly
stated by Bates and MacWhinney (1989:10), "the universal properties of grammar
are only indirectly innate, being based on interactions among innate categories
and processes that are not specific to language."

On this view, human beings' conceptualization of the real world imposes
constraints on linguistic structure. This means that both the structure of the
human body and the structure of the real world are reflected in grammatical structures. The neuro-physical structures of our eyes, ears and body are independent from our linguistic faculty; nonetheless, they affect linguistic structure. For instance, our spatial orientation is structured in relation to the position of our eyes in the front, upper part of our body. Thus, the oppositions between 'front' and 'back', and between 'up' and 'down', are structured in relation to the human body and the metaphorical extension of these opposition to objects, such as houses and cars, is based on the projection of the human face to the imagined bodies of cars and houses. Furthermore, we prefer 'front' to 'back', and 'up' to 'down' because of our human canonical upright body position, because our eyes are in our face and not in the back of our head, and because we walk forwards instead of backwards. Therefore, the asymmetry in the structure of our physical body is reflected in the asymmetry in the conceptual structure of our language. This important asymmetry is not arbitrary, and cannot be explained simply on the basis of the innate structure of the mind. Furthermore, as all humans live on the same planet, Earth, where there are trees, stones, mountains, rivers, and so forth, all human languages share a similar set of such vocabulary to describe the world around them. In short, in seeking explanations for linguistic patterns, we should recognize the close relationship among the physical world, human perception and conceptualization, and conversational structure between speaker and hearer.

The fact that humans have the same biological make-up and live in the same physical world does not necessarily mean that all human languages have the same conceptual structures. Admittedly, languages share many conceptual universals, but they may also exhibit differences in conceptual structures. This is because humans are endowed with the ability to conceptualize the same object or situation from different perspectives according to their experiences, imagination, and creativity. Thus, the same reality may be organized into different patterns, depending on the selection of different principles of organization. Consider, for example, the important role that the conceptual schema, action-result, has played in Chinese grammar. This schema underlies the following three sentence patterns, representing three different kinds of situations.

(12)  Ta zou-jin  gongyuan. (Situation A)
     he walk-enter park
     "He walked into the park."
(13)  Ta da-si-le  yi-ge  ren.  (Situation B)
       he  hit-die-ASP  one-CL  person
       ‘He killed someone.’

(14)  Ta  jia-cuo-le  ren.  (Situation C)
       she  marry-wrong-ASP  person
       ‘She married the wrong person.’

The situation in sentence (12) involves directional, spatial relations, that in (13) a
typical causal relationship, and that in (14) a situation wherein a mistake has
occurred. The three situations are construed as related patterns in Chinese,
sharing in common the action-result schema. This is reflected in the use of
action-result verb compounds in all three sentences. In contrast, in English, as
shown in the English translations, these three situations are construed as three
different schemata that are reflected in three correspondingly different syntactic
patterns. Situation A uses the directional preposition, 'into', to express the spatial
relationship. Situation B lexicalizes the action-result into an action verb with the
resultant state incorporated into the verb. Situation C attributes the 'wrong' result
to the target rather than the action per se.

It is important to note that this view does not embrace the strong form of
the Whorfian Hypothesis, namely, that different conceptualizations of the same
reality in different languages necessarily entail overt behavioral correlates.
Instead, it subscribes to a form of neo-Whorfian Hypothesis that assumes a non-
objectivist view of cognition. In other words, this view holds that whereas the
physical world may or may not have its inherent structure, our understanding of
the physical world is mediated through human conceptualization in different
cultural contexts. Hence, different linguistic structures describing the same
situation may be the result of different conceptualizations, as shown in Situations
A through C above rendered with one syntactic pattern in Chinese and three
different ones in English sentences.

This non-objectivist view of cognition is an explicit rejection of the
objectivist view of cognition that underlies truth-conditional semantics and
model-theoretic semantics. Formally elegant and rigorous though they are, truth-
conditional and model-theoretic semantics assume that linguistic structures are
arbitrary symbols, which are meaningless in themselves and are made meaningful
only by being associated with things and events in the world. In this kind of
objectivist cognition, human experience, imagination and creativity in different cultures play no role at all in mediating between the linguistic structures that surface in different languages, and the conceptualizing and understanding of the physical world. In short, rejected are both linguistic objectivism and the strong form of linguistic relativism; adopted, in their place, is a weak form of linguistic relativism, as found in works by Lakoff (1987) and Langacker (1987).

It should be noted that the view of linguistic cognition developed in this paper accepts the evolutionary concept of language; that is, linguistic structures arise from humans’ adaptation to their ever-changing living environment (Wang 1991a). Thus, this view is in line with Piaget's theory of child language acquisition in which language development depends on the development of other cognitive skills. It is also in keeping with the mosaic view of language, as advocated by Lieberman (1991), Wang (1991b) and others. In that view, language, like all other living organisms, consists of structures that are not master-designed at one time, but have evolved in stages, expanding and building onto older structures.

Finally, it needs to be emphasized that the utilization of general cognitive principles, such as temporal order, whole-before-part linearization, and various iconic principles in Chinese grammar, should not be construed as an indication of the relative primitiveness of the language, nor should it be inferred that the Chinese language is somehow less effective in communication than those employing fewer iconic principles. On the contrary, Chinese grammar can be viewed as a more economic communication system. Saussure's (1916/1959:68) arbitrariness principle claims that "signs that are wholly arbitrary realize better than the others the ideal of the semiological process". However, countering Saussure, Jakobson (1971) points out Peirce's thesis that a system of signs blending as equally as possible all three types of signs--namely, icon, index and symbol--is 'the most perfect of signs'. On this basis, the grammar of Chinese should be more ideal than grammars that rely more heavily on abstract and arbitrary principles.

POSTSCRIPT

This manuscript was written four years before the publication of Rethinking Innateness (Elman, Jeffrey L. et al. 1996). The evidence and arguments made in Elman et al. have shown that this author is on the right track in questioning the
validity of *representational nativism* espoused by Chomsky and his followers. In this paper, I have come to the conclusion that "grammar can be viewed as a complex mapping function from humans's conceptualization of the multiple-dimensional physical world to the one-dimensional linearity of human speech." (p.47) This view is in fact shared by Elman et al. who suggest that the grammars of natural languages may be thought as solution to an even more daunting dimension reduction problem (than the reduction from 3-D images to 2-D array), in which multiple-dimensional meanings must be mapped on to a linear (one-dimensional) output channel. (Elman, Jeffrey L. et al. 1996, p.386) The insights contained in this paper certainly deserve to be further elaborated and tested through rigorous connectionist modeling.

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REFERENCES


