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IN WHAT WAYS ARE LANGUAGE UNIVERSALS PSYCHOLOGICALLY REAL?*

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1. *Introduction*

Any particular human language can be specified by its location within an n-dimensional space which defines the limits of variation of all human languages. As a psycholinguist, I understand the study of language typology and language universals to be an attempt to determine what the relevant dimensions are, and to determine how many meaningful dimensions exist. I assume as a working hypothesis that the n-dimensional space bears some relevance to the facts of human language learning. Perhaps there is some isomorphism between the n-dimensional space defined by language typologists and the hypothesis space of the language learner. Basically, I see the n-dimensional space as a linguistic characterization and the hypothesis space as a psychological one, the goals of our interdisciplinary endeavor being to understand how they map onto each other.

Not everyone would agree that the study of language typology and universals will yield a full understanding as to the nature of the constraints and biases with which humans are equipped to acquire and use language. Perhaps, as Chomsky (1965) claims, much of our present state of knowledge about language universals reflects unimportant surface characteristics of languages that are trivialized by the potentially revolutionary insights to be gained from a careful and disciplined rationalist approach. Yet, the currently rapidly accumulating knowledge base of language universals will yield statements that challenge those who yearn for an empirical handle on the problem. They yield a network of hypotheses that have a potential contribution to make to an inquiry into the language-potentiated mind. This view, I believe, constitutes one half of the spirit under which the present conference was conceived.

The other half of the spirit is that the psychological study of the language

learner can help to discipline the definition of the n-dimensional space. Formulations of typologies and of language universals have been notably descriptive in nature. They can be seen as interesting empirical observations that are in need of some explanation (but see Comrie, 1981). While I am skeptical about the power of current psychological principles (if any exist) in accounting for the n-dimensional space, data from language learners can be informative in constraining its formulation. Aside from explicit psychological explanations with respect to principles of memory, attention, and so forth (e.g., Kuno, 1974), we can see how the n-dimensional space might be influenced by other psychologically relevant factors, such as age of the learner, and in the case of second language acquisition specifically, experience as reflected in the nature of the native language structure. The purpose of this paper is to make explicit the possible relationships between the study of language typology and universals on the one hand and the language learner on the other.

2. *The determination of the n-dimensional space.*

One might draw an analogy between the language typologist's attempt at mapping the n-dimensional space of language with attempts that psychologists have made in formulating personality dimensions through the statistical technique of factor analysis. Factor analysis begins with a matrix of correlations between a large number of variables. From this matrix, factors are extracted, through various alternative mathematical specifications, that are correlated with subsets of the variables. This approach has a great advantage in reducing large numbers of variables into fewer, supposedly more abstract and underlying factors.

In the factor-analytic approach to personality, the investigator typically begins with a set of 'trait' words about personality in the language, such as 'adventurous' versus 'shy'. Independent raters are asked to rate a large number of people with respect to each of these trait words. Then the ratings are factor analyzed. Cattell (1965), for example, derived roughly 15 or so factors of personality using this approach. He argued that these factors, rather than the trait words themselves, reflect true personality dimensions that are uncluttered by everyday colloquial nuances of trait words. While it would be unfair to label Cattell's approach to personality as atheoretical, Cattell was essentially at the mercy of the empirically derived factors. Often, he labeled the factors with words of his own invention, such as *H. Parmia* versus *Threctia*. Factor analysis was seen as the cornerstone of scientific research in personality: 'Factor analysis...believes that there are natural, unitary structures in personality and

that it is these traits, rather than the endless labels in the dictionary, on which we should concentrate. In other words, if there are natural elements in the form of functional unities, logically equivalent to an element in the physical world, then it would be far better to begin our studies...our comparisons and developmental understandings...on measures of such traits' (p. 55-56). He had, in short, great faith in inductively straining the building blocks of personality through factor analysis. These factors constitute the primitives of human personality which demand explanation.

On a conceptual level, the goal of language typologists can be seen as similar to the factor-analytic personality psychologist, with languages being used instead of people as random variables. Unlike psychologists, however, linguists do not go around asking raters to rate a large number of languages along various linguistic dimensions (although I wouldn't put it past simple-minded psychologists to try, and it might even be a worthwhile endeavor when we have a better idea of our variables). In addition, the types of data, or scales of measurement, used in language typology are different. The linguistic dimensions are commonly considered categorical (Greenberg, 1978), while personality dimensions are interval scale data, and assumed to be continuous. But these differences constitute differences in statistical treatment. Recent advances in statistics which enable the analysis of complex, n-way contingency tables opens the way for sophisticated analysis of the linguist's type of data, if such were desirable (Fienberg, 1980). The working assumption seems to be that once enough typological dimensions have been formulated and investigated with respect to a large number of languages, these variables can be reduced through statistical techniques to a smaller number of underlying dimensions by analyzing commonly co-occurring features. As Greenberg recently put it, 'a theoretical analysis of basic typological concepts helps us to broaden our conception of cross-linguistic generalizations, while its application provides a useful methodology for discovering such generalizations at the lower empirical levels and thus providing the materials for broader and deeper conclusions about the nature of human language' (p. 58).

I get the impression that linguists can be explanation-shy, and they have sometimes avoided hypothesizing as to the reasons for the existence of cross-linguistic generalizations (see, however, Kuno (1974), Givón (1979), and other papers in this volume). For example, Downing (1978), in formulating universal characteristics of relative clause structures, writes: 'In their present form they may serve as a summary of observations on the nature of relative clauses across languages, with which the data of additional languages may be

compared. As such generalizations are refined, they afford an increasingly solid empirical basis for the formulation of explanatory principles in functional and psychological terms' (p. 411). Along similar lines, Steele (1978) formulates constraints to account for word order variation, such as the following: 'A variation on basic word order in which the object precedes and the subject follows the verb is to be avoided' (p. 604). While such constraints serve to explain at one level the observed data on word order variation, she writes in a footnote that 'I am not offering explanations for the constraints' (p. 604, footnote 15). It appears to me that the best people to theorize about the causes of typological facts are the people who formulate the statements, and I am puzzled by the lack of their speculative efforts on this front.

Given this tendency, the developed product of language-typological research will be essentially a set of factors with loadings on different linguistic variables (e.g., direction of branching, order of verb and object, etc.). These n factors will constitute the n-dimensional space of human languages. My understanding of language typological research in its present state is that it is not yet at this stage, but it is perhaps not too early to discuss at the abstract level the psychological question, which is basically the title of this paper, 'in what ways is the n-dimensional space psychologically real, and how can we understand changes in the relationship between the n-dimensional space and the learner's hypothesis space under different psychological conditions of language acquisition?' I will use the term *psychological correspondence* to refer to an empirical correspondence between the linguist's dimensions and psychological data obtained from studies of language learners.

For the sake of discussion (and I realize that the crudeness of the units of analysis may offend some), consider the following variables along which languages are known to be distributed:

(1) POSITION (postposition/preposition)
(2) BRANCHING DIRECTION (left-branching/right-branching)
(3) WORD ORDER VARIABILITY (rigid word order/free word order)
(4) DUMMY SUBJECT (has no dummy subjects/has dummy subjects)
(5) OBJECT-VERB ORDER (verb-object/object-verb)
(6) AGREEMENT (has no subject-verb agreement/has agreement)
(7) PASSIVIZATION (has no passives/has passives)

TABLE 1
Distribution of 20 fabricated languages with respect to language variables.

	LANGUAGE VARIABLES						
LANGUAGE	POSITION	BRANCHING	WORD ORDER	DUMMY SUBJECT	OBJECT VERB	AGREEMENT	PASSIVE
1	0	1	1	0	0	0	0
2	1	1	1	0	0	0	0
3	0	1	1	1	0	1	1
4	1	1	1	1	0	1	0
5	0	1	0	0	0	0	0
6	1	1	0	0	0	0	1
7	0	1	0	1	0	1	1
8	1	1	0	1	0	1	1
9	0	0	1	0	1	0	0
10	0	0	1	0	1	0	0
11	0	0	1	1	1	1	1
12	1	1	1	0	1	1	1
13	0	0	1	0	1	0	0
14	1	1	0	1	0	1	1
15	1	1	0	1	0	1	1
16	1	1	1	1	0	1	1
17	0	0	1	0	1	0	0
18	1	1	1	0	0	1	1
19	0	0	1	0	1	0	1
20	0	0	0	1	1	0	1

Variable labels:
POSITION (0=postposition; 1=preposition)
BRANCHING (0=left-branching; 1=right-branching)
WORD ORDER (0=rigid word order; 1=free word order)
DUMMY SUBJECT (0=has no dummy subject; 1=has dummy subject)
OBJECT-VERB (0=verb-object order; 1=object-verb order)
AGREEMENT (0=has no subj-verb agrmnt; 1=has subj-verb agrmnt)
PASSIVE (0=has no passives; 1=has passives)

TABLE 2

Correlation matrix of language variables across 20 fabricated languages.

	POSITION	BRANCH	WORD ORDER	DUMMY SUBJECT	OBJECT VERB	AGREEMENT	PASSIVE
POSITION	1.00	0.66	−0.17	0.19	−0.66	0.50	.32
BRANCHING	0.66	1.00	−0.31	0.24	−1.00	0.52	.25
WORD ORDER	−0.17	−0.31	1.00	−0.38	0.31	−0.10	−.38
DUMMY SUBJECT	0.19	0.24	−0.38	1.00	−0.24	0.70	.53
OBJECT-VERB	−0.66	−1.00	0.31	−0.24	1.00	−0.52	−.25
AGREEMENT	0.50	0.52	−0.10	0.70	−0.52	1.00	.61
PASSIVE	0.32	0.25	−0.38	0.53	−0.25	0.61	1.00

TABLE 3

Factor analysis solution with varimax rotation for 20 fabricated languages.

	FACTOR 1	FACTOR 2
POSITION	0.63	0.26
BRANCHING	0.98	0.19
WORD ORDER	−0.21	−0.33
DUMMY SUBJECT	0.07	0.84
OBJECT-VERB	−0.98	−0.19
AGREEMENT	0.38	0.74
PASSIVE	0.15	0.70

Table 1 presents raw data for 20 hypothetical languages (fabricated from my imagination with a little help from the intuition of several colleagues about some real languages) with values on each of the variables. A value of '0' is entered where the language exhibits properties of the first level of the variable (e.g., for the variable position, if the language has postposition), and '1' is entered where the second level (e.g., if the language has preposition) is exhibited. The relationship between the variables across languages can be expressed in a correlation matrix, which appears in Table 2. A casual inspection of Table 2 reveals that there are many variables that are well correlated. For example, OBJECT-VERB and BRANCHINGNESS are correlated −1.00, a perfect negative relationship revealing that all OV languages are left-branching, and all VO languages are right-branching. AGREEMENT is correlated .70 with DUMMY SUBJECT, indicating that languages with subject-verb agreement also tend to have dummy subjects. An underlying structure of the intercorrelations between the variables can be revealed strikingly through factor analysis, the results of which appear in Table 3. Factor 1 is 'saturated' with the variables of branchingness, object-verb, and position. This may be interpreted as follows: languages that are left-branching tend to be object-verb and have postpositions, while right-branching languages tend to be verb-object and have prepositions. Factor 2 is 'saturated' with the variables dummy subject, agreement, and passive. The interpretation is that languages with

dummy subjects also tend to have subject-verb agreement and passivization. When I fabricated the data for Table 1, I had in mind two clusters of variables that have been suggested in the literature, one related to the order of elements in sentences (e.g., Greenberg, 1963; Lehmann, 1973) and the other related to the subject-topic typological dimension suggested by Li and Thompson (1976). The factor structures in Table 3 reflect these dimensions, although I should point out that, for purposes of the present paper, the actual variables that load on the factors are irrelevant. What is important is simply the fact that this is the kind of way in which the ultimate outcome of the current thrust of language typology might be represented. In subsequent discussion of the factor structure of language, I will simply label the factors as Factor A and B, and the individual variables that load on the factors as Variables 1, 2, and so forth, so that our discussion will be uncluttered by the truth value of linguistic statements and concentrate on the logic of inquiry.

3. *In search of psychological correspondence.*

As Stephen Jay Gould points out in his elegantly written book on intelligence testing (Gould, 1981), we human consumers of statistics have an inherent bias towards reifying factors derived through factor analysis. This is a higher order bias similar to the bias of inferring causality from correlation, against which we are warned repeatedly in elementary statistics classes. Language factors are no more than statements about the distribution of the world's languages. We should be wary of using observed language factors as explanations for psychological data. Rather, the questions should be 'What are the principles that determine the observed factor structure?'

One would like to be able to write a play which says here: 'Enter the psychologists with their principles that explain on independent grounds the language factors observed.' Life is, however, not so sweet. Aside from the span of apprehension, short-term memory span, and a handful of other trophies on the empirical shelf of psychologists, there is indeed very little that psychology can at present directly offer in explanation of the results of language typologists. A glance through any contemporary book on cognitive psychology (e.g., Dodd and White, 1980) should confirm this impression. Cognitive explanations for language factors are not forthcoming.

Data from the language learner can, however, constrain the psychological plausibility of the n-dimensional space. We can look for the preservation or fragmentation of the factor structure (the n-dimensional space) in the language learner, under different circumstances. If it can be observed in some

circumstances, but not others, then we might be able to formulate hypotheses about its governing principles. If we consider the n-dimensional space defined by language factors to be a good candidate as a psychologically real hypothesis about the target language on the part of the language learner, we expect there to be some correspondence between the language factor and data obtained from language learners. In this section, I will sketch out some considerations that must go into the search for psychological correspondence.

The task for the learner can be defined as a process of determination of the factor score for the particular target language. Having determined the factor score, the learner can be guided in the search for the particular realizations of the individual variables that go with the factor. Consider the situation in Table 4. A language with a high positive score on Factor A will have a value of

TABLE 4

Distribution of values on variables for three hypothetical languages.

	VAR1	VAR2	VAR3	VAR4	VAR5	VAR6
Loading on Factor A	+	+	+	−	−	0
LANGUAGE X	1	1	1	0	0	1
LANGUAGE Y	1	1	0	0	0	1
LANGUAGE Z	0	0	0	1	1	1

'1' on Variables 1 through 3 and a value of '0' on Variables 4 and 5, as in LANGUAGE X. A language with a high negative score on Factor A will have values of '0' on Variables 1-3 and values of '1' on Variables 4 and 5, a situation reflected in LANGUAGE Z. The two hypothetical languages, X and Z, are mirror images of each other with respect to Factor A. If all languages were of the types X and Z above, although this would be a highly interesting fact, it would be difficult to test for psychological correspondence, since there would be no variance across languages. However, such a situation is unlikely and is certainly inconsistent with current knowledge about cross-linguistic variation. Then, variations across languages with respect to their language factor scores, i.e., the extent to which they reflect the ideal factor structure, can be

used to test the psychological coherence of the factor. Take for example LANGUAGE Y in Table 4, conveniently created for our purpose. The values on the variables mostly reflect a high positive loading on Factor A, with the exception of Variable 3. The structure of Variable 3 for LANGUAGE Y in fact matches that for LANGUAGE Z, which is the ideal language with negative loading on Factor A. There are several predictions that can be made, and empirically tested, given such a situation. One would expect that the learner of LANGUAGE Y would have fewer cues than the learner of LANGUAGE X, due to the mismatch on Variable 3. If the determination of the factor score is a psychologically real process, then one can predict differences in the ease of acquisition of structures that reflect variables with the same values for both languages, assuming that other sources of differences, such as frequency, can be controlled. Thus, for Variables 1, 2, 4, and 5, the learner of LANGUAGE X is at an advantage over the learner of LANGUAGE Y. In Table 4, I have also inserted Variable 6, which has no loading on Factor A. This might be considered a control variable, for which no difference would be predicted between the two languages.

If we had LANGUAGE Z for comparison, we could make further predictions, since the values on Variable 3 are similar for both LANGUAGES Y and Z. Since the value for LANGUAGE Z is consonant with the factor structure, while it is not for LANGUAGE Y, we would predict that the structure for Variable 3 would be easier for the learner of LANGUAGE Z than for the learner of LANGUAGE Y. Furthermore, we can make predictions about the frequency and kinds of errors that might be expected in the course of learning. Learners of LANGUAGE X will be likely to make errors on structures reflecting Variable 3 that deviate towards the value of '1'. This can be compared to the likelihood of such errors for learners of LANGUAGE Z.

Whether the psychological correspondence can be determined or not is an empirical question. Ideally, one should be able to iterate the above process across each of the variables, finding strategically located languages. If we find that certain variables consistently do not affect the acquisition of its *related variables* (i.e., variables with which it is related through the factor structure), we can weed them out from our mapping of psychological correspondence. The end result would be a psychologically real hypothesis space of language learners, which can be used in the further, and necessary, investigations into the nature of the task-specificity and species-specificity of language.

Aside from the gross determination of the hypothesis space, one would also like to make claims about the deductive process, i.e. how the learner goes

about choosing between alternative structures for the target language. Each variable within a factor might be seen as having a particular weight value in the learner's deduction of the target language factor score. This might be empirically determined by computing, say, some transformation of the rate of acquisition of related variables in the absence of the variable in question.

There are, of course, an infinite number of ways in which the deductive process could take place. There are three alternatives, however, schematized in Figure 1, that might yield to empirical tests. Panel A represents an additive model, where the weights for the values on relevant variables observed are summed, and the sum is directly related to the deduction of the factor score for the target language. Panel B represents a threshold model, where the sum of the weights needs to attain a certain critical value before the determination is made. Panel C represents a 'triggering' model, where a single variable, or a set of variables, are necessary and sufficient conditions for the learner to conclude that the target language has a particular factor score. I must admit that at this highly abstract level of discussion, I find it difficult to specify exactly how one might go about distinguishing between these possibilities independently of the determination of psychological correspondence discussed earlier. The most important point, with respect to the goals of the present paper, is that the psychologically real hypothesis space available to the language learner should, in principle, be distinguishable from the deductive process based on the hypothesis space. One implication would be that child and adult learners may have similar hypotheses about language but may appear different because of differences in their deductive processes.

4. *Implications for second language acquisition research.*

Consideration of the problem of language acquisition with respect to the hypothesis space and the deductive process has the potential contribution of clarifying some questions that have been traditionally asked in second language acquisition research.

One recurring question is whether the processes of first and second language acquisition are similar or different. The route towards answering this question has been to look at errors produced by L1 and L2 learners, and to classify them with respect to their possible sources. Similar errors were considered to be evidence for the L1=L2 hypothesis, while dissimilar errors, such as native language transfer errors, were seen as evidence for the L1/L2 hypothesis. Alternatively, studies have concentrated on the acquisition order

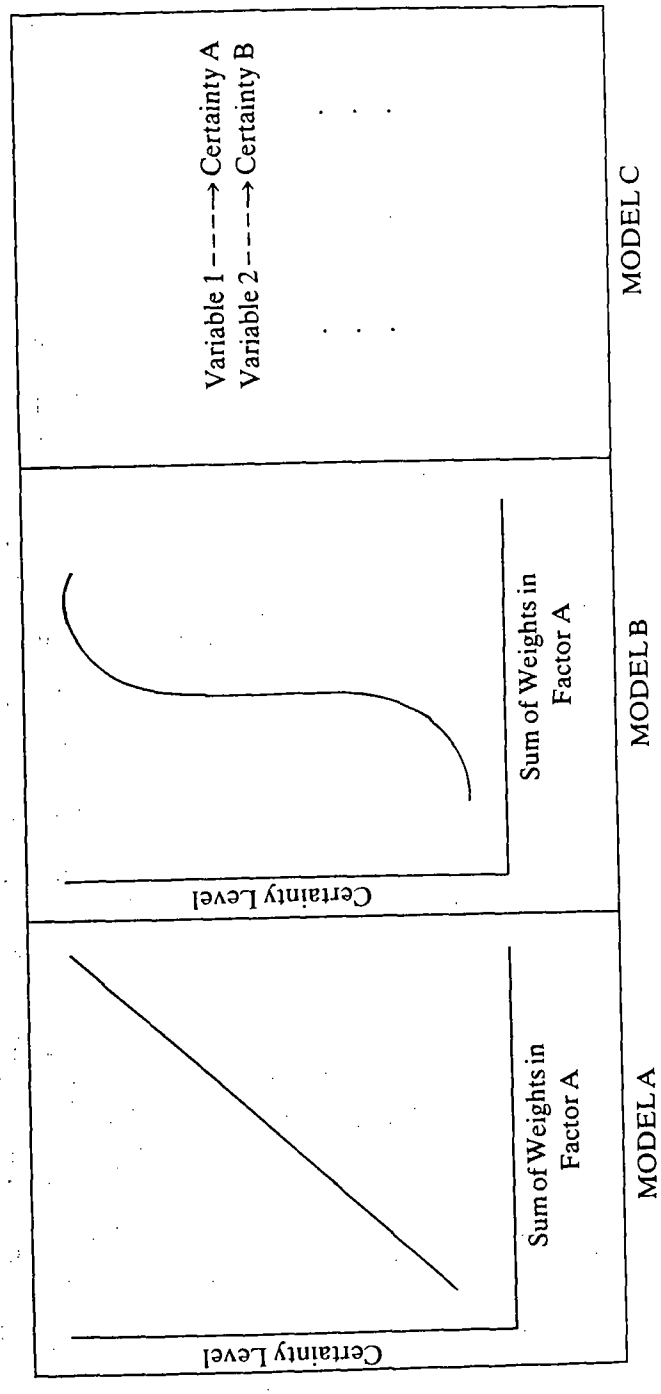

FIGURE 1

Three possible models for how the learner establishes the factor score for the target language. In the additive model (Model A) the weights for all the variables in Factor A are summed, and related additively to the certainty with which the learner establishes that the target language has a particular value on Factor A. In the threshold model (Model B) there is a critical value for the sum of weights. In the triggering model (Model C) any number of variables serve as sufficient condition for the certainty.

of grammatical morphemes in English, and results that second language learners show similar acquisition orders regardless of their native language background was seen as evidence for the L1=L2 hypothesis.

It appears that these studies take us no further than deciding between two alternative hypotheses. Consideration of language acquisition in terms of the hypothesis space and the deductive process sharpens the question: is the hypothesis space similar for L1 and L2 learners, and is the deductive process similar?

Naturally, if we found similar correspondences in L1 and L2 learners, the best conclusion would be that both the hypothesis space and the deductive process are similar. On the other hand, if we found differences between L1 and L2 learners, we would not simply conclude that they are different but ask in what ways they may be different. For example, it may be the case that the hypothesis spaces are different between the two types of learners but the deductive process remains unchanged. This might be revealed in differences in the psychological correspondence to the language factors between L1 and L2 learners, yet with similar weighting processes. Alternatively, it may be the case that second language learners construct their hypothesis space with respect to the factor weight of their native language, or it may be the case that the hypothesis space is similar across second language learners from different language backgrounds.

If the hypothesis space differs as a function of whether the situation is L1 or L2 acquisition, this tells us something about the nature of the hypothesis space. Perhaps certain parameters are unavailable to the learner due to the constraints of nonlinguistic, cognitive development. For example, the tense-aspect dimension of language may not be included in the young child's hypothesis space, while it would be readily available for the adult second language learner. On the other hand, the linguistic experience of acquiring the native language may profoundly affect the hypothesis space available to the learner in second language acquisition. In this case, there should be predictable changes in the hypothesis space of the second language learner, depending on the factor score of the native language. Observation of which particular variables show shift, and which do not, will bear heavily in the formulation of additional hypotheses about the nature of language acquisition. Particularly interesting would be if different shifts are observed for child and adult second language learners.

If the deductive process is different, the question is whether the differences in the deductive process are particular to the hypothesis space of lan-

guage or are more true generally of the cognitive system. For example, are there similar changes with respect to age in other cognitive abilities, such as problem solving and decision-making?

Finally, an intriguing possibility would be where differences are observed between L1 and L2 learners on some factors but not others. For example, we may find no influence of the native language factor structure on Factor A, but a strong influence on Factor B. This is essentially a situation hypothesized by Rutherford (1983), who claimed that syntactically-based word-order related structures do not transfer, whereas discourse-based word-order does (but see Schachter, 1974; Kleinmann, 1976). Such findings would be of particular value in beginning to understand the functional underpinnings of language, by justifying language typological characteristics on functional/psychological grounds. Under these conditions, we can fully appreciate the complexity of the interaction between native language structure, target language structure, and age of the learner in the process of second language acquisition.

5. *Conclusion.*

In this paper, I have simplistically reduced the study of language typology and universals to factor analysis, and glossed over many of the technical difficulties that the researcher would encounter in searching for psychological correspondence for language factors. I undertook this exercise because I wanted to emphasize the viewpoint towards first and second language acquisition that is implicit in an approach that incorporates language typology and universals, a viewpoint that I believe at present to be potentially the most productive.

Recently, there was an article in the *American Scientist* that reviewed some recent research in developmental biology (Tickle, 1981). In particular, the article was concerned with similarities and differences between the growth of limbs during ontogeny on the one hand, and the regeneration of severed limbs (in certain species) on the other. Essentially, the problems faced by the cells in these two processes are similar: how does a growing cell know what part of the limb it is ultimately to become? To make a long story short, there are marked differences between the two, which can be characterized by the degree to which developing cells are sensitive to, and interact with, positional specifications of neighboring cells. In development, the positional specifications are developed in cell generation, while in limb regeneration the positional specifications of the new growth interacts with the already established positional specifications of its neighbors. This is an interesting statement

about the relationship between the two processes that could not have been possible without a system for specifying position. (It turns out that position can be specified by three dimensions: anterior/posterior, dorsal/ventral, and proximal/distal, and some promising mechanisms for how this information is signaled have been proposed.)

The relationship between first and second language acquisition and language typology might be regarded in a similar way. The n-dimensional space hypothesized by language typologists, whose psychological correspondence is verified, can become a tool similar to the positional specification of the developmental biologist concerned with limb growth. It defines the problem, and the problem for the language acquisition researcher then becomes to observe and explain the role that this n-dimensional space might play in the different conditions under which language is learned. While we are still uncertain as to the nature of this n-dimensional space, I submit that it is not too early to begin speculating and formulating our research questions with respect to its manifestations under different psychological contexts.

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