Two Lessons from Psycholinguistics for Second Language Learning

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This paper draws on three kinds of psycholinguistic studies of language behavior that may have some implications for theories of learning a second language, as well as some pedagogic implications. First, I review models of first language learning and argue that its individual dynamics may be best understood as an early expression of human's love of solving problems: this does not undercut arguments that linguistic structure itself draws on unique cognitive endowment, rather it addresses the problem of what motivates the child to use that endowment to discover abstract properties of language. I suggest that the structure of attested languages exhibit properties that stimulate the child's interest in applying hiser problem solving strategies with the structural tools s/he is endowed with. The implication for second language learning after the critical period is that it may be productive to design curricula and teaching stages to bring out intuitively enjoyable problem solving strategies.

In the second section, I discuss some recent research on improving text comprehension by subtle linguistically motivated manipulations of physical parameters of the text. In particular, we have demonstrated improved reading speed, enjoyment and comprehension, when between-word spaces are made slightly larger when they are at points between phrases. This improvement has been demonstrated with several populations of ESL learners, from Chinese, Japanese and Spanish. Thus, it may have a special use in preparing reading materials for second language learners in general.

Learning a first language via hypothesis testing

In this section, I outline a problem-solving model of first language acquisition and offer some suggestions on its implications for learning a second language. The basic premise is phasing the training of constructions in L2 so that learners build up statistical patterns that can then be integrated with exceptions to those patterns. This model may be particularly appropriate for L2 learners who are beyond the normal childhood age for learning a new language by intuition alone. The goal here is to construct a training program that stimulates L2 learning as a kind of puzzle that taps the natural proclivity of humans to enjoy solving problems.

Background.

1. How long does first language learning really take?

A dominant explicit and implicit assumption of today's language science is "the biolinguistic assumption", that language learning is paced by internal maturational factors. The apparent formal similarities of all languages initiates the idea that biological linguistic universals underlie linguistic structure, and hence, language learning. This assumption has been a foundation for the assumption that the mechanism of learning a second language is fundamentally different from learning a first language. That, coupled with the undeniable fact that immersion in a second language after age 15 is far less successful than at an earlier age, has motivated treating second language training as though it had no relation to first language learning. This assumption is further supported by the fact that children are surrounded by ungrammatical and incomplete sentences, and haphazard exposure to critical examples, while adult second language learners are often given explicit instruction with carefully controlled examples designed to bring out important grammatical facts and contrasts.

For many years, the matter seemed open and shut to many: the notionally available model of language "learning" as an alternative to the biolinguistic model is "associative stimulus-response training" which is hopeless in the face of several facts. First, early language learning appears to proceed without direct feedback; second, the child is exposed to a very small number of grammatical utterances, usually without any didactic intent by its caretakers: finally, the similarity of stages in normal language learning in different languages – even sign languages – attest to universal constraints and computational stages that all children bring to language learning experiences (for recent discussions, see Hauser et al, 2002, N. Chomsky, 2007).

The emerging biolinguistic program defined research on language acquisition as the close study of specific stages and of the pre-figured typological dimensions of language (aka 'parameters') that a child must set for his or her native language (see, e.g., Hauser et al, 2002, Lightfoot, 1991, JDFodor, 2001, Fodor and Sakas, 2004). A strong empirical corollary of this research approach is that the critical features of each language are acquired by mid-childhood, certainly by age 6 years: children not only have mastered intricacies of syntactic patterns within clauses, they understand the structure of remote relations between clauses despite frequent patterns that seem identical but are not: for example, the difference between "John told Bill to go" in which "Bill" should "go", and "John promised Bill to go" in which "John" should "go".

C. Chomsky showed that even 10 year old children can systematically misunderstand "promise" sentences as being like "tell" sentences until at least age 10 or later. That is, a child of 9 might interpret "the monkey promised the dog to leave" as meaning "the monkey told the dog to leave". Similarly, children confuse so-called 'tough' constructions with corresponding actives: if a child is asked to make a blindfolded monkey "easy to see" s/he might simply remove the blindfold. In the language acquisition world, this landmark finding lead to a series of studies, actively pursued today, showing that many aspects of linguistic structure are mastered over a much longer period of childhood than was earlier believed. (e.g., see articles collected in Frazier and DeVilliers, 1990).

Several developments in recent years have increased the salience of the finding that at least some linguistic features are acquired slowly. First, there has been a burst of interest in showing that random discourses do contain statistically valid information from which it is possible to extract categorical structures, given the right sort of statistical engine (Cartwright, T. A., & Brent, M. R. 1997, Moerk 2000 Mintz 2002, 2006, Yang, 2006) At the same time, studies of infants and young children are showing that they do have pattern-extracting abilities that might interact with statistically valid information to aid, if not completely support language acquisition (Gerken, L. A. (1996)).

Finally, we have never actually been restricted to considering only two kinds of learning models: *behaviorist associationism* vs. *biolinguistic nativism*. A third kind of model integrates both biologically prefigured categories and the statistically valid features of experience: an *hypothesis testing* model on which language learning utilizes both innate structures and human problem solving strategies (Bever et al, 1984; Townsend and Bever, 2001, Bever, 2009).

In the last century, the sustained work of gestaltists (especially Wertheimer, 1945) outlined several features of how problem solving works. Humans experience an intrinsic thrill merely in solving a problem (the so-called "aha" reaction) – this is true, whether the problem is a practical one or not. An entire theory of aesthetic experience is based on this principle: music sets acoustic problems for resolution; graphic arts do the same in vision; of course, drama, literature and poetry are the flagship cases of problem creation-and-resolution (See Bever, 1988 for a discussion of the implications of this for first language learning)

It is instructive for our purposes to consider the phases of problem solving elucidated by Wertheimer. Characteristically, the problem solver often starts out with partial solutions each of which solves part of the overall problem: the insight occurs when the problem solver discovers how to integrate the incomplete separate solutions. For example, people solve the problem of how to use an Xray gun to kill tumors, in two typical stages. First, they delineate two (mutually incompatible) partial solutions: a) shoot the Xray directly at the tumor with enough energy to kill it; the obvious problem is that it will damage intervening tissue, which leads to the alternate solution: b) shoot the Xray towards the tumor with weak enough energy so it wont damage intervening healthy tissue; the problem of course is that this won't kill the tumor. Wertheimer uses this example to show the specific importance of accessing a different kind of representation of a problem to resolve a conflict it initially elicits. The subject has to recognize that repeated weak beams can have an accumulated effect, and thinking of the Xray gun as movable in a circle around the patient, with the tumor as the constant focus. This involves both dimensions of time and space to link the partial solutions in an overall solution to the initial conflict: it is accessing a different level of conflict resolving representation that is exciting to the problem solver.

How might this model apply to language learning? In this paper, I concentrate on a particular aspect of what is learned when a child learns hiser first language: the child has to recognize that sentences have both an outer and inner form. That notion goes back to Wundt's ideas about language, and has been a central feature of generative grammar starting with the first formulations of the generative transformational model (Chomsky, 1957) and all subsequent variants, including the latest, "minimalism" (Chomsky 2004). But the distinction between the derivational history and the surface sequence remains evident: and it is that that the child must discover.

Sinclair de Zwart (1979) cast the problem of learning syntax in terms of discovering "deep" structure as a way to mediate the regular relation between different surface constructions. For example, the relation between an active sentence and other versions that share the same inner form, may be discovered by the child via postulating a common inner form that binds them. Sinclair's framework was Piagetian, and modeled the "discovery" of the inner form of sentences via the same kind of cognitive mechanisms that Piagetian theory invokes to account for the child's discovery of constancies in the physical and conceptual world. In that framework, the argument was clearly that the relevant cognitive development must prepare the child to make the linguistic discovery that sentences have an inner form.

Suppose the child treats discovering the syntax of her language as one of the first big life problems to solve. This would explain it as motivated, not by the urge to communicate (as in the usual behaviorist explanation), nor as forced by maturation (as in the strong Biolinguistic explanation), but as an activity that is cognitively intrinsically thrilling and fun. (Bever, 1987). The cognitive thrill involved in successive solutions to how the adult system works provides stage by stage feedback and intrinsic reward.

What do the structural features of problem solving models tell us about language and language learning? Miller et al. (1960) rehabilitated the older Gestalt model of problem solving, as 'hypothesis formation and testing'. In the case of language, this requires a set of systems that formulate hypotheses and mechanisms for testing those hypotheses. Recently, we have formulated this in the framework of an analysis by synthesis model of language acquisition (Townsend and Bever, 2001; Bever, 2009). On this model, children apply both inductive and deductive computations for hypothesis formulation and confirmation. As in the formulation by de Zwart, the overall goal is to find a coherent structure for the language experiences that systematizes the relation amongst and between meanings and forms.

This model accounts for several kinds of facts:

a) Languages exhibit statistically valid patterns, independent from structural constraints. This is a necessity so the child can formulate initial hypotheses about hiser language based on pattern recognition. A simple example of this is the universality of a "Canonical Syntactic Form" in every language. In English, almost all sentences have a typical surface structure and near universal thematic relations: almost every sentence has the surface form, "Nounphrase" followed by a "predicate" that agrees with the Nounphrase, followed by other material. Other languages have other canonical forms, sometimes based on word order, sometimes based on inflectional morphology, sometimes on a combination of linguistic features.

b) It is critical that the canonical form both have a near universal surface appearance, but also have critical differences in some of the mappings of that surface form onto thematic relations. In English *almost* every sentence with the canonical surface form, assigns the initial nounphrase 'agent' or 'experiencer' status in relation to the following predicate. (the first group below) But it is critical for the model, that not every such sentence is mapped the same way (as in the second group). This variation sets a problem for the child to solve: what is the overall structure that accounts for both the surface features and the variation in the thematic mapping? This calls on application of the structural component of the dialectic involved in building up syntactic knowledge.

SURFACE STRUCTURE: N, Vagr, XP

The boy hit the ball
It is the boy, who hit the ball **N1=Agent**
The boy was happy
The boy was eager to see
The boy wants to be early

THEMATIC STRUCTURE

It was easy to see the boy
The ball was hit by the boy
The boy seemed happy **N1 ~= Agent**
The boy was easy to see
The boy was likely to be early
The cake tasted good

c) The canonical form is learned by the child as an inductive process rather than an initial stage. Numerous studies have confirmed this, that the child starts to rely on the canonical form of its language by age 3-4, but not initially. (Bever, 1970; Slobin and Bever, 1982)

d) Certain aspects of language learning may be relatively dependent on induction, and hence may take a longer time to be mastered than others. In the framework of an hypothesis testing model of acquisition, certain linguistic features will intrinsically emerge as the 'core' of the language, and others will be modifications of the core by virtue of their less frequent appearance. In this way, frequency of a feature in the child's experience can actually explain some aspects of the order of acquisition of different components.

It should be emphasized that this view does not deny nor minimize the critical computational capacities that underlie the successive structural hypotheses that the child formulates to match the empirical generalizations. The model requires the dynamic interaction both biological constraints *and* statistical features of experience. In each case, the universality and frequency of the canonical form is unmotivated by universal linguistic architectural constraints – thus, attested languages are a subset of architecturally possible languages, such that they exhibit forms that facilitate the discovery by the child of an initial set of generalizations for test and analysis in structural terms.

Consider a sketch of how all this might work for first language learning.

One of the major enduring touchstones of first language learning is the so-called "poverty of the stimulus". Even child-directed speech is often elliptical and ungrammatical. Thus, the child lacks sufficient evidence if language learning proceeds by successive refinements of generalizations.

This problem is exacerbated further by a property of normal conversation that is usually ignored: in everyday speech, many acoustic details are slurred or even omitted. This can be demonstrated by showing that fragments several “words” long are impossible to recognize in isolation, but pop into complete clarity (for native speakers) when heard as part of an entire sentence (N.Warner). Consider a written example from motherese. First, attempt to understand the fragment below, taken from an actual utterance by a mother to her child:

Gtmnrepm

Now go to the footnote <> to see the whole utterance first look at it with the approximate phonetic spelling for the whole utterance, then with the full normal spelling. Try sounding out the phonetic version alone to see if you can (suddenly) understand the whole utterance. In the acoustic version, the final excerpt immediately pops into perfect comprehension, with the conscious intuition that the entire utterance was reasonably clearly pronounced.

Oh good, mumy pt thos ma?zeenz weh so yu ca~t gtmnrepm

Oh good, mummy put those magazines away so you cant get them and rip them

It is amazing enough that adults can understand conversational speech like this. No doubt it depends a lot on grammatical knowledge and accumulated statistical patterns. But for a child the problem is doubly compounded since its grammatical knowledge is incomplete, and it has not yet had time to build up complex language patterns. This simple fact compounds the poverty of the stimulus problem, since in many cases the child may not be able to even encode the utterance in enough detail to serve as a learning model. It is worth noting that the example utterance is itself a coordination of two separate canonical clauses (mommy put those magazines away, you can’t get them and rip them)

The existence of canonical forms helps the problem solving model to mitigate the ‘poverty of the stimulus’, first by exhibiting a reliable surface frame and likely thematic relations: in the example utterance, the canonical forms aid in chunking the entire utterance into separately interpretable and mutually supporting subsets. Furthermore, the child can exploit the canonical form to generate sets of meaning-form pairs that the child has not yet experienced. This helps the language learning child to be a “little linguist”, (Valian, 1999) without having memorized a large number of form-meaning pairs, and without querying the adult world the way grownup linguists do. A classic reflection of this is in the research of Ruth Weir (1962) showing that children often manifestly “practice” to themselves the paradigms in their language – most important is the apparent fact that they utter sentences in canonical frames that they have never heard.

The CFC suggests a way in which the child can further transcend the ‘poverty of the stimulus’ by going beyond the surface form-meaning pairs it learns to isolate different thematic mappings onto those pairs. First, as I just noted, the child can create and then analyze hiser own set of form/meaning pairs going beyond the actual sentences it hears, based on these generalizations. Second, this solves an important problem for any language learning scheme – how do children remember and understand sentences for which they do not yet have a correct syntactic analysis? (Valian, 1999). It would not work for the child to maintain a list of grammatically unresolved sentences: any given list is heterogenous without prior structural ordering. The hypothesis testing model suggests that children can rely on statistical patterns and occasional false analyses to generate an internal bank of meaning/form pairs and maintain an internalized data bank to evaluate candidate derivational analyses. This reduces the need for children to access positive and negative feedback as guides to their emerging syntactic abilities. On this view, the child can attempt derivation of a construction based on a subset of sentences of a given general pattern, and then 'test' the derivational structure on other sentences of a similar pattern. (For related ideas, see Chouinard and Clark, 2003; Dale and Christiansen, 2004, Golinkoff et al, (2005); Lieven, 1994, Moerk, 2000, Morgan et al.,1995, Saxton, 1997, Valian,1999). These facts and considerations offer an explanation for the canonical form – an otherwise peculiar universal property of languages in the sense that the computational architecture of syntax does not in itself require a canonical forjm. It is reflected in attested languages because it makes them learnable, using a hypothesis formation procedure.

If this picture is correct, children should show evidence of actually learning perceptual strategies that reflect the canonical form of their language, based on statistical frequency of preponderant features of their surrounding language. We and others have found evidence supporting this (Bever, 1970; Maratsos, 1974; Slobin and Bever, 1988). The original finding was based on having children act out simple sentences with puppets. 2 year old children use a simple strategy that focuses primarily on the exact sequence Nounphrase+Verb, interpreting that as Agent+Verb (a). Thus, at age 2, children interpret declarative and object cleft sentences, along with semantically unlikely sentences above chance: in these constructions, the noun immediately before the verb is the agent. By age 3-4, they rely both on a more elaborated analysis of word order and semantic strategies (b, c).

a) N Verb = Agent predicate

b) #N… = Agent,

c) Animate nouns are agents, inanimate nouns are patients.

a) represents a shift from assigning the noun immediately before the verb as agent, to assigning the first noun in the overall sequence as agent. This produces correct performance on simple declarative sentences, but a decrease in performance on sentences types in which the first nounphrase is not the agent (object clefts and passives).

The canonical form justifies different perceptual strategies from language to language: we found that by age 4 years, children acquire processing strategies adaptive to the statistical regularities in the structure of their own language (Bever and Slobin, 1988). Thus, in English what develops is sensitivity to word order, in Turkish, sensitivity to patient/object inflectional markers, in Italian and Serbo-Croatian, sensitivity to a mixture of the two kinds of linguistic signals. This reflects the fact that each language has its own canonical form, which children learn.