

Transfer and Competition in Second Language Learning

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Recent work has explored the application of the Competition Model (MacWhinney & Bates, 1989) to the study of second language acquisition. In making this extension, it is important to distinguish between transfer from L1 and direct learning of L2. Both processes can be analyzed in terms of the constructs of cue reliability, cue cost, and form-function mappings. The model predicts certain typical varieties of transfer during the process of phonological, syntactic, and lexical learning. In the attempt to maximize the transfer of L1 structures the learner uses a variety of complex learning strategies. In areas where transfer is poorly supported, the learner acquires L2 structures directly. Cue reliability and cue cost estimates can also be used to characterize the direct acquisition of L2 structures.

Psycholinguists come in two types. There are those who study adults and those who study children. The psycholinguists who study children care about “acquisition” and the psycholinguists who study adults care about “processing.” Until recently, these two groups have acted much as separate “modules.” This separation is most unfortunate, since we know that acquisition influences processing and that processing influences acquisition. Fortunately, the study of second language acquisition provides a way to dissolve the barriers between these modules. Adult second language learners and adult bilinguals make excellent experimental subjects. Unlike children (Friederici, 1983; 1983; Tyler & Marslen-Wilson, 1981), adults can read printed words on a computer screen and make quick and well-controlled judgments in reaction time experiments. Because it is relatively easy to acquire data on language processing in adult second language learners and bilinguals, we can use this population to broaden our understanding of the changes in language processing that occur during language acquisition (Kilborn, 1989).

The study of adult second language learning also allows us to correct another limitation in the scope of adult psycholinguistics. Virtually all of the current edifice of adult psycholinguistics is built upon data derived from the study of language processing in English-speaking college freshmen. This anglocentric bias is bound to lead to a misleading view of the language-making capacity. Child language researchers have already begun to escape from this bias. The ground-breaking crosslinguistic developmental research of Slobin (1985) and his colleagues has vastly expanded our understanding of what it means to acquire a human language.

Adult psycholinguistics has only recently begun to escape from its anglocentric straight-jacket. Within the context of a model of sentence processing called the Competition Model, MacWhinney and Bates (1989) have opened the doors of psycholinguistics to a wider array of crosslinguistic data, including adult sentence processing, language in aphasia, and second language learning. Although the Competition Model (Bates & MacWhinney, 1982) was not originally based on data from second language acquisition, its crosslinguistic developmental orientation seems to make it well-suited for use in this area too. At the same time, it is clear that data on the learning of foreign languages can play an important role in the testing and elaboration of the Competition Model.

Form-Function Mappings

The fundamental idea underlying the Competition Model is simple and rather traditional. The model takes as its starting point the Saussurean vision of the linguistic sign as a set of mappings between forms and functions. *Forms* are the external phonological and word order patterns that are used in words and syntactic constructions. *Functions* are the communicative intentions or meanings that underly language usage. In the Competition Model, each lexical item or syntactic construction can be understood as a form-to-function mapping. Take the word “bat” as an example. The functions for this word involve the expression of the various semantic properties of the animal, along with its visual and auditory images. The form of the word is the set of phonological cues contained in the sound sequence /bAt/. On the syntactic level, a similar relation holds. Structures such as preverbal positioning or verb agreement marking are treated as forms. These forms are mapped to functions such as agency, topicality, perspective, first mover, causer, volitional agent, and so on.

In addition to the *correlations* between particular subsets of forms and subsets of functions, there are also correlations within the overall set of functions and within the overall set of forms. We can call these function-function correlations and form-form correlations. On the functional level, it is generally true that topics can also be animate, definite, given, and so on. These correlations are reflections of certain real correlations between properties of the world in which we live. Because the functions we choose to talk about are so highly correlated in real life, the forms we use to talk about these functions also become highly correlated. This makes it so that no single form expresses any single function and the relation between forms and functions is both fluid and robust. There are also important correlations on the level of forms. For example, words that take the article “the” also are capable of taking the plural suffix, and so on.

We speak of these various mappings as correlations because we know that all categories are imperfect and subject to category leakage (MacWhinney, 1989). For example, the correlation between preverbal positioning and agency in English breaks down in the passive and the imperative. Similarly, the correlation between plural marking and semantic plurality breaks down with words like “pants” or “faculty.”

Cues and Cue-Validity

Our analysis so far has kept close to the basic Saussurean concept of a form-function mapping. To recast this thinking in terms of a processing model, we will have to adapt some of the terminology. Instead of forms, we can talk about the “cues” used by the listener to facilitate the activation of alternative functions or “competing construals.” For example, the individual phonological segments in the word “bat” can each be viewed as cues to activation of the meaning underlying “bat.” The cues in the first two segments would also activate words like “bad” and “bag” and so on. For a fuller discussion of the ways in which cue match can facilitate activation see MacWhinney and Anderson (1986). Note, however, that the equation of “cue” with “form” holds only for comprehension. When we switch to thinking about sentence production, we need to think of the underlying functions as cues, and the actual forms being selected as “competing forms.” This use of the term “cues” allows us to draw parallels between processing and acquisition in comprehension and production. In both processes, the activation of certain cues as inputs is what leads to the final selection between competing outputs.

Most of the work on the Competition Model has focused on sentence comprehension. The interaction of cues such as preverbal positioning, animacy, case-marking, and subject-verb agreement has been modelled mathematically in the Competition Model using maximum likelihood techniques (McDonald & MacWhinney, 1989). The data modelled in these studies come from experiments with real subjects in many languages and at many age levels using sentences in which the various cues are placed into “competition” with each other in an orthogonalized ANOVA design. The maximum likelihood techniques make it possible to estimate the *cue strengths* of particular cues. For example, in our studies of sentence processing in English, Italian, German, French, and Hungarian, we have been able to estimate the relative strengths of preverbal positioning, subject-verb agreement, and animacy as cues to the function of “agency.” We have found that, in English, the preverbal positioning cue is extremely strong and that the agreement and animacy cues are only of any importance at all when there is no preverbal noun, as in VNN sentences. In Italian, on the other hand, the agreement cue is far stronger than the word order cue. Although both English and Italian are described as SVO languages, the actual strengths of the basic cues to sentence interpretation in these two languages are radically different.

Perhaps the most important empirical claim of the Competition Model is that cue strength in the adult native speaker is directly proportional to *cue validity*. What is crucial about this claim is that our cue validity measures are taken from actual text counts based on spoken or written discourse, whereas our cue strength measures are derived from experiments. This way of understanding the relation between the learner and the environment avoids the circularities often found in mathematical modelling in psychology. The idea is that, during language learning, the child comes to appreciate the relative order of cues in his language and to tune his cognitive system so that it correctly mirrors the environment. At first, the child picks up cues on the basis of their *overall availability*. At this early period, the English-speaking child is already paying more attention to word order than his Italian counterpart. And the Hungarian-learning child is making more use of case marking than his German counterpart. Within a single language, if there are two ways to mark a given function, the child will first start to use the one that is more frequent. For example, in Hebrew, the child will first use the inflectional reflexive, because it is more common. Only later will the child pick up the

periphrastic reflexive (Sokolov, 1989). In this early period, the child will also be strongly influenced by *cue detectability*, since it is difficult to pick up cues that are hard to perceive. For example, the Turkish child picks up accusative marking earlier than the Hungarian child (MacWhinney, Pléh, & Bates, 1985), largely because of the clearer phonological status of the Turkish accusative suffix.

As development proceeds, the learner adjusts cue strengths to be more and more in tune with the *reliability* of cues, rather than simply their overall availability. In particular, the learner wants to know which cue to bet on when there is a head-to-head conflict between cues. For example, the preverbal positioning cue is highly available and fairly reliable, but when it comes into direct conflict with the case-marking cue on personal pronouns, the case-marking cue always wins. In the end, it is this *conflict reliability* which determines the final strength value of the cue in the language. Often, a completely adult-like set of cue strengths will not be acquired until about age 12 (McDonald, 1989).

There are aspects of language for which the simple correlation between cue strength and cue validity tends to break down. These exceptions to the basic rule occur whenever a cue places a particular strain on the processing mechanism. For example, we have found that young Italian children take a long time learning to make use of the highly reliable cue of subject-verb agreement (Devescovi, D'Amico, & Gentili, 1999). The problem seems to be that the variable word order of Italian requires the listener to process long-distance dependencies between separate words. By way of contrast, the marking of case in Hungarian only requires the listener to detect the presence of an accusative marker placed directly on the noun. Another set of divergences from simple cue validity occurs in relative clause processing where the piling up of nouns without verbs in an SOV language like Hungarian (MacWhinney & Pléh, 1988) can lead to delays in processing. The Competition Model refers to these various processing factors as *cue costs*. We do not consider cue costs as noise factors to be swept under the theoretical rug. On the contrary, they provide us with important glimpses into those aspects of the language processor which determine language universals.

Transfer

The role of transfer in second language learning has been debated for decades. Empiricists have always emphasized the extent to which learners attempt to acquire L2 by generalization from L1. Intuitive accounts have focused on accents and culturally-specific learner styles as evidence of influences of L1 upon L2. The descriptivist-structuralist approach (Lado, 1957, 1971) looked at transfer as a way of supporting the usefulness of comparative analysis as a basis for language pedagogy. When research showed that many of the predictions of comparative analysis were only weakly supported, this also cast doubt on the role of transfer in language learning. In the early 1970's the established wisdom was that the predictions of contrastive analysis for second language learning were largely incorrect and that transfer played had little effect on second language learning. In hindsight, these failures to support contrastive analysis could just as well have been attributed to problems with the linguistic model and to limitations in the behaviorist framework, rather than to the process of transfer itself.

With the demise of behaviorism (Chomsky, 1959; Skinner, 1957) the theory of transfer was banished to the behaviorist dungeon. While it languished there, theorists treated L2 acquisition as a replay of the basic process of L1 acquisition (Dulay & Burt, 1974a, 1974b). However, this research program also ran into trouble (Huebner, 1983; Rosansky, 1976). Slowly, researchers began to realize that both transfer and direct acquisition of L2 had to figure as important components in an adequate account of second language learning (Dechert & Raupach, 1989; Gass & Selinker, 1983; Kellerman & Sharwood Smith, 1986; Odlin, 1989; Ringbom, 1987). But exactly how should this be done? The psychological theory of transfer has now been reformulated within the richer framework of problem-solving theory (Singley & Anderson, 1989) and analogical theory (Rumelhart, Smolensky, McClelland, & Hinton, 1986; Vosniadou & Ortony, 1989). However, these newer cognitive models have not yet been brought to bear on the problems of second language acquisition. In this section, I wish to explore some of the ways in which the Competition Model can be used to understand aspects of positive and negative transfer in the early stages of second language learning.

Phonology

How can we conceptualize transfer within the framework of the Competition Model? The easiest place to begin is with phonological transfer. Dickerson (1987), Flege (1987) and others have shown that a great deal of phonological learning within L2 relies upon the structures and units of L1. Within the Competition Model framework, we can view this transfer as involving the accretion of new lexical items based on an old set of phonological units. The crucial idea here is that the brain provides the language learner with neural substrate (Damasio & Damasio, 1992) that tends to facilitate the “fast mapping” (Carey, 1978) of new lexical items. Lexical items can be viewed as largely arbitrary (de Saussure, 1915/1966) associations of phonological forms to semantic functions. However, the system for coordinating phonological units is much more tightly integrated and less easily changed. Because of this, new words are constructed by simply devising new associations between old semantic units and old phonological units.

MacWhinney (1990) proposed a Competition Model view of phonology based on a connectionist network. This network learns to auto-associate a set of auditory units to a set of articulatory units. Presumably, these associations are built up and solidified during the first two years of life. Of course, we know that not all articulatory patterns are learned with equal ease. Phonological processes (Stampe, 1973) force certain patterns to have a higher cue cost. However, as the system matures, the strength of the various cues comes to approximate their true validity in the language. When the language learner begins acquiring vocabulary in L2, he simply treats these as additional words of L1 composed of sounds that match most closely to auditory and articulatory items already in his repertoire. Odlin (1989) reviews dozens of studies which illustrate transfer of this type in both segmental and supersegmental phonology. In some cases, this transfer is fairly successful and goes unnoticed. For example, the places of articulation of nasal consonants are often similar between languages and even stop consonants often have similarities. However, the exact amounts of voicing of stop consonants or the exact forms of articulation for vowels seldom transfer without producing some accent.

Some of the negative transfer also affects audition, where Chinese speakers may confuse “rice” and “lice,” because of the absence of the /r/-/l/ distinction in Chinese.

The Competition Model does not assume that all L2 phonological learning is based on transfer. There are two additional factors which determine the shape of the learner's system: cue costs and L2 generalizations (Gass & Selinker, 1983). Cue costs express language universal phonological processes such as devoicing, vowel harmony, and other neutralizations (Major, 1987). These processes can be expressed in terms of universal markedness theory. However, their real basis surely lies in the mechanisms of auditory and articulatory processing. In the early stages of L2 acquisition, L2 generalization plays only a minor role. However, as learning progresses, the L2 phonological auto-associative net begins to have a structure that is at least partially independent of the L1 net. As that network grows, we see the emergence of phonological overgeneralizations that match in part those exhibited by L1 learners.

How can we predict which of these three factors will be operative in a given stage of L2 phonological learning? The Competition Model prediction is that L2 learning will begin with massive transfer from L1 within the limitations set by cue costs or phonological processes. Here we expect some individual differences. Learners who have a richer array of auditory and articulatory patterns in L1 will be able to transfer somewhat more fine-grained patterns and show somewhat less negative transfer. These same speakers will also have succeeded more fully in overcoming cue cost limitations in L1. When they come to L2, they will also be able to overcome cue cost limitations. When L1 is close to L2, transfer will also be more clearly positive.

After a period of initial massive transfer from L1 to L2, we expect to see a long period in which the system tries to deal with the fact that its articulatory output does not correctly match the L2 target. Learning at this stage is promoted most strongly by correct registration of the phonology of the L2 target lexical items. If the target forms are passed through an L1 filter, the learner will never be able to detect a mismatch (MacWhinney, 1978) between his own forms and the correct target forms. Without the detection of error, the L2 auto-associative network will not develop. The learner must be encouraged to perceive the mismatch between his output forms and the correct input forms. It would seem that the best way to bring this about would be through a process in which learners attempt to match their own productions to computer-controlled digitized speech. Such a procedure should be particularly helpful in acquiring intonational contrasts.

Lexical Items

During the initial stages, much of the work of second language learning involves lexical acquisition. As we noted above, the organization of language within the brain promotes the relatively easy acquisition of new mappings between sounds and meanings. However, these mappings typically reuse old phonological units and old semantic units. In terms of semantic representations, there is a fairly massive conceptual transfer from L1 to L2. Consider the learning of the Spanish word /mesa/ by an English speaker. The speaker has already acquired a set of function-function correlations between the various meanings underlying the concept

of “table.” On the phonological level, the learner maps the sounds of /mesa/ onto already existing English segmental units. The only new learning that has to occur is in the mapping between the new sound string and the old meaning set. In this case, the transfer of old units and correlations is essentially positive. Of course, the actual phonological units used to represent /mesa/ will be English-based, but the learner is able to use this simple transfer process to express a meaning easily and with a minimum of new learning. For common concrete nouns like “table” and “salt,” the process of lexical learning may proceed with minimal error. However, abstract nouns, verbs, and adjectives may have subtle meanings that will have to be relearned in L2 (Ijaz, 1986).

Kroll and Stewart (1990) have shown that the transfer of old meanings to new lexical items in beginning L2 learners actually involves a mapping that goes through old L1 units. This makes sense when one realizes that, unlike the phonology, the meaning underlying a new word in L2 is not initially being restructured. Rather, the concept underlying “table” is taken as a whole and mapped to the new sound /mesa/. Of course, this leaves the learner with two phonological forms for “table.” There is little danger that /mesa/ will intrude upon English. What the learner has established is a set of associations between the new Spanish words that guarantees that they will be activated together when speaking Spanish as L2.

Automatization

So far, all of the strategies we have discussed involve ways of structuring the mapping between an L2 phonological string and an L1 conceptual or semantic representation. The mappings produced by these transfer strategies are not as direct as the corresponding native language mappings, because they use both L1 and L2 representations. Over time, the learner will attempt to restructure his representations so that true L2 phonological forms are mapped directly onto true L2 semantic forms. Instead of accessing the word “mesa” through the English word “table” (Kroll, 1990), the learner will access “mesa” directly. Increasing the speed of access involves processes which cognitive psychologists generally refer to as “automatization.” However, in the case of L2 acquisition, one needs to differentiate two ways in which automatization can be achieved. These are “proceduralization” and “compilation” (MacWhinney & Anderson, 1986). Proceduralization leads to the smoother and faster L2 functioning without major reorganization. Compilation, on the other hand, attempts to restructure processing so that processing goes directly from meaning to sound within L2. In many learners, these two forces work against each other. If a particular mapping using L1 transfer to L2 becomes highly proceduralized or automated, it becomes difficult to restructure it. In such cases, learners can end up blocking the “recompilation” of their processing system into more native-like systems.

Syntax through Translation

The basic lexical strategy we have been examining can also be applied to syntactic learning. Using a *one-to-one* lexical mapping strategy, we find learners producing sentences such as, “*Ich wurde möchte zu gehen in das Geschäft,” which derives apparently by word-

for-word conversion from the English sentence, “I would like to go into the store.” Or, to take an example from an English speaker's early Spanish, we find, “Yo soy hablando,” derived from English “I am speaking.” The corresponding German learner form would be “*Ich bin sprechen.”

What happens when a simple type of transfer is blocked? When this occurs, the learner utilizes a secondary path of transfer to go around the barrier. For example, when confronted with the failure of one-to-one mapping, the learner can attempt a *many-to-one* mapping. For example, he can translate the German word “möchte” by the English phrase “would like to.” At this point, his translation of “I would like to go into the store” would be “*Ich möchte gehen in das Geschäft.” In general, we can view transfer not as a simple uniform process, but as a general approach to language learning in which the learner is exploring all possible *paths of transfer*. When a particular path of transfer is blocked, the learner explores another path. When all transfer paths are blocked, the learner either gives up or waits for new information. According to this account, the beginning learner always attempts to construct an L1-based interpretation of L2 structures.

The reader may object that any reasonable approach to L2 learning will keep the learner from even attempting simple lexical translation schemes of the type discussed here. The whole point of functional language training is to avoid simple translation and to have the student thinking and speaking directly in L2 from the beginning. However, the analysis I am offering is not in disagreement with this position. The Competition Model holds that these simple mappings can be corrected without requiring that the learner produce errors overtly. As MacWhinney (1978) and Berwick (1987) have noted, errors in syntactic processing can often be corrected on the basis of data derived from “failure to parse.” If the comprehension system is unable to find a one-to-one map from German “möchte” to a single English lexical item, it can still attempt a many-to-one mapping. The learner simply realizes that the input form “möchte” maps onto the string “would like to.” In general, the learner will either discover such mappings for himself or perhaps acquire them from the textbook. In this way, many of the most obvious transfer errors will never actually occur in production. This is particularly true if the classroom emphasis is on listening to L2 forms and the learner is not required to produce forms which he does not control (Klein & Perdue, 1989).

The learner's lexical transfer strategies need not stop with one-to-one and many-to-one mappings. There are several additional strategies that can be used that still depend on a mapping from L2 to L1. These strategies are more abstract and less general than the simple strategies of one-to-one and many-to-one mapping. For that reason, we would expect that structures that require these elaborate remappings would be relatively more difficult to acquire. In *discontinuous mapping*, the learner picks up new lexical items that have discontinuous mappings onto L2 forms and vice versa. Here, again, it is the initial “failure to parse” that leads the learner to invoke the strategy. For example, the German word “keinen” can be mapped onto the English sequence “not ... a ...” This will allow the learner to formulate the English sentence “He has not seen a man” as the German sentence “Er hat keinen Mann gesehen.” Yet another strategy involves the *analysis* of pieces of L2 words. Using this strategy, the learner can identify the Spanish conditional suffix /ri/ with the English word “would.” Thus, the Spanish phrase “habría visto” can be analyzed in English as “have-

would-I seen.” At the same time, the learner can parse new strings such as “hablaría” or “comerían” always by pulling out the /ri/ from the surrounding material. This strategy is more analytic than a simple one-to-many mapping.

Cue-based Syntax

The various simple translation schemes discussed above can provide a beginning learner with a large initial vocabulary and some communicative abilities. Because the adult learner is already a competent member of one society, it is often possible to take these transfer-based abilities and achieve some level of communication. It is remarkable how much of L2 an adult learner can control without really dealing with L2 on its own terms. However, there are still higher levels on which the learner can transfer cues from L1. One of these higher levels involves the transfer of the overall weights of cues to syntactic roles in sentence comprehension.

Within the Competition Model (MacWhinney, 1987b), syntactic learning involves the formation and restructuring of the argument frames of particular lexical items, as well as the generalization of these frames across groups of lexical items. Some aspects of L1-to-L2 transfer involve the argument frames of particular lexical items. In general, when a new L2 word is learned, the complete argument frame of the L1 analog is transferred. In some cases, no error will result. However, for most closed class lexical items, there will be problems. For example, French and Spanish locative prepositions do not code directionality, whereas their English equivalents do. Direct translation of the English word “into” as French “en” will lead to errors such as the French sentence “*Je suis allé en la magasin” for “Je suis entré dans la magasin” on the basis of English “I went in the store.” In French, the verb that expresses the motion must also express the nature of goal. The correction of these mismappings involves more than simply lexical learning. It requires that the learner to restructure argument frames (MacWhinney, 1987b) for each new closed class lexical item and for many new verbs. This *frame restructuring* requires the learner to make a clear distinction between the L1 analog and the L2 form, thereby exerting a pressure toward the separation of the two languages.

Other forms of syntactic learning involve general patterns across constituents. Within the Competition Model, these general patterns are viewed as emerging from networks that correlate the semantics of lexical items to particular argument frames. Not all patterns are fully predictable from simple semantic patterns. However, the connectionist networks used in the Competition Model can handle the “abduction” of form classes from semantic-syntactic correspondences. Just as the learner transfers individual lexical frames from L1 to L2, so the learner can also transfer general patterns. For example, the English learner of Spanish initially assumes that the adjective precedes the noun. However, this rule is immediately subjected to massive negative evidence, as soon as the learner begins to hear Spanish noun phrases. At first, the learner may attempt to handle this through a process of *shuffling* in which a constituent is moved from its normal position to another position in the sentence. This strategy is used when formulating “Ella es una niña bonita” on the basis of “She is a pretty girl.” The shuffling strategy allows the learner to preserve the basic lexical transfer

strategy. Shuffling can also reorder major constituents. Initially, the Spanish learner of English uses Spanish-based patterns to produce “*Come here all my friends” on the basis of Spanish “Vienen aquí todos mis amigos.” However, the learner soon realizes that English requires the subject to precede the verb. These shuffling strategies are only crutches along the pathway toward real control of L2 syntactic patterns. Eventually, the learner is able to use a syntactic network in L2 to order constituents directly without reference to L1 patterns and without shuffling.

The learner also has to pick up patterns of *omission* and *agreement* marking through initial reference to L1 structures. For example, the English learner of Spanish may initially say “Yo tengo un libro” for “I have a book.” This use of the personal pronoun “yo” is not an error, but it implies some pragmatic contrast. At first, the learner must overtly delete the subject pronoun. Over time, he drops his reliance on the omission strategy as a way of correcting L1 transfer errors and directly produces sentences with pronouns omitted.

Generalized Cues

So far we have treated syntactic cues as primarily lexically-based. However, because there are so many words in many of the important syntactic classes, it is usually easier to think of these cues as general across word types. For example, it is a quite general fact across the thousands of transitive verbs in English that the noun preceding the verb is the subject and the noun following the verb is the object. This is a general cue to sentence processing in English. However, these same cues will not work for an SOV language like Turkish. However, when acquiring a new language, the learner is often in a position where he has to rely on these old cues.

There are now eight Competition Model studies that investigate the transfer of general L1 sentence processing cues to L2. Beginning with a study of German-English and Italian-English bilinguals (Bates & MacWhinney, 1981), we have found repeatedly that L2 learners have what we have come to refer to as a “syntactic processing accent.” This research is summarized in a special issue of the journal “Applied Psycholinguistics” in 1987 (Gass, 1987; Harrington, 1987; Kilborn & Cooreman, 1987; MacWhinney, 1987a; McDonald, 1987) and in Kilborn and Ito (1989). More recent studies (Kilborn, 1989; McDonald, 1989; Sasaki, 1991; Takehiko, Tahara, & Park, 1989) have extended and supported the earlier findings. To give an example of a typical finding, we observed that Germans listening to English NNV sequences assume that the first noun is the subject, whereas English monolinguals assume exactly the opposite. Similarly, Italians learning English pay attention to agreement cues and place little reliance on the preverbal positioning cue, whereas English monolinguals do exactly the opposite. This type of L1 to L2 transfer of cue strengths is exactly the pattern that would be predicted by the Competition Model.

McDonald and MacWhinney (1989) and McDonald and Heilenman (1991) have constructed mathematical models of the cue strength interactions in our experiments with bilinguals and L2 learners and found that the strength of cues at various points in learning are well-predicted by the various cue validity measures in the Competition Model. In general, the results to date have supported the Competition Model. There are two areas in which the

simplest predictions of a model based only on transfer driven by cue validity have not been supported. Gass (1987) suggested that the semantic cue of animacy seems to have a certain universal prepotency in both L1 and L2 learning. Within the Competition Model framework presented earlier, we can think of the prepotency of the animacy cue as involving a particularly low cue cost. In particular, Gass found that English learners of Italian are quick to drop their strong dependency on the preverbal positioning cue of English and pick up the reliance on animacy as a cue to subject that we find in monolingual Italians. A variety of additional evidence suggests that animacy may have the kind of prepotency suggested by Gass, although further work will be needed to understand the exact nature and size of this effect.

Another challenge to the Competition Model in its simplest form is the finding by Kilborn and Ito (1989) that English learners of Japanese attempt to make rigid use of SOV order as a cue to sentence interpretation, much as they have made rigid use of SVO order in English. Indeed these English-speakers relied much more on SOV than native speakers of Japanese. Of course, the system of case-marking in Japanese has aspects that may be difficult for learners and this may have led to a tendency to rely most heavily on the simplest cue, even though its actual cue validity is comparatively lower. But the point is that English speakers seem to be particularly interested in trying to find some cue that will look maximally like the preverbal positioning cue they have come to know and love in their native language. In other words, they seem to be exploring a secondary *path of transfer* that looks for something close to their major L1 cue, since it is clear that the exact preverbal cue of L1 is not used in Japanese.

Functional Restructuring

So far, we have assumed that L2 acquisition involves an absolute minimum of functional restructuring. However, there is good reason to believe that, after the earliest stages, L2 learners are spending a great deal of time creating a new set of conceptual categories. Many of these new categories are lexical. If two words in L1 map onto a single word in L2, the basic transfer process is unimpeded. It is easy for a Spanish speaker to take the L2 English form “know” and map it onto the meanings underlying “saber” and “conocer” (Stockwell, Bowen, & Martin, 1965). What is difficult is for the L1 English speaker to acquire this new distinction when learning Spanish. In order to correctly control this distinction, the learner must restructure the concept underlying “know” into two new related structures.

Functional restructuring also occurs on the level of grammatical categories. A prime example of this type of restructuring might be the foreigner's attempts to pick up the category structure underlying the two major verbal conjugations of Hungarian. The intransitive conjugation is used not only when the verb is intransitive, but also when the direct object is modified by an indefinite article or by no article at all, when it is in the first or second person, when the head of the relative clause is the object within the relative clause, when the direct object is quantified by words like “each,” “no,” and so on. For example, the “intransitive” conjugation is used when a Hungarian says “John runs,” “John eats an apple,” “John eats your apple,” and “John eats no apple.” On the other hand, the transitive conjugation is used when the object is definite, when it is modified by a third person possessive suffix, when it is

possessed by a third person nominal phrase, and so on. Thus, the “transitive” or “definite” conjugation is used when the Hungarian wants to say “John eats the apple” or “John eats Bill's apple.” There are some 13 conditions which, taken together, control the choice between the transitive and intransitive conjugations (MacWhinney, 1989). There is no single principle that can be used to group this 13 conditions. Instead, both transitivity, definiteness, and referential disambiguation all figure in as factors in making this choice. This way of grouping together aspects of transitivity, definiteness, and possession is extremely foreign to most non-Hungarians. Not surprisingly, L2 learners of Hungarian have a terrible time marking this distinction; errors in choice of the conjugation of the verb are the surest syntactic cue that the learner is not a native Hungarian.

In order to acquire this new category, the L2 learner begins by attempting to transfer from L1. To some degree this can work. The learner attempts to identify the intransitive with the English intransitive. However, the fact that many sentences with objects also take the intransitive if the objects are somehow “indefinite” tends to block the simple application of this conceptual structure. In the end, no simple transfer will succeed and the learner must resign himself to picking up the pieces of this new category one by one and welding them together into a connected system. Here is an area where attempts at linguistic analysis on the learner's part only make matters worse. If the learner had proceeded like a Hungarian child (MacWhinney, 1974), he would have learned the conjugations by generalizing from a few key collocations and phrases. The adult needs to amplify this case-based approach to learning with a way of focusing on contrastive structures in which cues are competing. For the adult, such focusing on particularly difficult parts of a grammatical system will increase the efficiency of acquisition.

In many cases, the transfer of syntactic patterns from L1 to L2 is structurally correct, but pragmatically inaccurate. For example, Trévisé (1986) observes that French speakers make excessive use of topicalization structures in English in the form of structures corresponding to left-dislocation, right-dislocations, and “c'est .. que” in French. Although these structures are all permissible in English, the actual conditions on their usage are far more restrictive than in French. Similarly, Seliger (1989) notes that Hebrew learners of English tend to systematically underuse the passive. He attributes this underusage to the relatively tighter, genre-dependent conditions on the use of the passive in Hebrew. In general, it is clear that simple transfer of an L1 structure to L2 is not sufficient to guarantee correct usage, since both underutilization and overutilization can occur until the full conditions governing the use of a construction in L2 are learned.

Fossilization and the Critical Period

In his seminal analysis of the biological bases of language, Lenneberg (Lenneberg, 1967) argued for a critical period for language acquisition. It is clear that, past a certain age, at least some aspects of a second language become more and more difficult to acquire. The most obvious problems are in the area of phonological learning. If the learner has not been exposed to a wide variety of phonological contrasts before puberty (Oyama, 1976), the decreased plasticity of the brain can make it progressively more difficult to acquire new

articulatory patterns, since these patterns will be driven by the ability to code auditory contrasts. There are apparently important individual differences in the nature of early experiences and the extent to which they leave some residual plasticity for later learning, since some adults are able to pick up second languages with only some difficulty and others find full acquisition of L2 virtually impossible.

How does the Competition Model account for these apparent problems in later acquisition? The basic account is that increased automatization of the L1 system makes the addition of new auditory, articulatory, and semantic contrasts progressively more difficult. The more automatized a system becomes, the less it is available for restructuring. It may be this automatization, that is the root cause of “fossilization.” Even learners who are continually being exposed to large amounts of high quality L2 input may fail to shake off certain fossilized errors.

There is a second important difference between L1 and L2 learning that tends to support fossilization. This is the fact that L2 learning relies on a massive amount of top-down constructive processing. The L2 learner can often pull one or two words out of a conversation and understand fully what is being discussed. This form of processing is not available to the child. Unfortunately, constructive processing of this type tends to bypass some of the basic processes of lexical analysis and acquisition which may be crucial for acquisition of full native-like control of the language (Johnson & Newport, 1989).

Yet a third factor supporting fossilization can be the diminished pool of perceived error facing the language learner. The L2 learner who is able to maximize top-down comprehension processes and who is able to utilize simple transfer processes to acquire a moderate ability to produce sentences may find himself in a position where the remaining amount of error he can easily detect in his own productions is insufficient to force a full reorganization of his decidedly non-native system. To make further progress, the learner would have to refocus attention on the details of phonological form and argument structure, rather than on the actual process of communication. Even if errors are detected, the actual reorganization of the system to decrease particular errors will run against the strength of already automated procedures. Unless the learner diverts attention to these secondary concerns, his control of L2 will tend to fossilize.

Instruction and the Competition Model

The issue of pedagogical approaches to second language learning is one which has both theoretical and practical importance. If a pedagogical approach can be grounded on psycholinguistic data, it may be possible to elaborate both practice and theory in tandem. From the previous discussion, it would appear that the Competition Model would be most in accord with the following pedagogical principles:

1. Language should be learned in context with maximal experiential grounding.
2. Early instruction should use simple, frequent forms.
3. Early training should focus on the restructuring of the *phonological* system in the context of computer-controlled exercises encouraging the learner to match his own productions to clear L2 samples.

4. Neither grammar nor phonology should be taught apart from particular lexical forms. Phonological training and grammatical instruction should be done in the context of the acquisition of new lexical items in simple syntactic frames.
5. Since *transfer* is inevitable, instruction should be designed to maximize the positive effects of transfer and minimize the negative effects.
6. Early in learning, there is an important role of *rote* acquisition of forms. Later in learning, such rote learning should be deemphasized.
7. Ideally, new *lexical* items should be acquired in the context of syntactic groupings which fully display their alternative argument frames. Implementation of a HyperText system for lexical frames can allow the student to learn syntax in terms of operations on particular lexical groups. The instructional process does not need to specifically teach transfer or remapping strategies, since students will automatically apply them. However, errors produced by the transfer of L1 lexical frames need to be clearly presented in terms of HyperText systems.
8. Inevitably, the simplest transfer strategies will produce errors. However, it is better to focus on allowing the student to first deal with difficult materials in *comprehension*, rather than attempting, initially, to generate, detect, and correct errors in production.
9. As the student advances, the goal of instruction should be to progressively sharpen attention to those aspects of language which had previously been ignored and where the student is likely to make the largest numbers of errors. This can be done most effectively by increasing emphasis on *error detection* and *error correction* in later stages of L2 learning to prevent the fossilization of forms and mappings. This type of training should focus on *functional restructuring*.

A complete instructional system should include tools that facilitate error detection and provide the learner with specific instruction designed to correct each error type. In accord with the Competition Model, error-driven instruction should focus on the presentation and elaboration of the L2 pattern that should compete with the learner error. For example, if the learner produces a gender error in German in a particular case, there should be instruction to correct this error that illustrates the particular form in the context of others that are phonologically similar and which have the same gender (MacWhinney, Leinbach, Taraban, & McDonald, 1989).

The generation of errors and the use of tools for correcting these errors can provide us a way of gaining new psycholinguistic data on learner strategies and the relative efficacy of different instructional methods. The current top priority for research in foreign language learning should be the acquisition of new empirical data of this type. Using structured methods such as fill in the blanks, matching, question-and-answer, dictionary exercises, translation, error detection, and multiple choice, we can elicit similar responses in a group of learners which can be tracked within the program. It will then be possible to conduct psycholinguistic experiments within the context of the tutoring system itself. These data will allow us to elaborate increasingly refined models of the learner and will also facilitate development of the Competition Model for second language learning.

Summary.

Research within the context of the Competition Model is now focusing increasingly on L2 acquisition. The model views L2 learning as a process of cue acquisition which relies initially on transfer from L1 to L2. Cues with the strongest strength have the strongest transfer, although there is fairly general transfer across particular well-worn paths, such as the path which allows the transfer of the meanings underlying L1 words to L2 words. In some cases simple transfer is blocked and the learner develops a set of strategies to get around this blockage by postulating more complex remappings from L1 to L2.

The learner's attempt to proceduralize the mappings from L1 to L2 runs counter to attempts to restructure the L2 to avoid reliance on L1. In order to prevent fossilization and to facilitate functional restructuring, it is important to expose the learner to precisely those structures that differentiate true L2 strategies from transferred L1 strategies. Because transfer is inevitable, there is no sense trying to defeat it. Instead emphasis should be placed on moving the learner through the period of transfer into a period of functional restructuring.

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