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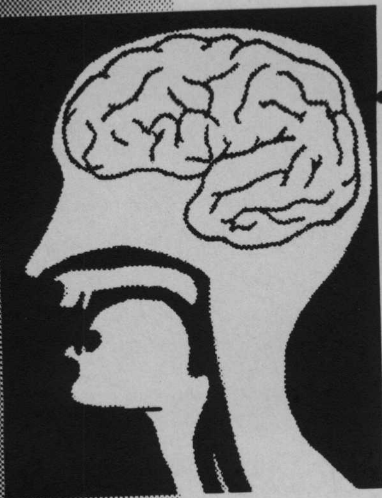

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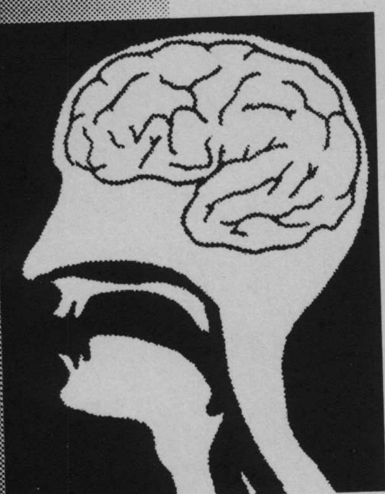

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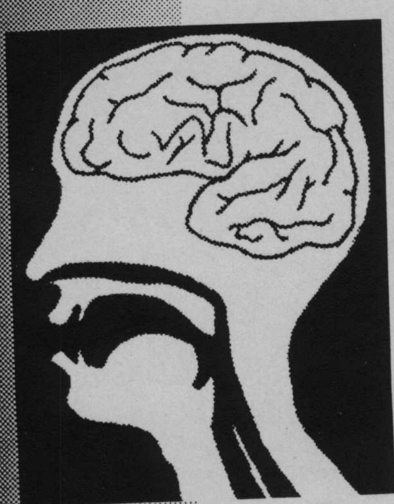

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Spring 1996

Vowel Epenthesis By Spanish Learners of English

By Charles Baker

Two well-known rules of Spanish phonology are the marked nature of word-final consonants and the prohibition against word-initial consonant clusters beginning with /s/. English, on the other hand, has both word-final consonants and word-initial onsets of the form /sC/. In both environments, Spanish speakers of English epenthesize, inserting /e/, the default vowel of Spanish, as shown in (1) an (2):

(1) $\emptyset \dashrightarrow$ e / C_#
(2) $\emptyset \dashrightarrow$ e / #_sC

Carlisle (to appear) studied the interaction between these two rules in Spanish/English interlanguage phonology. He gave his subjects a list of 435 sentences with word-initial onsets, /sl/, /sm/, and /sn/ appearing after twenty-eight different word final segments. He found the following frequency of epenthesis:

(3)

Environment	/sl/	/sN/
Consonant	.312	.391
Vowel	.226	.282

There was a greater frequency of epenthesis before /sN/ than before /sl/ in both environments. This was the predicted result since /sN/ is a more marked onset than /sl/ according to Clements' (1990) Dispersion Principle:

(4) The preferred initial demisyllable minimizes D, where D is the complexity ranking based on the sonority scale O < N < L < G < V.

Similarly, there was a greater frequency of epenthesis after word-final consonants than after word- final vowels before both onsets. This, too, was expected, given Cressey's (1978) rule that word- final consonants in Spanish are marked:

(5) [+ consonantal] --> [-consonantal] / _ #

What was expected was that, in the aggregate, the markedness of the environment was a more powerful factor in triggering epenthesis than was the markedness relationship between the onsets. Carlisle concludes his study by stating the need for a principled linguistic explanation for this phenomenon. This squib seeks to investigate the viability of several alternative explanations.

Markedness of Word-Final Consonants. Can it be that word-final consonants in Spanish have a greater degree of markedness than do word-initial /sC/ onsets? This would be an easy solution, but the evidence to support it is simply not there. Carlisle's study systematically varied the environment in front of /sC/ onsets, but he did not systematically vary the environment after word- final consonants. Rule (1), per se, was beyond the scope of his test, which focused on rule (2). To test rule (1), we would need to expand the test data to include word-initial vowels and other word-initial consonants in place of /sC/.

Two other points are relevant. First, while word-final consonants are marked in Spanish, they are not rare by any means. Spanish L1 speakers would frequently have occasion to use C#C combinations such as the two in (6) without epenthesizing:

(6) Mejorar bajo nivel educacional chileno.
To improve low level educational Chilean.

Second, there are strategies other than epenthesis for dealing with word-final consonants by Spanish speakers of English. MacDonald (1989) mentions deletion of word-final consonants, as in (7), and devoicing of word-final voiced obstruents, as in (8), as two of the twelve most frequent problems of fossilized Hispanic English:

(7) C --> Ø / _ #
(8) [+obstruent] --> [-voice] / _ #

Curiously, she does not list rule (1) as one ofthe twelve most frequent problems.

<u>Resyllabification</u>. In Spanish, /sC/ clusters may appear internal to words but never in the same syllable. Compare the English and Spanish syllable structures shown in (9) and (10):

(9) per.spec.tive
(10) pers.pec.ti.va

Spanish follows Harris' (1983) rule shown in (11):

(11) Adjoin the segment /s/ to the right of an existing rhyme.

It is also a well-known fact of Spanish phonology that resyllabification occurs across word boundaries. It is tempting to analyze Carlisle's data in terms of such a rule, hypothesizing that when there is an /sC/ cluster in Hispanic English, the /s/ adjoins to the last syllable of the preceding word. When the preceding word ends in a vowel, this would normally be done without epenthesis. When the preceding word ends in a consonant, epenthesis would normally occur to maintain the unmarked CV syllable structure. Although such a theory fits rather neatly with Carlisle's data, it would violate another rule of Spanish phonology given by Harris:

(12) Resyllabification only occurs on the string [+consonantal] # V.

One of the reasons why this rule is especially important for [+consonantal] # /s/ strings is that /-s/ is an important morpheme in both noun plurals and verb conjugations. If it were to adjoin to word-final syllables, it would have the potential to inadvertently change the syntax and semantics of the sentence, which would not be desirable. Since resyllabificationof /s/ across word boundaries does not occur in Spanish, there is no reason to postulate its appearance in Hispanic English.

Obligatory Contour Principle. Carlisle analyzed his data by distinguishing only two environments for his /sC/ onsets, word-final vowels, and word-final consonants, the latter having a greater frequency of epenthesis than the former. If, however, we divide the word-final consonants into two groups, an interesting pattern emerges: Coronal consonants induce a greater frequency of epenthesis than do non-coronal consonants. If we further divide the coronals into two sub-groups, an even more interesting pattern develops: Coronal continuants trigger more epenthesis than do the other coronals. (13) arrays these data by distinctive feature from lowest to highest degree of epenthesis with /s/ shown at the bottom for purposes of comparison:

(13)

Frequency	Consonantal	Coronal	Continuant
1	-	-	-
2	+	-	-
3	+	+	-
4	+	+	+
/s/	+	+	+

By this point, the nature of this pattern is fairly obvious--the more the word-final segment and the word-initial segment /s/ resemble each other, the greater the frequency of epenthesis. This is the Obligatory Contour Principle: Distinguish like segments. In this case, the distinction is done by epenthesis.

Such a solution still leaves many unanswered questions. Why should it be that the OCP comes into play in Hispanic English before /sC/ clusters when combinations such as (14) occur in Spanish without epenthesis?

(14)	Nosotros salimos.	¿Quiénes son?
	We left.	Who are (they)?

Similarly, can we find evidence of the OCP coming into play when other like segments are juxtaposed in Hispanic English? These and other questions will be a fruitful subject for future research.

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How Does Motivation to Learn a Second Language Differ from Other Performance Skill Motivation?

By Cam Esser

While extensive testing has been carried out on motivation as a factor in second language learning, considerable work still needs to be done to accurately measure and explain its function. I categorize learning a second language as a performance skill and suggest that *motivation* to learn a second language is significantly different from motivation affecting other performance skills. Viewing second language motivation from this perspective can add new insight into research whose aim is to define, and increase motivation, in students.

Humans speak to each other through language -- a system of vocal sounds and combinations of sounds to which we attach meaning. The brain does not handle language as one large, amorphous task, but rather, delegates certain areas to handle particular language tasks. It is usually when an injury to the brain occurs, such as Broca's aphasia or a stroke, that linguists and physicians have been able to pinpoint which part of language ability is affected.

Just as the language faculty is different from other human faculties, factors that impact on language may themselves be language specific, and particular to the language faculty itself.

In many respects, learning a first language is an unconscious act. Children simply use the faculties of speech and language they have at their disposal. To be successful, however, learning a first language must be triggered by input from external sources, e.g., we must first hear (or see) others speaking to, and around, us before we can emulate their behavior. All human children, barring physical and mental barriers, or deprivation and abuse, learn a first language.

Children (for the most part, before puberty) also successfully learn a second or third language if their exposure to these languages meets the same learning conditions as their first language. Most adults, however, fail to achieve native-like second language competency, even after expending tremendous effort to do so. Some linguists ascribe the fact that children learn a second language more successfully to possibly their having the luxury of much more time to practice than adults (Bialystok, 1994). Why children gain native-like competence more often than adults has yet to be fully explained.

There is no doubt that motivation plays a significant role in successful adult second language acquisition. Next to aptitude, it is widely considered the most important affective factor influencing second language acquisition; it is "consistently the most successful predictor of language learning success" (Skehan, 1989, p. 26). Just as aptitude to learn a second language correlates specifically to language, I suggest that the motivation that drives adults to successfully learn a second language is also language specific and arguably distinct from motivation that affects other human performance skills.

Canadian researcher Robert C. Gardner, a pioneer in his field, has conducted numerous experiments on the role of second language motivation. For more than 35 years, Gardner has made the scientific measurement of motivation (as well as other affective variables, such as attitude and anxiety) his prime concern and has written prolifically on the topic. The findings of Gardner and Wallace Lambert (in Gardner's early research) still serve as the basis for ongoing studies. It is the motivation research of Gardner that I will principally comment on, and to a lesser degree, studies on motivation by other researchers.

In groundbreaking work with English-speakers learning French in Canada, Gardner and Lambert made several important claims: that motivation can be *integrative*, "where the aim in language study is to learn more about the language group, or to meet more and *different* people"; or *instrumental*, "where the reasons reflect the more utilitarian value of linguistic achievement" (Gardner and Lambert, 1959, p. 267). They further state that the "integratively oriented students are generally more successful in acquiring French than those who are instrumentally oriented." (Gardner and Lambert, 1959, p. 271). Writing later, they state that "The language student must be willing to adopt appropriate features of behavior which characterize members of another linguistic community" (Gardner and Lambert, 1972, p.14).

While the instrumentally motivated learner's commitment can wane if the utilitarian aspect of learning a second language disappears -- such as temporary need, financial reward, or political expediency -- the integratively oriented learner is seen to be much more strongly committed to the learning process. Because this kind of learner is less influenced by outside expedient forces that could derail progress in learning a second language, I will concentrate mainly on the motivation that affects the integratively motivated learner.

Interestingly, Gardner and Lambert were not the first to hypothesize that first language learning is motivated by a desire to identify with a member of the new language group. Mowrer theorized that a first language is learned because a child wants to be like a valued member of the family, and later the whole language community (Mowrer, 1950). Gardner and Lambert's early work models second language motivation on Mowrer's theory, stating that "achievement in a second language is dependent upon essentially the same type of motivation that is apparently necessary for the child to learn his first language" (Gardner and Lambert, 1959, p. 267).

Identifying with this new culture involves the adoption of another mindset. In other words, "The successful learner of a second language must be psychologically prepared to adopt various aspects of behavior which characterize members of another linguistic-cultural group" (Gardner and Lambert, 1972, p. 3). Not only is the lexicon of the new language completely different, but expressions and idioms have to be recast in a new way. Concepts that the learner knows in his first language may not apply to the new language. To my knowledge, no other human pursuit demands that the learner assume such a complete psychological (and phonological) transformation in order to achieve success. I have even had bilingual friends say to me that they feel that their personality changes when they switch from one language to another, so complete is the psychological transformation!

It is obvious from observing those who speak a second language that these speakers have *re-learned* a skill that they already possessed. In order to achieve mastery comparable to the first language, they have had to construct a parallel system of thinking and speaking. By adopting a multitude of characteristics of the new language group, these speakers eventually reconstructed, or duplicated, the ability they possessed in the first language. To use railroad imagery, the first and second languages are two rails that run parallel to each other on which the speaker rides, with the transformational concepts from first to second language serving as ties that connect the two rails. The parallelism aspect of the two languages seems to support Gardner and Lambert's position that second language acquisition is dependent on, or at least seems to copy, the motivation found in first language acquisition.

In contrast to learning a second language, all other skill acquisition is first-time acquisition; the learner is laying down a one-rail track that does not duplicate an existing one.

It is not a far stretch to assume, then, that motivation to succeed at such a unique human activity as re-learning a basic tool -- language -- must itself be unique from other skill demanding a considerable investment of time and effort.

We can safely say that learning a second language is an accomplishment of the highest order. Since it is also apparent that all accomplishments are not equal in their purpose nor in the amount of effort required for success, it would be helpful for our discussion to divide accomplishments into two categories: *achievements* and *performance skills*. *Achievements* are based on practical, external considerations, such as losing weight, building a house, or launching a business while *performance skills* are based on personal excellence in execution, such as athletics, dance, drama, music and the mastery of a second language.

Mastery of a sport demands tremendous physical discipline. The body is trained to perform physically challenging acts that push it to the edge of what is humanly possible. Motivation to reach that point is fueled by competition, since the desire to be the best strongly drives its performance. Although it brings satisfaction to the performer, excelling at a sport is generally not a solitary pursuit that is done just for the athlete's sole pleasure. There has to be some outside measure against which the athlete can compete. By the same token, dance can be as physically demanding as athletics. Motivation to pursue excellence in dance combines intense interpretative feelings with the desire to be the best interpreter of those feelings. Playing an instrument well shares the same kind of competitive motivation to interpret feelings inherent in dance.

In two other performance skills, singing and drama, language plays an indispensable role. Manipulating one's voice to produce beautiful sound through music and words that convey human experience commands the greatest respect and admiration from others. Here again, motivation to express one's innermost feelings through language and music is an important factor in the skill.

Upon careful consideration, it would seem that all performance skills have one thing in common: they are accomplishments for which a public gauge of success is necessary in order to deem them successful. After all, performers *perform* -- not in isolation -- but before an audience. Dancers, singers, and second language speakers are deemed proficient not because *they* consider themselves so, but because others recognize that they have reached certain standards of proficiency. Motivation to succeed in these performance skills, therefore, is significantly bound with the desire to excel before an audience.

It is axiomatic that performers seek public approval of their uniqueness; they seek to stand out from the ordinary; to be distinguishable from the crowd. In this respect, however, motivation to succeed in a second language is uniquely different from that of other performance skills.

As we have seen from Mowrer and Gardner and Lambert, second language motivation derives from a desire to identify completely with a new language community; to be integrated so fully that one becomes indiscernible from the native speaker population. A second language learner strives *not* to stand out, *not* to be different, since that would indicate less than successful acquisition. Motivation for success in a second language seems, therefore, to stem from an entirely different base than involved in the acquisition of other performance skills.

There also is a conspicuous lack of competition motivating second language learning compared to the competitive drive in other performance skills. Whereas dancers and musicians compete for recognition against others in their field, who does a second language speaker compete against except herself? She does not try to outdo native speakers because she knows she will never equal them; the most she can hope for is "near native" skill.

When we further analyze performance skills, another aspect marks second language acquisition as different from other performance skills. All performance skills, except execution of a second language, are specific acts realized within a specific time frame. Singers don't sing all the time, nor do athletes engage in sports all the time. There are times when performers are "on call" and times when they are not. But with a second language, the speaker is always "on call" because, put in a situation where the second language (French) is being used, they must always speak French, or risk not being understood. There is no such thing as down-time (except when no language is being spoken). Therefore, motivation to learn a skill where one must be *always* ready to respond with the skill is different from motivation where one can choose not to perform.

When we consider also that to perform is to make a conscious effort, that it requires total concentration in order to execute the skill, we can see how second language acquisition again is unique in that it does not require manifest concentration on the act of speaking to speak well. In fact, learning a second language to near-native status means submerging the language into the subconscious so that the speaker really does not have to think analytically about what she wants to say. She says it "naturally" -- as easily as she would say it in her first language. In contrast to an athlete or singer, a person speaking a second language is not conscious that she is speaking a second language. She is just "talking".

It is regrettably true, that as the body ages, performance skills suffer. This happens even when the opportunities to perform are still present. After a period of excellence, the ability to perform deteriorates so that eventually one has to abandon the project altogether. This often occurs well before old age and/or senility sets in. For athletes and dancers, it can happen in the late forties, for singers when their voices are no longer strong, and for musicians when their technical skills diminish.

Such decline is not the case, however, with a second language. Barring medical problems or senility, age is not a factor in second language use and continuity. Once learned, and given opportunities to use it, a second language is a lifetime acquisition. So too, motivation that drives learning a skill whose performance can last a lifetime differentiates it from motives driving acquisition of skills that decline with increasing age.

As important as Gardner is in motivation research, other researchers have proposed differing interpretations of motivation. In all probability, more research will reveal more orientations than integrative and instrumental motivations for studying a second language (Gardner and MacIntyre, 1993). Clement and Kruidenier (1983) already proposed that, in addition to integrative and instrumental factors, the nature of the language community and the language itself are significant motivating factors for studying a second language.

One theory to gain recognition in the linguistic community holds that instead of integrative and instrumental orientations, motivation can be described as *intrinsic* or *extrinsic*. *Intrinsic* motivation results in a feeling of competence and self-determination whereas *extrinsic* motivation relies on rewards (Deci, 1975). Since an intrinsically motivated learner resembles an integratively motivated one, I will concentrate on that kind of learner. I suggest that intrinsically oriented motivation also is particular to language and differs from other kinds of motivation in the performance skill area.

With intrinsic motivation, the sense is that the learner is on an adventure by herself, with the landmarks of self-realized success marking the way. The act of discovery is in itself a reward and propels the learner on to further competence and mastery.

Compared to integrating herself totally into a new linguistic community, the learner is seen as on a self-guided mission. She is encouraged to continue her second language skill by self-gratifying accomplishments along the way. Unlike Gardner and Lambert's explanation that motivation is integratively driven by a desire to identify and integrate into the new language community, the *intrinsic* view positions the learner as a self-contained learning unit that functions well within the community but never identifies completely with it. The learner is like one ball in a room full of similar balls -- inconspicuous from the rest, yet always separate, independent and never fully integrated.

We mentioned that performance skills require some sort of public gauge to measure success. With the intrinsically motivated learner, however, there does not seem to be a need for outside approval; all the gratification and measurers of success come from the learner herself, making second language motivation in this area distinct from other performance skills.

To conclude then, second language motivation (when *integratively* oriented) contrasts with motivation of other performance skills in that it derives from the desire to

- psychologically adopt the characteristics of another group
- duplicate an existing skill
- be indistinguishable and indiscernible
- down play competition
- be always "on call"
- learn a skill of lifetime use
- perform an "unconscious act"

• and when *intrinsically* oriented, not to be dependent on an outside gauge of success

There is no doubt that analyzing differences in motivation between second language acquisition and other performance skills can have far-reaching implication for second language acquisition studies and pedagogy. Further studies on motivation can be a crucial factor in developing effective curricula in the classroom where highly motivated students can increase their skills and motivate others (Rubin, 1975).

Measuring motivation, however, has been notoriously difficult, with Gardner himself noting that considerable attention is still needed to verify the validity of measurement strategy (Gardner, LaLonde, Moorcroft, 1984). Although Gardner is preeminent in the field of second language motivation studies, his measurement strategies have come under considerable scrutiny by Oller (1981).

Given this controversy, the introduction of new data regarding second language motivation based on how it differs from other performance skills would be extremely helpful to future researchers. I suggest that the ideas presented in this paper might provide worthwhile insight into that process.

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Two Models for Understanding Differential Substitution in Interlanguage

By Sarah Noll Roman

The voiced and voiceless dental fricatives /ð/ and /θ/ are among the most marked structures in the English phonemic inventory. These segments, which are not even found in the majority of the world's languages, are highly problematic for an adult learner of English as a second language. The learner, faced with a dental fricative in the L2, must select a sound that is closely related (in fact, which is minimally phonetically distinct) from the native language phonology to serve as a substitute for the difficult and unfamiliar target segment. Depending on the speaker's native language, the selection differs; this phenomenon is known as "differential substitution." For example, a speaker of Russian, Hindi, Serbo-Croatian, or Vietnamese will systematically substitute /d/ for /ð/, as in "this" and /t/ for /θ/ as in "thank you," while French, Egyptian Arabic or Japanese speakers replace /ð/ with /z/ and /θ/ with /s/. Other languages appear to use different variants depending on where the segment occurs, for instance Dutch and Korean learners use the stop substitutes /d/ and /t/ word-initially, but the sibilant /z/ and /s/ in word-medial or word-final position.

Current research on differential substitution suggests that any given interlanguage production can be explained as a result of "non-obvious transfer" from the speaker's L1 segmental inventory, and that the source of variation stems from underlying differences in native language structures. This paper will discuss two models proposed to explain differential substitution, one called the Feature Competition Model presented by Hancin-Bhatt (1994) and another, based upon a theory of Feature Pruning, in Weinberger (in press). In parts I and II, I will begin by outlining the two proposals, and Part III will address the significant ways in which their approaches differ. Part IV will suggest further implications of differential substitution for other aspects of phonological theory.

Part I: The Feature Competition Model

The Feature Competition Model, or FCM, proposes that phonological features "compete" to be noticed in the learner's input, and that those features that are most prominent or salient in the L1 inventory will be perceived and retained in the interlanguage while the less prominent features become the "variable" features that are not correctly mapped onto the target structure.

The FCM assumes that all features are not created equal, and that this inequality not only biases but eventually constrains perception of L2 input. Unlike previous analyses, the FCM claims that features do not have discrete values, but rather, are more or less prominent in the phonological inventory. Rather than be either "absent" or "present" in a matrix of radical under-specification, features are assumed to be potentially present in the "dynamic system" of the underlying representation. A feature's apparent absence is actually a lack of prominence. In fact, this distinction between the binary approach of underspecification and the "dynamic approach" of the FCM seems to be largely theoretical; as we will see, it has no real bearing on the determination of feature prominence.

In order to calculate a feature's prominence in a language's inventory, Hancin-Bhatt makes a number of theoretical assumptions based on previous research. The underlying representation (UR) of a pattern of features is minimally specified in order to achieve economy of representation. In other words, redundant or predictable specifications are simply filled in by default rules; only the distinctive features are contained in the UR. Radical underspecification takes this process one step further by completely underspecifying one segment.

The FCM's derivation of values for feature prominence draws on previous analyses of segmental transfer in which radical underspecification serves to determine feature inequality. After redundant specifications are eliminated, the most "unmarked" or predictable value of a feature is also eliminated from the UR. Markedness is determined on the basis of each language's inventory; obviously, this will result in different underspecified URs for different languages.

Having established a language's underlying representation by radical underspecification of the phonemic inventory, feature prominence can be calculated by applying a formula that compares the number of phonemic distinctions a feature makes to the total number of phonemes in the inventory. The number of phonemes a feature distinguishes is known as the feature's "functional load." The ratio of distinctions to total phonemes yields a ranking of features on a sort of "prominence continuum" --those features that make the most phonemic distinctions are ranked "most prominent" and those with the fewest number of distinctions are "least prominent." The FCM proposes that features of high prominence will be perceived and retained in a learner's interlanguage, whereas the specification of low prominence features will be variable when the learner maps the L1 inventory onto the target phonology. Thus, if a feature such as [cont] is of high prominence in the L1, we would expect the [+cont] value of the problematic dental fricative to be noticed and retained such that the substitution would match in continuance. In this case, the segmental substitute would be the sibilant /s/ or /z/.

In order to test the FCM, Hancin-Bhatt analyzes the perception of certain English phonemes by speakers of German, Japanese and Turkish. Using underspecified obstruent inventories for the three languages, the features are ranked for feature prominence according to their functional load. Predictions are made that German, Japanese and Turkish speakers will all perceive the [cont] feature of the interdentals because [cont] carries a fairly heavy functional load in the native language phonemic inventory. Perception of [cont] during feature competition will lead them to misperceive the dental fricatives as the coronal sibilants /s/ and /z/. It is predicted that Japanese and Turkish speakers will demonstrate more variable results as the prominence of [cont] is not as great as it is in the German inventory; for these two languages, [cont] is competing closely with other features.

The prediction made by the FCM, that speakers of German, Japanese and Turkish would misperceive English interdentals as coronal sibilants rather than stops, was clearly not borne out by the data. In fact, only the Germans performed as expected, although even this data is questionably significant in that the German speakers had very few misperceptions at all compared to the other ESL subjects. The

Japanese speakers seemed to misperceive the interdentals as sibilants more often than as stops, but there was considerable variation. The Turkish speakers made few of the expected misperceptions of interdentals as sibilants, but had a significant number of misperceptions of interdentals as stops, undermining the FCM's predictions. Why did the FCM fail to correctly predict the results of the test?

A primary weakness in the FCM is anticipated in a discussion of the notion of "functional load" in a footnote early in the article (Hancin-Bhatt, p. 246). The number of phonemes in a language's inventory distinguished by a certain feature determines that feature's functional load, regardless of the actual number of times the distinction occurs in the lexicon. Hancin-Bhatt concludes that while the phonemic inventory suggests a particular hierarchy of features, the hierarchy may also be affected by other variables, such as the number of lexical distinctions a feature makes in the language. A possible refinement is suggested which would add a frequency-based variable to the FCM.

In fact, this refinement, while not irrelevant, does not recognize the more serious problem with the FCM's method of ranking feature prominences based upon phonemic inventories. If features are battling for attention as the FCM supposes, with the triumphant (most prominent) feature guiding the selection of the segment used in transfer, it would be desirable to have a stronger method of determining prominence. Looking at the hypothesized prominence hierarchies for any of the languages discussed, it is hard to believe that the distinction between a feature with a 6/14 ratio and one with a 5/14 ratio is really meaningful or accurate. Because the competition is so close, the prominence hierarchies are extremely prone to disruption by other factors, including those suggested by Hancin-Bhatt: Language-specific phonetic rules, phonotactics, or lexical pattern frequencies.

Part II: Minimal Segments and Feature Pruning

An alternative solution to the question of differential substitution is offered by Weinberger (in press).

It should be stated that although these two articles share much in common -- both deal specifically with differential substitution of stops and sibilants for English interdentals in interlanguage--their goals are actually quite different. Whereas the Feature Competition Model attempted to predict the segment substituted in transfer, Weinberger's theory of Feature Pruning proposes using L2 data as a diagnostic to construct maximally underspecified matrices for the L1 phonology. In other words, Hancin-Bhatt established the feature hierarchy to predict the L2 output, while Weinberger takes the L2 output as language external evidence by which the feature hierarchy might be predicted.

Like the FCM, the model of Feature Pruning rests upon phonological underspecification theory, which claims that (radical) underspecification is valued in the grammar, accounts for rule markedness and contributes to formal simplicity or economy. Underspecification theory proposes that the UR specifies only the idiosyncratic features of a phonological system, leaving the predictable features to be derived by redundancy rules, consequently, different languages have different underlying matrices.

How can we formulate the optimal underspecified matrix for a given language? Weinberger suggests the needed evidence might be garnered by an analysis of differential substitution in L2 data . Setting the stage for the discussion of differential substitution is a presentation of a similar phenomenon that occurs with vowels in interlanguage. Vowel epenthesis--the insertion of an empty V slot as a strategy for syllable simplification--is a well known characteristic of certain interlanguages. Following underspecification of the particular L1 vowel matrix, the features of the epenthetic vowel are supplied by a redundancy rule. We can form a hypothesis about a language's optimal underspecified matrix base if we know which vowel is chosen for epenthesis in the interlanguage. In fact, such hypotheses have been confirmed by corpus-internal evidence that the underspecified "default" vowel has special characteristics and functions.

Although there are certainly similarities between an analysis of L2 vowel epenthesis and differential substitution, Weinberger notes that the two processes differ significantly because epenthesis involves the insertion of an empty V slot, whereas differential substitution works on a segment that is already there in the target language. The C slot remains, along with certain features (as we will soon see) to ensure that the problematic segment is replaced, as opposed to deleted altogether, and replaced specifically with a C segment.

Determination of an underspecified matrix for vowels using evidence from second language data suggests that a similar process might be applied to understand the variation found in the differential substitution of consonants. Again, the difficult interdental segment is addressed (this analysis uses the voiceless interdental rather than both, which behave identically differing only in issues of voicing). Russian and Japanese are examined because their inventories both contain an alveolor continuant /s/ and an unaspirated dental stop /t/. Because the articulation of these segments is very similar in both languages, explanation of the variation must be language-specific.

Assuming that the segment chosen for substitution of the interdental is the most underspecified coronal obstruent, underspecified matrices and redundancy rules can be posited for the L1. In segmental transfer, L2 learners retain many features of the problematic target segment; specifically, sonority, nasality, and value for [voice]. Other features, such as [cont], [stri] and [ant] may be variables in the selection of a minimally distinct substitute.

The fact that certain features always remain intact, while others are variable, coincides with the FCM's assertion that some features are more prominent than others in a language's phonemic inventory. We might conclude that the tenacious retention of [nas] and [voi] features in transfer from many different L1s supports a claim that these features are always highly prominent. A feature such as [cont] may or may not be prominent. In fact, it is generally accepted that features are valued differently, and in fact are organized into hierarchical structures with certain groups of features clustering together.

The tree-like structure of feature organization, after it undergoes Feature Pruning, yields a language's minimally specified representation. Weinberger adopts a feature hierarchy from Paradis and Prunet, and proposes that Feature Pruning lops off everything below the Place Node, which contains the variable feature [cont] and the cluster of features that fall under [coronal]. Information missing in the Place Node is filled in by redundancy rules formulated on the basis of the underspecified matrix. The redundancy rules for Japanese supply [+cont], and redundancy rules for Russian supply [-cont]. Consequently, since Feature Pruning implies an economy of learning, the learner need not regard any tier below the Supralaryngeal node, as these features will be automatically filled in by their L1 redundancy rules.

Part III: Comparing the FCM and Feature Pruning

The Feature Competition Model is based upon a precariously balanced hierarchy that can be toppled by any number of language-specific rules, all of which must be factored into the equation in order for the model to work. Predictions of segmental transfer require us to know:

1) the complete phonemic inventory of a language
2) the language's phonetic rules

In the "refined" FCM we would also need to know:

3) the number of distinctions each feature makes in the lexicon

This model demands that we know a language inside and out before we are able to predict which segment a speaker of this language will choose as a substitute for the L2 interdental.

Weinberger proposes a more user-friendly model, arguing that in all cases differential substitution can be attributed to one simple process: the elimination of the place node by Feature Pruning. Significantly, Weinberger does *not* propose a way to predict which features will fill the missing place node in a given interlanguage--this is the goal attempted by Hancin-Bhatt--but Weinberger's model works using the L2 data as the starting point for the construction of the L1 feature matrix. The two models cannot be compared on one level; they are not trying to accomplish the same goal. However, Weinberger's approach is economical and usable as a model for understanding a phonological process; the FCM is not. All that is required to operate the Feature Pruning Model is a minimal amount of data from L2 production. The FCM demands a tremendous amount of language-specific information to be pre-programmed into its machinery, such that it is rendered virtually unusable.

Part IV: Further Implications of Differential Substitution

One question not addressed by Weinberger's article and inadequately explained by Hancin-Bhatt is the question of systematic variation within an individual speaker's interlanguage. Hancin-Bhatt notes that Dutch speakers of ESL substitute the interdental fricative with the stop variant syllable-initially and the sibilant in syllable-final position. Her own data from the Japanese, German, and Turkish speakers suggests related evidence that stop substitutions occur far more frequently in word-initial positions than word-medially or word-finally. This is explained by the influence of 'phonological context,' and Hancin-Bhatt concludes that "The feature [continuant] is more salient in word-final position than in word-initial position, perhaps the result of suprasegmental or phonetic constraints on perception or production" (p. 262).

In fact, the systematic preference for stop substitution in word or syllable-initial position can be understood in light of Clement's theory of the Obligatory Contour Principle (OCP). Based on the idea of sonority sequencing, the OCP proposes that the syllabic onset should provide a steep rise in sonority while the coda should exhibit a minimal or gradual fall. Because the stop is the least sonorous element on the scale, a syllable-initial stop-vowel sequence is the optimal onset. The fact that ESL speakers choose a stop substitution syllable-initially and a sibilant substitution elsewhere provides support for a revision of Clement's sonority sequence that would distinguish between stop and fricative sonority values. Furthermore, this evidence would indicate language-specific differences in the strength of the OCP. In some interlanguages, the OCP guides segmental transfer to the extent that the [cont] feature is variable depending on whether it allows the optimal rise or fall of sonority. In other interlanguages, the appropriate value for [cont] is mapped onto the L2 regardless of where it occurs in the word or syllable, and it does not vary in order to conform to the OCP.

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The Maximally Unspecified Vowel In Farsi

By Penelope Roberts

A significant body of L2 acquisition research has centered on repair strategies L2 learners use to deal with syllable structures in the TL that are not present in their NL. One of these strategies is the use of epenthetic vowels to break up illegal consonant clusters. In this paper, I will attempt to demonstrate that for speakers of Farsi, the choice of the epenthetic vowel is not random but is, in fact, predictable from the NL. Specifically, I will show that these speakers insert an empty V slot, the features of which are filled in by NL redundancy rules.

The following analysis makes use of the theoretical approach to underspecification provided by Archangeli (1988) and Pulleyblank (1988) by which only idiosyncratic features are specified and predictable information is provided by rule. It is within this framework that asymmetrical behavior can be fruitfully examined to provide insight into the grammar. For the purpose of developing a tentative hypothesis based on L2 data, I will adopt the position taken by Broselow (1987), Weinberger (in press) and others that L2 acquisition information can also open a window onto the grammar of the NL.

L2 Data[1]

Karimi (1987) provides the following vowel insertion data from her study of English initial consonant clusters produced by Farsi speakers:

1a)	proved	p[u]roved
	progressive	p[o]rogressive
	drink	d[i]rink
	Fred	F[e]red
	three	th[i]ree
1b)	proud	p[e]roud
	plastic	p[e]lastic
	statistic	[e]statistic
1c)	street	[e]st[i]reet
	spring	[e]sp[i]ring

From these data, one can assert that Farsi speakers break up illegal initial consonant clusters by the insertion of a vowel between the two consonants. If the cluster consists of [s] plus a stop, the cluster is broken up by the insertion of a vowel to the left of the [s].

The data yield additional information relevant to this discussion. In the examples in 1a and the second inserted V slot in 1c, there is evidence of vowel harmony. One hypothesis to be derived from this is that Farsi has a productive rule of vowel assimilation which has been transferred from the NL to supply the epenthetic vowel. An alternative assumption is that these speakers have developed an interlanguague rule of vowel harmony independent of any native language rules. Having postulated that there is vowel harmony at work, a further implication can be made that this assimilation process is blocked in some way by the st/sp clusters. As a result of this blockage, Farsi redundancy rules are free to fill in the empty V slot.

From this we can hypothesize that [e] is the default vowel in Farsi.[2] To explore this hypothesis further, an examination of the NL is necessary.

NL Data

The approach to underspecification suggested by Archangeli provides one means of explaining why a segment behaves asymmetrically in one language but not in another.[3] Following along these lines, Pulleyblank utilizes a number of asymmetry arguments to demonstrate that /i/ is the completely unspecified vowel in Yoruba. Farsi has six vowels: [a], [æ], [e], [i], [o], [u] (Lazard, 1992).[4] Of these, [e] is typically the vowel that participates in asymmetrical behavior as the following data will show.

Deletion:

Lazard provides evidence that in colloquial Farsi[5] [e] is deleted in the second of two open syllables in a word of three or more syllables:

2a)	minevisam ---> minvisam	I write
	benevis ---> benvis	write (imp)
	motesakker-am ---> motsakker-am	I thank you
	midaham ---> midaham	I give
	manzel + eman ---> manzel-mun	our residence
	pesar + esân ---> pesar-sun	our son

The same rule is evident in loan words such as:

2b) telefun ---> telfun

Insertion:

In addition to deletion, insertion phenomena provide additional evidence of the asymmetrical behavior of segments. Karimi states that Farsi has no rule of epenthesis. Conversely, Lazard provides evidence that Farsi speakers insert a vowel [e] between two consonants when they are preceded by a long vowel (â, i, u):

3a)	âftâb --->	âfetâb	sun
	kârgar --->	kâregar	laborer
	ruzgâr --->	ruzegâr	eternal
	afkandan --->	afkandan	to throw

3b) This rule can be stated as: ø ---> V / VVC_C

	-low
	-hi
	-bk

Loan Phonology

Loan phonology is also a fruitful source of data for identifying default vowels (Pulleyblank, Weinberger). It has already been stated that Farsi does not permit initial consonant clusters. Both Kirimi and Lazard show that [e] is the vowel used to repair unacceptable consonant clusters in loan words:

4)

(Karimi)		(Lazard)	
kelâs	class	pelâtin	platinum
estatistic	statistic	Ferânse/Farânse	France
eski	ski	beronz/boronz	bronze
		eskelet	skeleton
		esport	sport

It should be noted here that Lazard makes a specific note (p 24ff) of the fact that the inserted [e] may change under the influence of the following vowel as in Farânse and boronz. It will be recalled that a similar process is visible in the vowel epenthesis strategies of our Farsi speakers.

The preceding examples have demonstrated the [e] exhibits asymmetrical behavior in deletion and insertion phenomena and in loan phonology. Having adopted the position that such behavior is a diagnostic for lack of underlying features, it is now possible to conclude the [e] is the underlying unspecified vowel in Farsi. From this, the following underspecified matrix can be constructed:

5) Underspecified Matrix for [e] in Farsi

	a	æ	e	i	o	u	Redundancy rules:
high				+		+	[ ] -> [-hi]
low	+	+					[ ] -> [-lo]
back	+				+	+	[ ] -> [-bk]

The rule in 3b) can now be restated more simply as:

6) ø ---> V / VVC_C

Vowel Assimilation

Examples of vowel harmony were exhibited in both the L2 data and in loan phonology. A further search of Farsi shows that the short vowels [æ], [e], and [o] are regularly subject to assimilation to the following vowel when they are in an open syllable position. Some examples follow:

7a)	[jelow][6]	[jolow]	before
	[devist]	[divist]	two hundred
	[forus]	[furus]	sale

The rule can be formualted as in 7b):

7b) cvcv...

o o root node

It should be noted that with benevis --> benvis (2a above), vowel deletion is ordered before vowel harmony.

These data provide convincing evidence that the vowel harmony processes exhibited by L2 learners are, indeed, an example of direct transfer from Farsi. The conclusion that these speakers have inserted an empty V slot to break up the offending clusters is also supported by this information.

CONCLUSION

At the beginning of this paper, I proposed that the strategy used by Farsi speakers to address initial consonant clusters in English is the insertion of an empty V slot, the features of which are filled in by a rule. An examination of the vowels used by these speakers led to the hypothesis that [e] is the default vowel in Farsi. Examples o f asymmetry were then found in deletion, insertion, and loan phenomena in the NL to support this hypothesis. The L2 data also clearly showed evidence of the transfer of a productive rule of vowel assimilation in Farsi. The question of whether or not the behavior of [s] + stop clusters resisting intercluster insertion and blocking vowel assimilation are also examples of language specific transfer, though tantalizing, is outside the scope of this paper and awaits further research.[7]

Finally, this paper utilized L2 data to develop a hypothesis about the NL. Confirmation of this hypothesis further supports the conclusions of Broselow, Weinberger, and others that L2 data, in and of itself, provide a useful diagnostic for uncovering NL information.

Notes

1. The data were provided by four speakers, all of whom had three to six years of English before coming to the United States, and all had lived more than seven years here. The data were taken from reading and discussing a passage from a textbook and a word list.
2. It is unclear from these data whether insertion of [e] in plastic and proud is also the result of a block to assimilation, or an assimilation rule specific to low vowels. In either case, it would support the present hypothesis.
3. See Weinberger (in press) for a useful comparison of the behavior of epenthetic vowels in Spanish and Kannada. See also Archangeli for a concise discussion of the Asymmetry Effect and Radical Underspecification.
4. [a] = â and [œ] = a in Lazard's transcription.
5. The term *colloquial* is used here to distinguish spoken Farsi from the literary

language, hereafter referred to as *classical* Farsi.
6. Lazard uses classical Farsi forms against which to compare colloquial Farsi.
7. Karimi offers several possible explanations for the erratic behavior of the [s]C clusters. Although no evidence of NL transfer was found, Karimi suggests that further research is necessary. Evidence in the NL that these clusters are treated as linked in some way might be worth exploring.

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On Modularity

By Alexander Starz

1. Introduction

The study of language deficiencies has ignited a discussion about the modularity of language. The systematic defaults in language production and acquisition have lead to the idea that different faculties of language operate independently from each other--at least to a certain degree. Crocker (1991) distinguishes four such language modules that operate parallel to each other and take care of either phrase structure, chains (movement, case), thematic structure, or coindexation (binding, control). Other studies involve neurobiological research and speak against at least the innateness of modularity (Karpf 1991), if not against the whole idea (Benke and Wagner, 1990), as incompatible with findings in this field.

With this project I will develop a theory for the biology of modularity. For this I will treat modules of the mind as distinguishable sets of knowledge. They are not part of the 'hardware', the brain, but part of the 'software', the data. Data in the brain have a chemical realization in the form of protein. These macromolecules have different geometries and therefore distinguishable features. My claim is that these geometric features are the modules of language.

2. Mind and Memory: Neurons and Beyond

So far, data in the brain were thought to consist of electrical impulses in neurons. An electrical impulse can be there or not, but it can not be marked as belonging to a certain module or class of data. It is binary. Therefore the idea that modularity could be a part of the data rather than something organic never occurred to any neurolinguist. But impulses in neurons are only a small part of the mental processes that in sum create the mind. Other parts are the chemical processes in mid- and long-term memory.

Two experiments from the sixties show what happens beyond neuronal activities in the brain: In one experiment (Babich et al.[1]), rats were trained to find their way through a labyrinth. After they had acquired the task the animals were killed. A substrate from the brains of the trained rats was transferred into brains of untrained rats. Exposed to the labyrinth, they found their way through it right away.

The impact of this experiment is that there is something in the brain that keeps its information value even after death and that can be transferred from one individual to another. This goes far beyond the capability of electrical impulses. But then, what is it?

When the other experiment I am going to describe was directed, the suspicion was that protein might play a role. So in this experiment (Flexner et al.[2]), the animals involved were medicated during acquisition phases. The medication blocked protein synthesis. The animals never acquired their task.

Further variation and comparison of the two experiments showed that the rats from the first experiment had a long-term knowledge about their way through the labyrinth. They were able to perform their task even days after their last run. The animals in the second experiment could acquire knowledge about their task so that they were able to perform the same task several times in a row. But after a time lapse of a certain

[1] see Shepherd for exact reference
[2] see Shepherd for exact reference

length they could not perform anymore. They only had acquired midterm memory that was lost in a day.

It follows that there must be a step between neuronal patterns and the synthesis of protein. Although we do not know all the details at the moment, a good guess for the mechanism of this intermediate level of data processing is RNA. RNA is necessary for protein synthesis, is proven to contain data, has chemical reaction times that make it fast enough to be counted to the processing unit, and is normally stable for several hours. All characteristics we would want our model of midterm memory to have.

In summary, what was said above shows that proteins play a crucial role in learning. Furthermore it very strongly suggests that RNA is the mechanism of midterm data processing. This enables us to postulate a very clear-cut model of short-, mid-, and long-term memory:

input -> short-term memory -> midterm memory -> long-term memory

3. Modules are in the Data

With this model of cognition in mind, I would now like to shift the discussion about modularity from "Where in the brain are the modules?" to "Where in the data are the modules?". The traditional claim for modularity of language states that language consists of independent and distinguishable, though interacting modules. A module in this sense is seen as a machine that fulfills a certain task, like an organ in the body, with a certain location. Though studies in aphasia and acquisition support the idea of modularity, neuroscience makes it clear that modules can not be located in certain regions of the brain. The model of cognition developed above now provides explanations independent from specific regions of the brain. Modules can be regarded as bits of information that are built in the geometrical form of the relevant protein. These modules make the data distinguishable and classifiable for language use. Every module that theory and further research finds necessary to claim is a special adjunct that defines that class of data: NP, V, Wh-word, S, etc.

4. Implications from Data based Modularity

The second part of this paper will deal with implications from this model of modularity and its impact on research in the fields of aphasia and acquisition. Furthermore the notion of 'strict modularity' needs some discussion in the new light of data based modules.

4.1. Aphasia

Certain forms of aphasia affect special language skills. In one patient grammatical skills are affected, while in another patient, lexical reference is inappropriate. How can the new model of cognition answer to that? How can data in the protein be unavailable?

Again, there is a biological answer that employs some basic mechanisms in protein synthesis and protein interaction. This field is far too complex to have even the hope to present final answers at this point. But some 'mishaps' in protein synthesis are known that can give us an idea what might go on. I will use one mechanism, the one of protein blockage, as an example. Protein is produced at all times in large quantities everywhere in the body. Accidents can and do happen. One kind of accident can be the production of an antigen to an existing molecule. This leads to the destruction of the molecule in question. Or a 'mirror' protein might be produced that has the exact opposite geometry to a certain molecule. These two bodies fit together like a key and its lock. When they combine, the result can be a bigger, but worthless protein that has lost all the properties of its components.

A stroke, as one of the most common causes for aphasia, would trigger many repair mechanisms in the brain. All these repair mechanisms include protein synthesis, since antibodies must be produced, structural elements must be replaced, etc. Here it can happen very easily that antibodies for a certain language module are produced that then block exactly these modules on the language information proteins. The data can not be retrieved, hence the language performance of the speaker is affected. However, it must be understood that this is not the answer to aphasia. It is just one of the multiple possibilities that the human body is capable of and that might play a role.

4.2. Acquisition

The model of cognition introduced above should be expected to be relatively independent of maturational processes. As such, it could be taken as support for the anti- critical period league in language acquisition. But this is not necessarily so. Though it can be taken for granted that the mechanisms described above start working from the first moment on and keep doing so throughout life, they cannot be seen in isolation. The brain undergoes maturational processes, and puberty is a hormonal (guess what: protein again) shock in which we don't know exactly what happens. So data processing might be affected in ways we do not know yet.

Two conclusions can be drawn from this model for acquisition. The first one is trivial and simply states "eat healthy, so that you provide the necessary nutrition for your body to produce protein". The second one is well known, too, but finally gets a biological foundation. Only constant repetition guarantees learning. I will add to this later on when I talk about 'Problems' of my theory and discuss LTP.

4.3. Strict Modularity

'Strict modularity' is the idea of absolutely independent modules of language. It is opposed to the notion of interacting modules. Data based modularity can not finish this dispute. It can be used for both.

One single protein may very well contain several module parts. So the information can be read by all these modules. Whether this makes the modules interact or not is unanswerable at the moment.

5. Problems to be Solved

Biology gives us some basic mechanics of the brain which I used as a tool to create a model of cognition that answers nicely some questions in linguistics. Other questions remain open: How do we retrieve certain information from storage? How much information is stored in one protein? Can proteins be transferred to other regions of the brain and be read and transformed into neuronal patterns there without losing information, or is the whole system bound to the neurons that got the input?

I will not try to answer these questions here, but two important problems shall be mentioned that definitely need to be answered by further research. The first one consists of the question of bidirectionality for protein synthesis. Although the way from the input over neuronal patterns and RNA to protein is taken care of in the research (except for what I will discuss below), the way back is not yet documented.

The other problem is the transfer of neuronal patterns into RNA. Obviously, not all input is transferred. How does it work, and which input is taken over? A concept called Long Term Potentiation (LTP) (Shepherd, p. 640) seems to form the filtering level: Neurons that are frequently stimulated achieve Long Term Potentiation, which is a higher synaptic response ability that persists over hours and days. The important point is the 'frequent' stimulation, which I addressed earlier.

6. Conclusion

Cognitive mechanisms other than neuronal activity have been neglected so far in linguistic research. The idea of a cognitive model like the one described in this paper is attractive for several reasons. First of all, it can be proven or disproven with the necessary research. It provides a much more reasonable and efficient machinery than the 'just neurons' approach. And it is based on processes that other sciences already deal with effectively. This could form a basis on which theories about language can be compared in a very direct way.

In the end, a vision: We will find the molecules of language. One day in the future, we will have big tanks of bacteria with DNA engineered in a way that they produce these molecules. Language in a jar, learning by injection.

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