

NAVAJO VERBAL PREFIXES IN
CURRENT MORPHOLOGICAL THEORY¹

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0. INTRODUCTION

During the last few years, there has been increasing interest in the principles of word formation and structure, which are thought to be "distinct and separate from the principles of sentence formation." (Allen 1978:2) The earlier of the proposals for the organization of the morphological component (eg. Allen (1978), Siegel (1974), Aronoff (1976)) dealt only with derivational morphology.² Inflectional morphology was presumed to fall within the domain of syntax, and therefore was not expected to adhere to the same principles or utilize the same machinery as derivational morphology.

Recently, several morphological theories have been proposed which provide a uniform set of machinery for accomplishing all inflectional and derivational morphological processes within the lexicon. These theories, in which words "emerge" from the lexicon fully formed, can yield interesting results for syntax, as illustrated in Farmer (1980).

The majority of these modals of word formation within a generative grammar have been based on English or other (rather closely related) Indo-European languages. In this paper, we intend to investigate the claims of some recent morphological theories using facts from Navajo, an Athabaskan language with a rich polysynthetic system of morphology. In particular, we will investigate the applicability of the theories of Lieber (1980) and Williams (1981) to Navajo's elaborate verbal prefix system.

In Section 1, we will outline the facts of Navajo verbal morphology which must be dealt with in a morphological theory. We will show that the Navajo verbal prefixes display a striking pattern of internal organization that has not been noticed before.

In Sections 2 and 3, we will outline the proposals of Lieber and Williams, respectively, discussing the applicability of each to Navajo.

In Section 4, we will describe the type of system which would be appropriate for the Navajo verb. In this regard we will address the question of hierarchical structure in Navajo verbal morphology.

In Section 5, we will address the general questions which our study of Navajo raises for general morphological theory:

- 1) How are the differences between derivational and inflectional morphology to be characterized? and
- 2) How does this characterization bear on the possible parameters of a typology of morphological structure?

1.0 PREVIOUS DESCRIPTIONS OF THE NAVAJO VERB

Before we can approach general theoretical questions with respect to Navajo, we need a working model of the Navajo verb's structure. As Kari (1973) pointed out, "The Navajo verb has acquired a reputation for being complex...the most formidable problem is posed by the verb prefixes, which appear before the stem in ten or so positions and which perform a dazzling array of derivational and paradigmatic functions." (1973:1)

The best existing descriptions of the Navajo verb (eg. Sapir and Hoijer (1967), Hale (1972), Kari (1973), Young and Morgan (1980)) are based on an approach that Sapir labeled the "slot and filler" approach, whereby the function of each prefix position is described and a list of all prefixes which can be found in that slot is provided. (See Young and Morgan (1980) for an exhaustive list of the prefix slots and the morphemes which may fill each slot). Figure (1) compares the above-mentioned linguists' analyses of the prefix positions. The differences among these three analyses are primarily terminological (i.e. whether to call certain positions "derivational", "thematic", "adverbial" or "aspectual") or a matter of further sub-division of certain positions.

Figure (1) can be said to outline the domain of the possible verb in Navajo. The order of slots given is rigid³ and these, and only these, prefixes combine with stems to form new words.⁴

No actual lexical items have prefixes from all of the slots. The "mode" prefixes, positions II and VII,⁵ are mutually exclusive, and a lexical item may have several or no prefixes from positions I and VI ("adverbial" and "thematic").

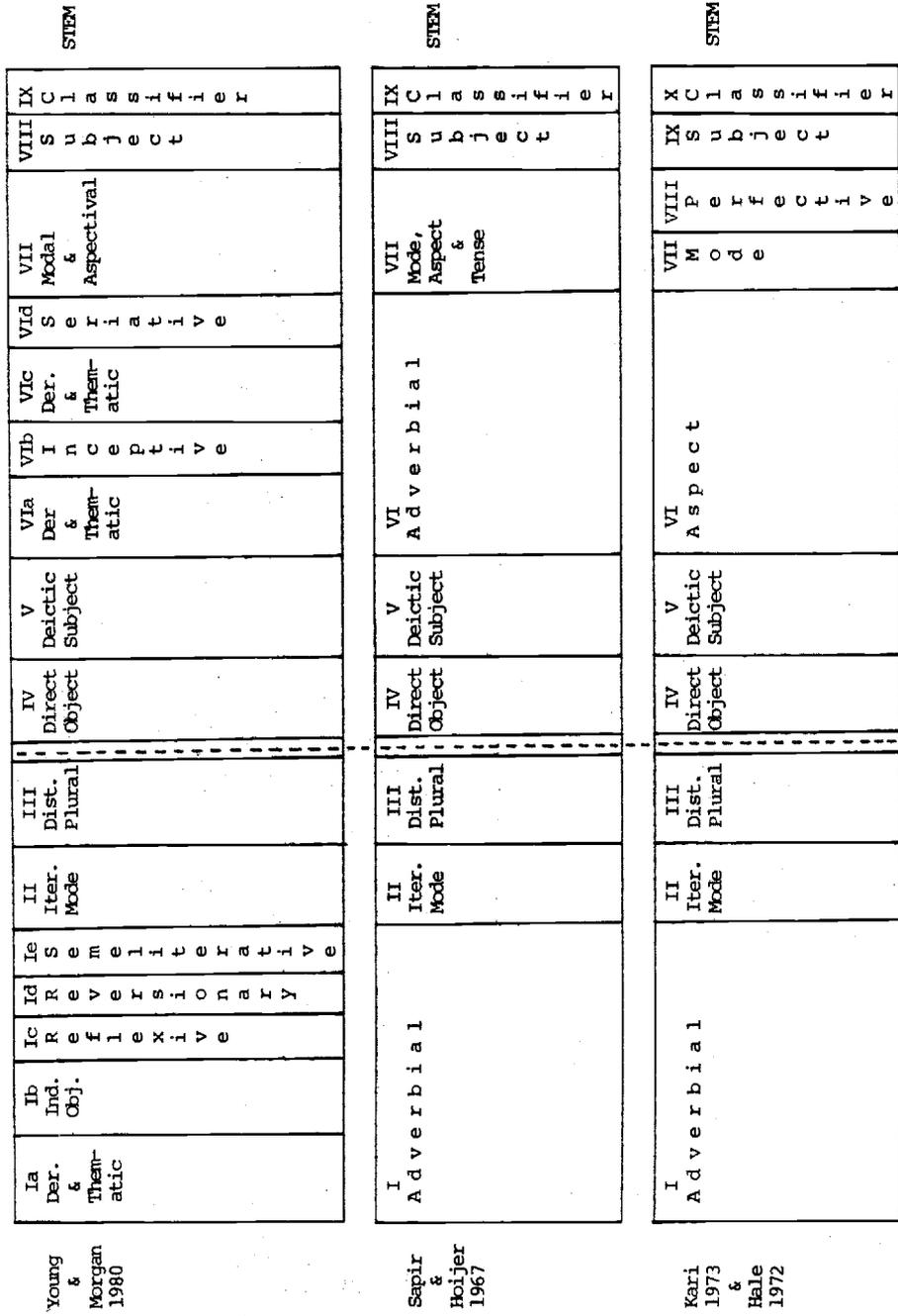
According to Young and Morgan, the minimal (intransitive) verb in Navajo must have at least one of each of the following:

- (1) a classifier (pos. IX) (may be \emptyset)
- (2) a subject prefix (pos. VIII or V) (may be \emptyset)
- (3) a mode prefix (pos. VII or II) (may be \emptyset)

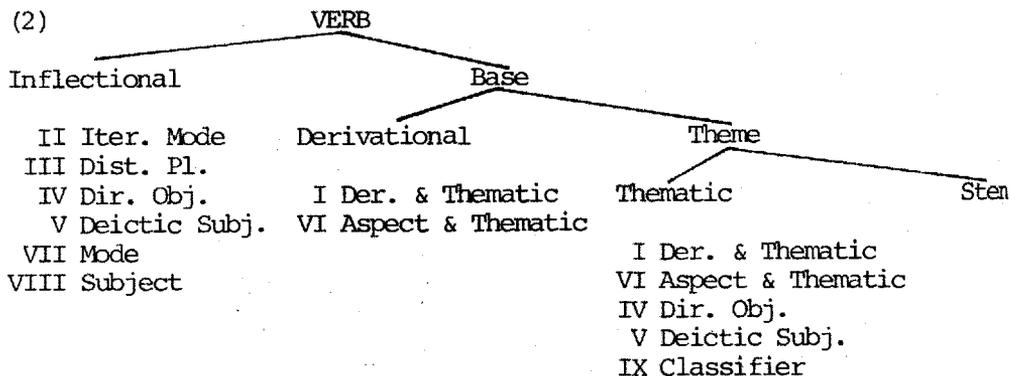
As most researchers have noticed, the positioning of these prefixes does not appear to be random. Kari (1973) has presented convincing phonological evidence for a boundary between positions IV (direct object) and III (distributive plural), thus separating the "conjunct" prefixes (those closer to the stem) from the "disjunct" prefixes (those farther from the stem).

Previous researchers have also noticed that the prefixes seem to fall into several different types: Therefore, they have categorized the prefixes as either inflectional, derivational or thematic.⁶ The inflectional prefixes are those which may be conjugated for person, number or mode. The derivational prefixes are those which add various adverbial or aspectual meanings productively to verb stems. The thematic prefixes are "derivational or paradigmatic elements bound to

FIGURE 1



certain stems with which they form a unit in the composition of a verb theme". (Young and Morgan 1980:101) In other words, the thematic prefixes are found in certain lexical items, but their precise meaning is not known. Thus, the verb is broken down into three levels, as shown in (2):



A verb stem combines with thematic prefixes to form the verb theme. This theme combines with derivational prefixes to form the base, to which the inflectional prefixes for person, number and mode are added. This breakdown can be illustrated as in (3):

- (3) náshizhdiiʔteeh
 'he picks me up'
- stem: -teeh
 'move an animate object'
- theme: -ʔ-teeh
 (thematic classifier+stem)
 'move an animate object'
- base: ná...di...ʔ-teeh
 (ná...di = compound prefix 'movement upward')
- pos pos
 I VI
 'to pick up an animate object'
- word: ná-shi-zh-di-(y)i-ʔ-teeh
 ná- ls.dir.obj.-4s.subj.-di-imperf.-ʔ-stem
- pos-pos - pos - pos-pos pos
 I IV V VI VII IX

In addition to the position/morpheme bipolarity emphasized by the slot and filler approach, there is another facet of the Navajo verb,

which Sapir called "interrupted synthesis". Whorf described this facet in a paper he wrote for Sapir in 1932:

This trait of split semantemes, of making the expression of an idea depend upon a binary compound that is readily interrupted by the expression of auxiliary ideas or by some of the interrupted parts of auxiliary expressions likewise binomially composed - "interrupted synthesis", to use Sapir's term for it - is the outstanding peculiarity of Athabaskan: The interlocking of a number of interrupted semantemes into a firmly knit structure seems to be a leading principle of coherence in these languages...

Athabaskan languages present the appearance of highly patternized combinations of small elements having independent and discernable meanings, but used largely in formula-like combinations...There is, however, much phonetic interaction and contraction between the elements of a combination. (Whorf 1932:17-19, cited in Kari 1979:3)

An example of a "split semanteme" would be the compound prefix á...di in (3) above.

So we see that Whorf and Sapir were interested in the interaction among various prefixes. However, if we try to use the three-way categorization of prefixes shown in (2) and (3) to come up with a model of the Navajo verb compatible with the observations of Whorf and Sapir, we run into difficulties.

The main problem is that the criteria for membership in the categories are not transparent, since the categories overlap. That is, a particular prefix can be functioning as one type in one word and another type in another word. For example, a prefix in position I or position VI can be either derivational or thematic, as illustrated by ná in (4) a and b:

- (4) a. chidí dah
car on it
násts'id (= ná-si-Ø-l-ts'id)
'up⁴perf-3s:subj.-classifier-'it bounces against a surface'
'The car got hung up on high center'
- b. násh'ah (= ná-Ø-Ø-sh-ɣ-'ah)
ná-3s:obj-prog-ls:subj-cl-'to skin or butcher it'
'I am skinning or butchering it'

In (4a), the ná is derivational, because it means "up", whereas in (4b), the ná is thematic, because it adds no meaning to the stem.

Likewise, position IV and V prefixes can be inflectional or thematic, as illustrated by 'a in (5) a and b:

- (5) a. 'asdiz (= 'a-Ø-sh-Ø-diz)
3s:indef:obj-prog-ls:subj-cl-'twist'
'I am spinning something'

- b. 'ashhosh (= 'a-Ø-sh-χ-hosh)
 'a-prog-ls:subj-cl-'sleep'
 'I'm asleep'

In (5a), the 'a is inflectional, because it expresses the 3rd person indefinite object, whereas in (5b) the 'a is thematic because it has no discernable meaning.

Another problem is that the categorization of prefixes shown in (2) does not result in any particular pattern of organization in the ordering of the prefixes. That is, it gives no indication of how "interrupted synthesis" might actually be working as a system. In Section 1.1, we will discuss an alternative categorization of the prefixes and show that it results in an interesting pattern.

1.1 Navajo Prefix Patterning

As we said in Section 1.0, the minimal Navajo verb must have, in addition to the stem, at least one of each of the following:

- a classifier (position IX) (may be Ø)
- a subject prefix (position VIII or V)
- a mode prefix (position VII or II)

Thus, for the minimal (intransitive) lexical item there is a three-way split among the prefixes: the classifier is required, but does not have a predictable meaning. The subject prefix is inflectional according to Young and Morgan, but its function differs from that of the mode prefix, which is also inflectional. If we look back at Figure 1, we see that previous analyses have posited a three-way split among the prefixes, but that those categories do not match the requirements of the minimal lexical item. Both the subject and the mode prefix are in the inflectional category, and the classifier is in the thematic category, with no derivational prefixes being required.

The breakdown that we are proposing divides the prefixes into three mutually exclusive types, in keeping with the requirements of the minimal lexical item:

- (6) a. Basic (B) prefixes are those which are a basic component of the lexical item, and which remain constant in all forms of the paradigms for mode and person/number. That is, all and only the non-inflectional prefixes are basic.
- b. Person/number (PN) prefixes are those which function to specify the subject, direct object and indirect object of the verb.
- c. Mode (M) prefixes are the members of the paradigm which modifies the verbal action for what has been called "mode" in previous research on Navajo: perfective progressive, imperfective, optative and iterative.

Under these definitions, the classifier is a basic (B) prefix, the subject is a person/number (PN) prefix and the mode prefix falls into our mode (M) category. Now we will look at the other prefix positions to see what type they would fall into.

According to previous classifications, position VI prefixes may be either "derivational" or "thematic", although all previous analyses do consider this to be one distinct position. Recall that Young and Morgan define "derivational" prefixes as "the adverbial stem theme modifiers" and "thematic" prefixes as "those that function as bound components of the verb theme." (1980:99) In other words, the only difference between the two is that the derivational prefixes have totally predictable meanings while the thematic prefixes are found obligatorily in particular lexical items but do not necessarily have specifiable meanings. Such a difference in productivity is, of course, not to be overlooked, (especially since in this case it appears to involve the Navajo aspect system) but it does not automatically constitute a difference in category. Therefore, it is plausible that derivational and thematic prefixes may be considered the same prefix type, as we are doing. All position VI prefixes are basic components of the lexical item, and thus would fall into our B type.

Positions IV and V contain the direct object and "deictic subject" prefixes, respectively. Previous analyses have labeled them either inflectional or thematic, depending upon whether the English translation includes an object or subject, or appears to be intransitive. For example, *ha*, third person impersonal, is said by Young and Morgan to be thematic in *hashne'*, "I'm telling" and inflectional in *nahashshooh*, "I'm sweeping (an area)". However, Young and Morgan do say that "From the point of view of Navajo, it is illogical to speak of performing an action such as that of 'eating, drinking, killing' without an object -- the very action involved implies an object, and if the latter is not identified as a definite person or thing, then it must perforce be an indefinite person or thing." (1980:179) Thus, we can see that it would be ill-advised to use the English translation to assign a given prefix to a type. As with the B type prefixes above, we will not consider meaning predictability to be a criterion for assignment of a prefix to a type. Since both IV and V prefixes function to specify or fill a slot for subjects and direct objects, we will consider both slots to fall under the person/number (PN) type.

Since positions IV and V are adjacent members of the same category, we may ask if they might be collapsed. Kari notes that "The 'i and 'a 'third person indefinite' prefix seems to have an ergative function." (1973:24) Also, many recent analyses of the 3rd person sg. *yi/bi* prefixes in position IV (eg. Perkins 1978, Hale, Jeanne and Platero 1977) suggest that these prefixes are better considered markers for construal of subject and object rather than direct object pronouns. Further, considering IV and V as one ergative (using the term loosely to distinguish these prefixes from straightforward subject and object pronouns) position would account for the fact that occasionally a "thematic" position V prefix can cooccur with a position VIII subject prefix.

Thus, we now have the following pattern of prefixes to the right of the disjunct/conjunct boundary:

(7)	PN	B	M	PN	B	
	IV/V	VI	VII	VIII	IX	stem

several "stem sets" (i.e. different aspectual conjugation paradigms) depending on which thematic prefixes are present: Sapir and Hoijer (1967) illustrated the stem sets with the stem meaning "to handle a solid round object" (low tone is marked with a grave accent):

(9)

(a) 'handle a round, solid object'					
	Ipf.	Pf.	Prog.-Fut.	Iter.-Cust.	Opt.
S1	-ʔààh	-ʔá	-ʔááɣ	-ʔááh	-ʔááɣ
S2	-ʔá	-ʔá	-ʔàáɣ	-ʔàáh	-ʔá?
S5	-ʔààh	-ʔá	-ʔàáɣ	-ʔááh	-ʔááɣ
S6	-ʔá	-ʔá	-ʔááɣ	-ʔááh	-ʔááɣ
S7	-ʔá?	-ʔá	-ʔàáɣ	-ʔàáh	-ʔá?
S8	-ʔààh	-ʔá?	-ʔàáɣ	-ʔàáh	-ʔá?
S9	-ʔááh		(appears only in the imperfective)		

(1967:103)

These allomorphs are so similar that it is likely that they are related by some phonological rules. At this point, however, such rules have not been discovered.⁸

The second fact involves the phonological form of the prefixes. The prototypical shape is (C)V, and an examination of Young and Morgan's (1980) list of prefixes shows that there is a great deal of homophony. In fact, of the 16 conjunct prefix forms listed by Young and Morgan, all but 5 are of the form (C)i. This form is quite rare among the disjunct prefixes.⁹

2.0 LIEBER'S ORGANIZATION OF THE LEXICON

The theory of the organization of the Lexicon presented by Lieber (1980) is attractive to the student of Navajo, in that inflection and derivation are both carried out in the Lexicon, using the same set of machinery. As we have seen, inflectional and derivational affixes are interspersed in the Navajo verb, so a theory which does not leave inflectional affixation to syntax is desirable. Lieber's theory is intriguing to the student of Navajo because it is based on enriched lexical entries for affixes. Navajo, with its elaborate inventory of affixes, can provide a worthy challenge to Lieber's claims.

2.1 Overview of Lieber's Theory

According to Lieber, the grammar includes an autonomous Word Formation Component which is responsible for the "syntax" of all lexical items (i.e. their internal structure). The Word Formation Component is composed of three sub-components: the permanent lexicon, the lexical structure component and the string-dependent rule component. The first two of these are intended to account for all affixational word formation. The third introduces transformational rules to account for string-dependent morphological processes, which, according to Lieber,

have a special group of properties which warrant the introduction of special rules. Since Navajo does not, to our knowledge, have morphological rules involving umlaut or reduplication, we will not discuss the string dependent rule component here.¹⁰

2.1.1 The Permanent Lexicon

In Lieber's permanent Lexicon, both stems and affixes are listed with fully specified entries. These entries are organized into classes of related items, with the relationship among items being specified by morpholexical rules. Below we will describe her lexical entries and her definition of morpholexical rules.

Every lexical terminal ("unanalyzable terminal element" (1980:62)) has a lexical entry which specifies:

- (1) category and declension class
i.e., which morpholexical rule class the entry falls under
- (2) underlying phonological representation
- (3) semantic representation
- (4) subcategorization frame
i.e., what the terminal attaches to
- (5) diacritics
i.e., any special features needed to fit the subcategorization frames of other terminals
- (6) insertion frame
i.e., where the resulting lexical item may be inserted in a syntactic string

Inflectional affixes, derivational affixes and stems all have the same sort of lexical entry. In fact, stems and affixes are defined in terms of the only difference between them:

- STEM: a morpheme whose lexical entry does not subcategorize another morpheme
- AFFIX: a morpheme whose lexical entry specifies some sort of lexical terminal to which it can attach (1980:67)

Thus, the prefix in-, the suffix -ize and the stem run would have lexical entries as follows: (from Farmer (1980:54-55))

- in (phonological representation)
semantic representation: negative
category/subcategorization: A[___]A
insertion frame: (whatever insertion frames for A's
look like)
diacritics: level I

ize (phonological representation)
 semantic representation: causative
 category/subcategorization: N] ___]V
 insertion frame: NP___(NP)
 diacritics: level II

run (phonological representation)
 semantic representation: ...
 category: v[___]v
 insertion frame: NP___(NP)
 diacritics: -linate

Lieber's morpholexical rules define the classes into which the separately listed but apparently related lexical terminals fall. These rules "do not change category, alter subcategorization or add to, change or subtract from semantic content". (1980:75) The permanent lexicon, then, is organized into categories (N, V, A, P, \emptyset) and each category is subdivided into conjugation or declension classes, in which each allomorph has a separate listing but is related to other allomorphs by virtue of membership in the class. Regularities in the relationships between allomorphs are expressed by morpholexical rules, which are predicates relating ordered pairs of entries. For example, the word redden would be a member of the category V and also of the subclass defined by the morpholexical rule:

$$X \sim Xen$$

The morpholexical rules mimic productive word formation processes. The criterion for assignment of a word to a morpholexical class (rather than having an entry for the stem and one for the affix) is the arbitrariness of its participation in the affixation process. Morpholexical rules are entirely arbitrary in their application.

2.1.2 Lexical Structure

Lieber's Word Formation Component includes context-free re-write rules generating unlabeled structures into which terminal elements from the permanent lexicon are inserted. Features originate in the lexical terminals and percolate up into the lexical structure (and then into syntactic structure). Lieber's trees are binary, although she does not rule out the possibility of n-ary branching trees.

These trees are labeled with the features of the terminals based on three labeling conventions:

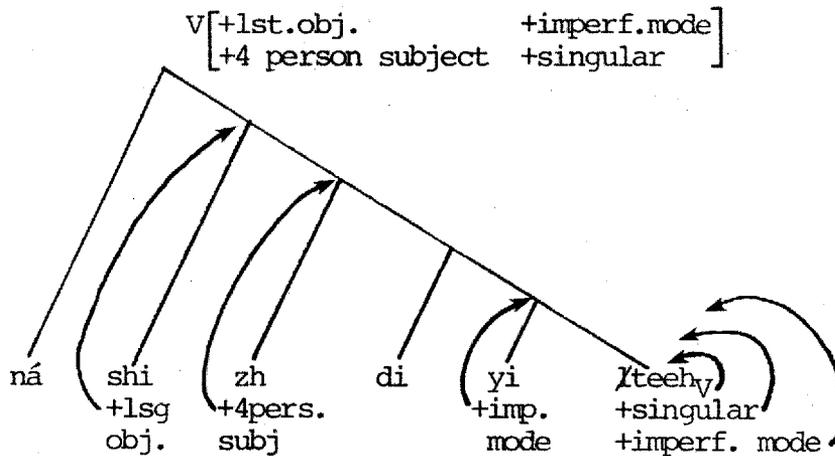
Labeling Conventions

- I All features of a stem morpheme, including category features, percolate to the first non-branching node dominating that morpheme. (1980:85)

Lexical Entries:

- ná (phonological representation)
 semantic representation: upward
 subcategorization frame: [V___]V above level 1
 diacritics: +level 1
- shi (phonological representation)
 semantic representation: 1st person sg. object¹¹
 subcategorization frame: [V___]V above level 4
 diacritics: +level 4
 +lp:sg:obj
- zh (phonological representation)
 semantic representation: 4th person subject
 subcategorization frame: V[___]V above level 5
 diacritics: +level 5
 +4p:subj
- di (phonological representation)
 semantic representation: none
 subcategorization frame: V[___]V above level 6
 diacritics: +level 6
- yi (phonological representation)
 semantic representation: uncompleted action
 subcategorization frame: V[___]V above level 7
 diacritics: +level 7
 +imperfective mode
- χteeh (phonological representation)
 morpholexical class: X ~ χX
 stem set 2
 semantic representation: handle an animate object
 insertion frame: (NP) (NP) ____
 category: V[___]V
 diacritics: +singular
 +imperfective aspect

Resulting Lexical structure:



By Percolation Convention I, all features of the stem percolate to the non-branching node dominating it. By Convention II, the features of the Affixes percolate to the branching node dominating them. Then all features go to the top by Convention III.

Notice that this procedure makes a false prediction for Navajo. It predicts that the affix *yi* could join with, for example, a perfective stem, and its features would override those of the stem, creating a grammatical and interpretable imperfective verb. In fact, such a combination would be either interpreted as perfective or uninterpretable. Of course, Lieber's proposal could be accompanied by a theory specifying which features count as "the same" for the purposes of her Percolation Conventions, and perhaps such a theory could deal with this problem.

Lieber does outline one important constraint on the process of building structure through affixation: the "adjacency condition". This constraint, which was formulated by Allen (1978) as (11), was adapted by Lieber as (12):

- (11) No rule of word formation can involve X and Y unless Y is uniquely contained in the cycle adjacent to X. (Allen 1978:155)
- (12) No subcategorization frame can state a dependency between X and Y if there is more than one bracket between X and Y, i.e.:
- * X/ Y] Z] ____
- * X/ ____ [Z [Y where Z may be \emptyset (Lieber 1980:107)

Among other things, this constraint prevents word formation processes from referring to notions such as "deverbal", "deadjectival" etc.

The interest and validity of this restriction with regard to Navajo depends upon what kind of features it is allowed to restrict. In Allen's argument for the constraint, she includes semantic features. Specifically, she explains the restrictions of affixation of the negative

prefix un- in terms of the adjacency condition. Un- cannot attach to words with negative semantic content, unless the negative content is found in a cycle which is not adjacent to un-; cf.:

- (13) unhappy *unsad [un[[blemish]ed]
 ungraceful *unclumsy [un[spite]ful]]

If we attempt to apply the adjacency condition to semantic features in Navajo, we find that Navajo is a counterexample to the constraint, since the principle of interrupted synthesis is based on composition of non-adjacent morphemes.

In Lieber's theory, semantic interpretation is done by an autonomous component, so the adjacency condition would only have to apply to structure. Since none of the verbal prefixes change category, the Percolation mechanisms let all necessary structural features get to the top, so the adjacency condition doesn't provide any particular constraint, and is more or less irrelevant for the Navajo case.

We have been arguing that the sort of structure built for Navajo by Lieber's machinery is inappropriate. It might be possible to attribute to some prefixes subcategorization frames that do not add a bracket, that is, to say that addition of certain affixes "builds" a flat "structure". But if we allow subcategorization frames of this type for affixes, we will be forced to express typological differences between morphologies in terms of individual affixes and not in terms of the resulting structural generalizations. Lieber would like general morphological structure to "fall out" from the theory of lexical entries. This may be the case in English and Latin, where words do appear to possess branching structures. But even if we weakened Lieber's theory to allow non-structure building affixes,¹² the general pattern of organization of Navajo would not be explained.

2.2.2 The Notions "Stem" and "Affix"

In Lieber's system, the notions "stem" and "affix" are not basic; rather, they differ only in that affixes have subcategorization frames while stems do not. She says that "to use terms like stem, affix and root¹³ as primitives in our phrase structure rules then introduces a bit of redundancy into our morphology that might better be dispensed with." (1980:81)

Our investigation indicates that these are notions which are independently necessary. The phonological constraints in Navajo are clearly different for stems and affixes. Stems are closed syllables, and affixes are generally open syllables. Thus; morphemes must be somehow identifiable as stems or affixes so that this phonological constraint can refer to them.

2.2.3 Actual Words and Lexical Relatedness

In Lieber's lexicon, "there exists no representation at all of actual words... (except insofar as unanalyzable stems like dog and run are also actual words)". (1980:178) Only stems and affixes are listed, and the meanings of words are composed by the separate semantic component.

In order to solve certain "relatedness paradoxes" and to give content to the notion of "lexically related", Williams (1981) outlines a theory of lexical relatedness which is based on structural characteristics rather than derivability or semantic compositionality. His definitions of "head of a word" and "non-head position" allow him to explain the fact that English inflectional affixes are always on the outside of derivational affixes, and to deal with relatedness paradoxes involving compounds.

As Williams states, the traditional definition of "lexical relatedness" is something like (15):

- (15) X and Y are lexically related if they share an element of meaning and Y is derived from X by a morphological¹⁴ rule, or

$$Y = X \begin{array}{l} \diagup \\ \text{af} \\ \diagdown \end{array} \text{ or } \begin{array}{l} \diagup \\ \text{af} \\ \diagdown \end{array} X \quad (\text{Williams 1981:258})$$

This definition of relatedness involves derivability and also compositional semantic interpretation. Williams points out that if we maintain this conception of relatedness we must reject the useful generalization that all affixation precedes compounding, and provide extra rules in the word formation component for inflectional affixes and compounds. By allowing non-compositional interpretation of words and providing a definition of "head of a word", Williams is able to reduce the number of rules generating word structures and restrict the possible position of affixes.

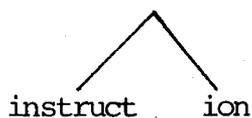
Williams defines the general notion of "head" as

- (16) If both X and the head of X are eligible members of category C, then

$$X \in C \equiv \text{head of } X \in C \quad (1981:247)$$

He then goes on to state that "In morphology, we define the head of a morphologically complex word to be the righthand member of that word." (1981:248) The head is underlined in (17) a and b:

- (17) a.

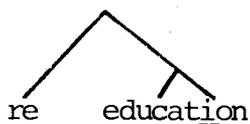


- b.



Williams calls this definition the "Righthand Head Rule" (RHR). When there is ambiguity as to the head of a word with more than one affix, as in (18), Williams says that both are heads.

- (18)



In (18), -ion is the head of education, and both -ion and education are heads of reeducation.

The RHR appears to be arbitrary, but Williams illustrates that it actually explains several different phenomena. Given the above notion of "head", it is not accidental that suffixes generally determine the category of a word in English, while prefixes do not.¹⁵ This phenomenon is in fact predicted by the RHR. Pursuing the notion of "head position" further, Williams argues that the abstract features [tense] and [case] can be considered head features in both syntax and morphology. Thus the inflectional morphemes carrying these features must appear in ultimate head position in their phrases and also in their words. Therefore, the fact that inflectional affixes in English are found at the end of words is not accidental. Williams' RHR can be seen as a constraint on feature percolation, and inflectional features must be in a position to percolate up to the node available for syntax.

Williams then uses the notion of head in his definition of lexical relatedness. After having added the following definition of "non-head":

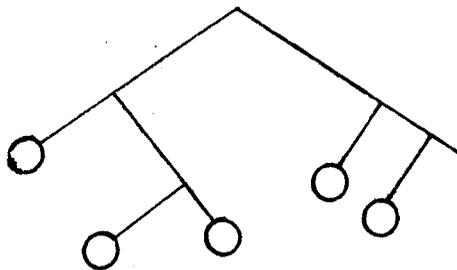
- (19) Non-head: the highest left branch of a word (1981:261)

he defines "lexical relatedness" as:

- (20) X can be lexically related to Y if X and Y differ only in a head position or in the non-head position. (1981:261)

In other words, if we vary the highest left branch of a word, or any of the rightmost constituents, the resulting word will be related. Varying the items circled in (21), then, would not result in a related item.

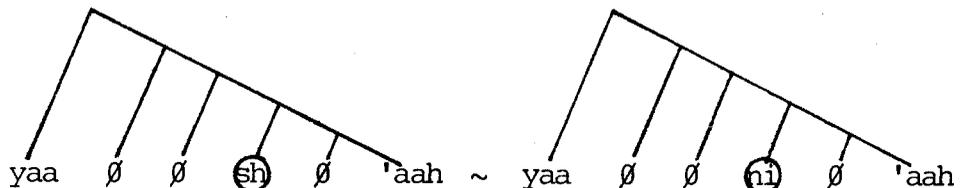
- (21)



3.1 Lexical Relatedness and Head of a Word in Navajo

In discussing Lieber's theory, we argued against the building of a hierarchical left-branching structure for Navajo verbs. Williams' proposal provides even clearer evidence against a left branching structure. If we assign a left-branching structure to Navajo and then vary an affix in a position equivalent to those circled in (21), we do get a related lexical item, as illustrated in (22):

- (22) yaash'aah 'I pour it out' ~ yaani'aah 'You pour it out'



Williams' proposal is structural, so it is obviously only relevant to languages which have hierarchical morphological structure. However, if we look at the prefix types that we proposed in Section 1 for the Navajo verb, we notice that there are "Basic" parts of the lexical item, plus two types expressing the very features that Williams says must be "head" features. It is the Navajo Mode (M) prefixes that designate the temporal reference of the predicate, so the M prefixes could plausibly be associated with [tense]. It is the "Person/Number" (PN) prefixes that serve as input to the rules of Logical Form which interpret grammatical relations, so they might plausibly be associated with [case]. It is worthwhile, then, in looking at Navajo with Williams' proposal in mind, to see if the empirical generalizations that his model accounts for are true in Navajo.

Williams discusses three empirical phenomena in English, and it turns out that none of them hold true for Navajo. In English, 1) all inflection precedes compounding; 2) inflectional affixes are always on the outside of derivational affixes; and 3) the morphemes that bear inflectional features appear rightmost in a word. Below we will present Navajo examples illustrating each of these phenomena.

Inflected Compounds

- (23) a. 'áχchíní 'óχta'ígíí (= 'óχta' + ígíí)
 child he goes to school-N
 'schoolchild'
- b. 'áχchíní da'óχta'ígíí
 child pl.-'he goes to school'-N
 'schoolchildren'

Inflectional Affixes Inside Derived Forms

The Navajo nominalizing affixes *-í*, *-ii* and *-ígíí* can go on "virtually any mode, tense, or aspect of the verb." (Young and Morgan 1980: 13)¹⁶ This is shown in the examples in (24) and (25).

- (24) a. ch'íhoot'á
 'a statement was made' (perfective)
- b. ch'íhoot'ánígíí (= ch'íhoot'á+ligature n +ígíí)
 'statement'
- (25) a. bídokijíχ
 'they will give sustenance' (future)
- b. bídokijíχii
 'supplies; provisions'

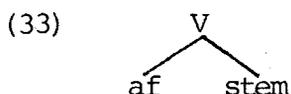
have consistently argued against the sort of structure imposed on Navajo by these two frameworks, yet the abstract features needed for interpretation in syntax appear to be the same for Navajo and English. Just what sort of structure, if any, does Navajo have? In this section, we will present the available evidence for structure in the Navajo verb and discuss the status of that evidence in determining an appropriate model for the Navajo verb in the Lexicon.

Hale (1978) has commented that "Navajo gives little evidence of hierarchical structure internal to the word." (1978:66) By dividing the prefixes into three different types, according to the minimal requirements of the verb, we have precipitated a pattern of organization. There is also some other evidence of a certain amount of structure that we have discovered in our investigation of Navajo. Is the Navajo verb structured after all?

There is phonological, semantic and structural evidence that Navajo verbs are sub-divided at least into a group of affixes plus the stem. In Section 2 we mentioned the fact that stems and affixes have clearly different canonical phonological shapes, so the phonological component must have the notions "stem" and "affix" available. Semantically, it is the stem that contains the core idea of a verb; words that differ only in stem are not perceived as related, whereas words similar only in stem are perceived as related. The structural argument for a division between stems and affixes involves the fact that there are \emptyset prefixes but no \emptyset stems. In fact, although each verb must have a subject, a classifier and a mode prefix, these may all be \emptyset , and in this case a special "peg element" prefix is used, as in (32).

- (32) yiwozh (= \emptyset - \emptyset - \emptyset -wozh)
'he's ticklish'

The existence of this obligatory peg element suggests that Navajo verbs have at least the structure in (33).



There is some evidence that the conjunct/disjunct boundary actually does divide the affixes into 2 different groups. Kari (1973) presents convincing phonological evidence involving assimilation. Also, we pointed out in Section 1.2 that there is a difference in phonological shape between the conjunct and disjunct prefixes.

Another piece of evidence for the structural reality of the conjunct/disjunct boundary is the fact that all \emptyset morphemes occur to the right of this boundary. That is, all of the positions that are required for all verbs are filled by conjunct prefixes.

A final bit of evidence for this boundary is provided by the pattern of prefixes that we described in Section 1. The pattern is repeated on either side of the conjunct/disjunct boundary, and the only instance of

two adjacent members of the same type occurs across the boundary. Note that this general restriction on adjacent morphemes in Navajo¹⁷ is structural and not phonological – two morphemes of the same shape can occur together, as in (34).

- (34) nininisse (= ni -ni -ni -sh -ʃ -se)
 I VI VII VIII IX stem
 'I'm in the act of stopping growing'

Also, in actual words, two morphemes of the same type can be adjacent (separated by \emptyset forms).

Above we have presented evidence for a certain amount of structure in the Navajo verb. At this point, it is appropriate to comment on the status of morphological "structure".

Recent theories of the Lexicon have tended to emphasize the parallels which can be found between sentence and word structure. The mechanisms for generating new words are not separated from the mechanisms for analyzing existing words. However, as Halle (1973) has pointed out, "there is a fundamental difference between the use of words and the use of sentences. In general one uses familiar words, words one has heard and used before, and one does not expect to encounter new words, whereas one rarely uses sentences that one has encountered before". (1973:16) Use of the regularities that a language learner observes in morphology is made occasionally in coining or interpreting a new word, but use of these morphological rules is not the basis of understanding a word in the same way that assigning a structure is the basis of understanding a sentence. Nearly as often, we must ignore a false analysis, or we are totally unaware of the derivation of a word, allowing combinations like green blackboard or low highheels without anomaly. For this reason, we must carefully weigh the status of any apparent word structure. Morphological "structure" may be apparent in each lexical item without being related to each use of the word. Thus, some word structure may be redundant. In fact, backformation seems to provide evidence that redundant principles of morphological structure co-exist in the lexicon with complete listings of "structured" words.

Furthermore, all of the evidence presented above for "structure" in Navajo verbs can be taken instead as simply evidence that there exists in Navajo, in addition to the distinction between B, PN and M affixes, a linear order and phonological distinction between conjunct and disjunct prefixes and a basic distinction between "stem" and "affix".

4.1 Interrupted Synthesis

In Section 1, we claimed that the affix pattern we found provided organization to the principle of interrupted synthesis articulated by Whorf and Sapir. What, then, is the status of the alleged interdependencies among the prefixes? In this section, we will argue that interrupted synthesis does not involve any structural requirements. All interdependencies can be explained in terms of independently necessary semantic considerations. Because the principles of organization

in the Navajo verb will be shown to be semantic rather than structural, we will propose model of the Navajo verb in the Lexicon which is typologically different from the structural models that we have examined so far.

Discontinuous dependencies can be found among the prefixes of a particular type as well as between systems of prefixes. We cannot exhaustively chronicle and discuss every dependency cited by previous researchers, but we will select one frequently described dependency within each prefix type, as well as one dependency between systems.

We can state the following formational restriction regarding the PN prefixes in positions IV/V and VIII:

- (35) If the prefix yi or bi appears in position IV, the subject prefix, position VIII, must be \emptyset .

However, as we pointed out in Section 1, yi and bi provide the input to Platero's (1978) Interpretation of Grammatical Relations (IGR), which actually specifies both the subject and the object. If we presume a general semantic constraint like (36), which is hardly specific to Navajo, then the formational restriction in (35) is unnecessary.

- (36) Sentences never have more than one subject.

The M prefixes in positions II and VII are mutually exclusive. We could similarly say that a sentence can only have one mode, but there is even more compelling evidence that this restriction is not structural. The form of the position II mode prefix, which expresses iterative mode, is na. It happens that the Basic prefix immediately to its left has precisely the same shape, and expresses reversionary and semeliterative aspect. So, in fact, if a word includes na as well as a position VII mode prefix, the na is simply interpreted as a similar aspect. This "constraint" is clearly a question of interpretation and not of word structure.

Among the B prefixes, there are many discontinuous combinations which are listed as compounds in Young and Morgan (1980). If drift occurs with such compounds, then they should be listed in the lexicon, as we would list English idioms with gaps in them, like those in (37).

- (37) throw NP for a loop
 show NP the ropes
 NP₁ broke PRO₁'s leg

However, we clearly do not want to state this "dependency" in terms of a restriction on one or the other of the affixes, any more than we would want to state the restrictions in (37) in terms of subcategorization features on break, throw, ropes, etc.¹⁸

One often-cited dependency between affixes of different types is the fact that some B prefixes are "perfective mode choosers", that is, they occur only with one of the three possible shapes (yi, ni or si) for the position VII perfective mode prefixes. We might state this dependency in terms of a subcategorization feature on the B affixes. However,

Young and Morgan indicate that this restriction is more appropriately characterized as a semantic constraint when they say, "(the perfective mode prefixes) include aspectual connotations as well, distinguishing the verbal action as simply completive (yi), terminal (ni) or stative (si)". (1980:207) The restriction on the "perfective mode choosers", then, is very likely a matter of semantic compatibility.

We have shown that various examples of discontinuous dependencies in the Navajo verb are better handled through interpretive principles than through structural constraints. In the final portion of this section, we will present an overview of the representation of Navajo verbs in the Word Formation Component. Then in Section 5 we will discuss the position of Navajo in a typology of morphological structures.

4.2 The Navajo Verb in the Lexicon

Throughout this paper, we have presented data and arguments which support the model we are now proposing.

We will organize the Lexicon the way Lieber did, in that the permanent lexicon is separate from the lexical structure component. The major difference is that instead of including binary branching structures, the "lexical structure component" for Navajo contains parsing rules which impose a labeled bracketing upon affix + stem combinations. These parsing rules would be quite similar in form to Platero's IGR for syntax, and would utilize the conjunct/disjunct boundary and the pattern of interrupted synthesis to locate and interpret the prefixes. Note that it is not incompatible with Lieber's theory to attribute different "lexical structure components" to different languages.

Since we are interested more in expressing lexical relatedness and locating inflectional features than in avoiding redundancy, we propose that the permanent lexicon include a listing of all stems and affixes as well as a listing of all B+classifier+stem "actual words", with spaces for the PN and M prefixes, like the spaces in the idioms shown in (37).

Each lexical entry will indicate:

morpheme type (stem, affix_B, affix_{PN}, affix_M or word)
 phonological representation
 semantic representation (including argument structure for stems' entries)

Thus, the lexical entry for náshizhdii/teeh, 'he picks me up' would be as follows:

(38) Verbs

ná ____{PN} di ____M ____{PN} /teeh
 (phonological representation)

semantic representation: X pick Y up; (NB) (NP) ___ word

Any PN affixes can go in the PN space, and any M affix can go in the M space. Ná, di, χ and teeh all have separate (redundant) listings.

5.0 NAVAJO AND MORPHOLOGICAL TYPOLOGY

We began by explaining that recent morphological theories carry out both inflection and derivation in the Lexicon, and indeed, do not make any basic distinction between the two. In Williams' system, the position of those morphemes with "head" features was predictable because percolation and interpretation of those features was dependent upon the configuration of the word. In Navajo, we found that we did not have the same sort of available configuration, so we had to allow access to those "head" features some other way, namely by distinguishing various types of affixes corresponding to various levels of interpretation. Thus, although we have not dispensed with the assumption that both derivation and inflection should take place in the lexicon, we have made a distinction between derivational and inflectional affixes which is reflected in the lexical entries: actual words are listed, with spaces for the inflectional affixes. This decision was based upon the following considerations, which approach a definition of inflectional morphology:

- 1) obligatoriness: \emptyset forms of inflectional affixes have fixed interpretations.
- 2) predictability: inflectional affixes are semantically predictable.
- 3) productivity: inflectional affixes always attach to an infinite set (the question of relative productivity is irrelevant).
- 4) contribution: inflectional affixes do not change features.
 inflectional affixes do not change the semantic content of the word.
 inflectional affixes express features interpretable at the level of the sentence.

Since Navajo verbs did not show a configurational structure, we proposed an interpretive approach based on the pattern of prefix types. In fact, we might say that Whorf and Sapir's observation about interrupted synthesis was an early statement of so-called W^* properties in Navajo. That is, rather than constituent structure, Navajo verbs display extensive use of discontinuous expressions, use of linear order but not hierarchical arrangement in interpretation, and no "dummy elements" (the "peg element", yi, described in Section 4 has no interpretation, and fills only a phonological, not a structural, position). These are three of the four properties which Hale (1978) suggested were "earmarks" of W^* syntax. The fourth property is "scrambling", or "free word order", although Hale says that it is "quite consistent with the W^* type of grammar for a language to utilize the linear order

of words in parsing a sentence, and therefore to exhibit what is normally thought of as fixed word order". (1978:54) Indeed, he uses an example from Navajo syntax to illustrate this point.

If there is, then, a typology of morphological structures parallel to that of syntactic structures, the natural question to ask is, what is the relationship between the two typologies? It seems reasonable to assume that all four logically possible combinations of the two (and those in between, since it's likely that this distinction is a continuum rather than a dichotomy) could be instantiated in natural languages:

- (39) \bar{X} word structure ----- \bar{X} sentence structure
 \bar{X} word structure ----- W*sentence structure
W*word structure ----- \bar{X} sentence structure
W*word structure ----- W*sentence structure

It would indeed be interesting to find that the possibilities were more restricted. While it is primarily an empirical matter, we should reiterate our earlier proviso about the nature of word structure. If word structure is not used for each interpretation, then it could be a phantom. Word structure could be simply an overgeneralization by a speaker of a language who knows some rules for imposing order on a string. If this should turn out to be the case, it would predict that sentence structures and "word structures" in a given language would tend to be parallel.

Of course, languages also appear to vary in the extent to which they do utilize word structure in sentence interpretation. This adds another dimension to the possibilities in (39). If the \bar{X} - W* distinction is a continuum, it is crucial that we explore the interactions between syntactic and morphological structure.

FOOTNOTES

¹An earlier version of this paper was presented at the California Linguistic Association's Athabaskan Session, June 27, 1981. I am grateful for the valuable comments offered by the conference participants. All of the U. of AZ Linguistics professors have tried their best to steer me right. I especially thank the members of my two graduate committees, Ellavina Perkins, Ann Farmer and Chisato Kitagawa for suggestions and encouragement. Thanks Jane, Tom, Esmeralda, Osamu, Heizo, Stuart, Linda, Bernice and the rest of the Linguistics Circle. Thanks also to Dick Carter for recent comments. Ultimate thanks to Otto for the inspiration and musical background score of symphonies, corridos and kazoo karols.

²As Lieber notes, Halle (1973) was the exception.

³Young and Morgan (1980) give some examples of metathesis, but they indicate that these are phonological.

⁴Young and Morgan investigated the possibility of borrowed verbs and found not one example. Ellavina Perkins (p.c.) has indicated to me that if a foreign verb were used, it would be considered code-switching, i.e., that a borrowed word could not be used as a verb stem.

⁵From here on, the numbers we use to indicate prefix positions will be Young and Morgan's.

⁶Sapir and Hoijer (1967) called the prefix types "paradigmatic" and "derivational/adverbial" and "thematic". They put the classifier in the paradigmatic category. Otherwise, the breakdown is the same.

⁷This was pointed out to me by Dick Oehrle (p.c.).

⁸Linguists at the Alaska Native Language Center have made great progress in this area, and there may be research that I am not aware of.

⁹In fact, most of the disjunct prefixes of the form Ci are those for indirect object.

¹⁰In her introduction, Lieber does mention infixing as possibly occurring in the Strong-Dependent Component. Infixing might be applied to Navajo, but Lieber does not include infixing in the actual discussion of string-dependent rules, so we will not discuss that component here.

¹¹It is not clear which inflectional "features" are part of the semantic representation and which are diacritics.

¹²The rules of the string-dependent rule component do not build structure.

¹³Lieber defines root as follows: "...if a lexical class has an element a such that a RX for every X in , then a is the least element in (borrowing the set-theoretic terminology). The least element in a partial ordering of lexical terminals will be called the root". (1980:76)

¹⁴"Morpholexical" is used here in the traditional sense, not in Lieber's more specialized sense.

¹⁵Williams mentions that en+V appears to be an exception to the RHR.

¹⁶Of course, in English there are examples of forms derived from [+tense] verbs. Such forms are frozen, and inflection is on the outside of them. cf. a has been; *an is being; *a couple of have been.

¹⁷Dick Carter has pointed out to me that this seems to be a general restriction. For example, French pronouns exhibit characteristics that indicate that a sequence of identical pronouns is only possible across a structural boundary.

¹⁸This was pointed out to me by Dick Carter (p.c.). Adrian Akmajian has also suggested that Navajo affixes might share properties of idioms.

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