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James E. Redden, Editor

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PREFACE

Unfortunately, everyone who presented a paper at the 1978 Hokan Languages Workshop was not able to prepare a final version for inclusion in this volume. All the papers in this volume were presented in an earlier version at the 1976 workshop. The papers are arranged in the order that they appeared on the program at the workshop.

The participants of the 1978 Hokan Languages Workshop gratefully acknowledge all the work done by Professor Carol Baker Slater and the students at the University of California, San Diego, which made the workshop run so smoothly and enjoyably.

Copies of the 1977 workshop are still available from the Department of Linguistics, Southern Illinois University, Carbondale, IL 62901. The volumes for the 1975 and 1976 workshops, which appeared in the SIU-C University Museum Studies, are now out of print, but copies may be obtained in microfiche or hard-bound copies from ERIC Clearinghouse on Languages and Linguistics, Center for Applied Linguistics, 1611 N. Kent Street, Arlington, VA 22209.

The 1979 Hokan Languages Workshop will be held at the University of California, Los Angeles, June 25-28. The proceedings of the 1979 workshop will appear in Occasional Papers On Linguistics in late spring 1980. Copies may be ordered from the Department of Linguistics, Southern Illinois University, Carbondale, IL 62901.

James E. Redden
Carbondale, May 1979
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The Semantic Domain 'tree': Hokan Lexical Evidence

Nancy M. Webb

I. In a recent study titled "Some Northern Hokan Plant-Tree-Bush Forms" (1974) Shirley Silver displayed and discussed cognate sets from several Hokan languages of northern California glossed 'sugar pine nut', 'sugar Pine' and botanical affix forms. She discussed the internal development of the etyma and, also, possible intersection of these forms with other California language superfamilly members. She pointed out the need for further study. Some expansion of this subject is presented here.

The cultural area of the plant domain contains in the published literature suggested cognate forms from almost all of the hypothesized Hokan languages. I have been assembling lexeme sets of determined cognates, the determination based on regularly recurring sound correspondence, from some sixteen Hokan languages of the first order and isolates in pursuit of postulating some proto Hokan phonological rules and lexical elements. Here I shall present and discuss items in the botanical domain from this assembled data in hope of extending insight in Proto Hokan form and intersection.

II. Parameters. a. The Hokan languages are isolates or of the first order representing some twenty-nine synchronic languages. b. The cognate lexeme sets are recognized on the basis of recurrent consonant sound correspondence. c. The selection of the items semantically is to be strict within the range or domain, here glossed 'tree' unless otherwise noted, some kinds of trees and some parts thereof. In "Major Focus of Reconstruction and Change" (1974) Hamp points out that change tends to move from left to right, most frequent and regular on the left, the phonological field and least on the right or semantic area. J. Deese in "Thought into Speech" (1978) in discussing the burden of speech to convey meaning to the hearer finds that the fewest corrections are semantic and the most frequent are phonological. Uncorrected semantic errors are often of the paired sort - left and right, husband and wife, even assumed for presumably. Therefore, the sets used here while strict semantically are not so rigid as would be required for glottochronological statements. The semantic interchange allowed is rather of the "paired sort": as 'tree'and 'wood' or 'stick'. Where there is interchange of denotata it is so marked. d. Finally, only sets with data in at least half of the languages considered Hokan are used. Many sets are almost complete. Included, also with some sets are suggested cognate forms, at least "look alikes", from some presumed non-Hokan languages for intersection discussion.

III. Data. In the following display the abbreviations used are:
Chim., Chimariko; P Fal., Proto Palaihnihan; Ac., Achumawi; At., Atsugewi; P Pomo., Proto Pomoan; Ess., Esselen; Sal., Salinan; Chun., Chumash; P Yuma., Proto Yuman; Tcq., Tecoistlatec; Sub., Subtiaba; Jica., Jicaque; Tlapa., Tlapanaq; P Urq., Proto Uralic; P Mn., Proto Mixtecan; P Wn., Proto Miwok-Wintun; Pn., Northern Pomo; Psw., Southwestern Pomo.
Lexeme sets.

'tree' #1

<table>
<thead>
<tr>
<th>Language</th>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karok</td>
<td>?i pahu</td>
<td>wood</td>
</tr>
<tr>
<td>Shasta</td>
<td>?i pa</td>
<td>wood</td>
</tr>
<tr>
<td>Chin.</td>
<td>?i p xoc'</td>
<td>bark</td>
</tr>
<tr>
<td>P Pal.</td>
<td>shawa (At.)</td>
<td>a bu</td>
</tr>
<tr>
<td>P Pomo.</td>
<td>hi?bu (potato)</td>
<td>a hay (wood, stick)</td>
</tr>
<tr>
<td>Yana</td>
<td>?i (wood, stick)</td>
<td>a xa</td>
</tr>
<tr>
<td>Washo</td>
<td>?i p</td>
<td></td>
</tr>
<tr>
<td>Ess.</td>
<td>i</td>
<td>y xay (wood, stick)</td>
</tr>
<tr>
<td>Sal.</td>
<td>paxakil (oak)</td>
<td>a t'</td>
</tr>
<tr>
<td>Chum.</td>
<td>do m'</td>
<td>a ni (Purissi.)</td>
</tr>
<tr>
<td>P Yuma.</td>
<td>?i</td>
<td>a x/ha</td>
</tr>
<tr>
<td>Seri</td>
<td>-i-p xo 1 (stick)</td>
<td>-3 ha. (also, wood)</td>
</tr>
<tr>
<td>Tlapán.</td>
<td>i t/ci (Sanir)</td>
<td>awa (fire)</td>
</tr>
<tr>
<td>P Úral.</td>
<td>puu</td>
<td>xa la- 'wild potato'</td>
</tr>
<tr>
<td>P.M.</td>
<td>Takelma</td>
<td>xo (fir tree)</td>
</tr>
<tr>
<td>Coos</td>
<td></td>
<td></td>
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</tbody>
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#2

<table>
<thead>
<tr>
<th>Language</th>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>k a' f (a sp.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>?á k'a: ha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>?a q eu (cone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>q'a le</td>
<td></td>
<td></td>
</tr>
<tr>
<td>caxak'ha 1 (cone)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-a'ag (wood)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ké (pine nut)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k'sel (cottonwood)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a- (wood)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k'ho (wood)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k'</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k/oi (Sanir)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>k'hewel (vucca)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ku'wl (spruce)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>co/aq (wood, stick)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#4

<table>
<thead>
<tr>
<th>Language</th>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Karok</td>
<td>-i pa (bot. affix)</td>
<td>hu-s ip</td>
</tr>
<tr>
<td>Shasta</td>
<td>-i pu? (bot. affix)</td>
<td>a ccáwi hu?</td>
</tr>
<tr>
<td>Chin.</td>
<td>pu su a (wood)</td>
<td>a tswu p</td>
</tr>
<tr>
<td>P Pal.</td>
<td>-o-p (bot. affix Ac.)</td>
<td>a S wí (tree)</td>
</tr>
<tr>
<td>P Pomo.</td>
<td>-?b- (bot. affix)</td>
<td>še-wa (bark, Fn.)</td>
</tr>
<tr>
<td>Yana</td>
<td>p'u-ra (wood)</td>
<td>cu ye (Psw.)</td>
</tr>
<tr>
<td>Washo</td>
<td>?i-p</td>
<td>c au ?i</td>
</tr>
<tr>
<td>Ess.</td>
<td></td>
<td>zu mmir</td>
</tr>
<tr>
<td>Sal.</td>
<td>ket-loui</td>
<td>ša'</td>
</tr>
<tr>
<td>Chum.</td>
<td>pono (Ubisp.)</td>
<td>š o (tobacco)</td>
</tr>
<tr>
<td>P Yuma.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seri</td>
<td>haspén (stick)</td>
<td>p ta' ct</td>
</tr>
<tr>
<td>Teq.</td>
<td>fana (seed)</td>
<td>k'ek (tree)</td>
</tr>
<tr>
<td>Sub.</td>
<td>Jica.</td>
<td>lo (leaf)</td>
</tr>
<tr>
<td>Tlapán.</td>
<td>puu (wood, stick)</td>
<td>sa/um? bo g'a/i</td>
</tr>
<tr>
<td>P.M.</td>
<td>law'ahe-</td>
<td>co no'xis paphth</td>
</tr>
<tr>
<td>Yokut</td>
<td></td>
<td>ow</td>
</tr>
</tbody>
</table>
IV. Discussion. In the preceding data in the first four sets the semantic interchange is considerable with much overlapping but the range is limited almost entirely to the words for 'tree, wood and stick'. They are rather of a paired sort. The Chemnash /con'/ and the Juman 'Yili' can mean any one of the three. In many others the word for 'wood, stick' is the same form while 'tree' takes a different etymology. Yana
and Seri use distinct forms for each as does P Pal. Pal. uses the etymon
glossed 'sugarpine' here for 'tree' and Chim. uses a form cognate with that
of P Pal. for 'tree', also. Yana has a fourth form which is glossed both
'wood' and 'stick'. In these sets, 'tree' #1, #2, #3, and #4, where the
meaning is not one of these three it is a meaning denoting a specific kind
of tree or some tree part. The semantics are quite particular.

There would appear to be three separate shapes for this lexeme
in Proto Hakan. The reflexes in sets numbered 1, 2, and 3 describe them.
Set 4 really is just an expansion of set 1. The etyma are displayed with
the corresponding consonant proto phonemes aligned vertically. 'tree' #1
suggests a Proto Hakan **?hun** , an initial high front vowel preceded
usually by a glottal catch and followed by a bilabial stop plus a back
vowel. This basic shape develops variously with either the high front
vowel and/or the bilabial stop as a constant. Alone or together these
denote 'tree', kind of tree or part of a tree. Further, when affixed to
other stems they denote specific plants or parts thereof. Some develop-
ment of this basic form seems to be lacking, so far in my search, in none
of the 16 postulated hakan languages. The form is quite rare in meso
American languages. (See 'edible root' here for Jica, and for Sub. my
collection gives /ba'i/ 'ashes'). Among non-Hakan California languages I
find only Yokut 'manzanita' (see data) and Wintun /bagi/ 'bush'. Looking
much farther afield the Proto Uralic data is interesting. Collinder reconstructs
a Proto Uralic *pu- 'tree' from Finnish /puu/ 'tree, wood, stick, fire-
wood'; Cheremis /pu/ 'wood firewood'; Votyak /pu/ 'tree, wood'; Yurak
Samoyed /fei/; /pee/ 'tree, wood, stick, firewood'; Tavgi Samoyed /faa/
'tree'; Yenisei Samoyed /fei/; /pee/ and Selkup Samoyed /puu/; and
Kamasian /pa/ 'tree, wood, stick, cane, forest'; Koibal /pa/ 'tree'.
Thus all across the north of Asia occurs a very intriguing set with the
semantics split or lumped as with Hakan. This is only one of many Proto
Uralic sets that lock 'cognate' with Hakan.

A second Proto Hakan 'tree' would be of the shape **?axa**; a
backed lower vowel preceded by a glottal catch and followed by a palatal
or pharyngeal spirant plus a back vowel. This form is more often glossed
'wood, stick'. In development it can lose part or all of its first element
and it often occurs in compound with 'tree' #1, above, in the denoting of
particular trees or plant parts. Reflexes can be found in all of the
languages used here except Washo, Sub., Jica, and Tlapan. For the last
three my material is scant. Pin shows a seemingly related form. There
has, however, be found in Uralic, again, suggestive etyma. These are
Motor /ha/, /hâ/ 'tree'; Taiji /ha/ 'forest'; Karagas /ny/ 'tree'. These
are languages from the east of north Siberia.

A third Proto Hakan 'tree' would be of the shape **?axa** as
delineated by the data in set #3. This is a first element like that of #2
above followed by a palatal stop which is sometimes aspirate and then a
backed vowel. It denotes 'tree' specifically only in Shasta, P Pomo,
Teq., Jica, and Tlapan. It means a kind of tree or plant in Aror, Chun,
Jica, and P Uralic. Otherwise it is 'wood, stick, or pine cone'. This is
the case in Proto Miwok-Wintun.
Distribution of forms and intersection of meaning

<table>
<thead>
<tr>
<th></th>
<th>'tree'</th>
<th>'wood, stick'</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ʔipu</strong></td>
<td>Karok, At., Washo,</td>
<td>Chim., Yana, Seri,</td>
</tr>
<tr>
<td><strong>ʔi</strong></td>
<td>Yuma.,</td>
<td>Puma.</td>
</tr>
<tr>
<td><strong>ʔ-1</strong></td>
<td>Tlap. As an affix only-</td>
<td>Shasta and P Pomo.</td>
</tr>
<tr>
<td><strong>ʔaʔa</strong></td>
<td>Chim., Yana, Sal.,Chum. (?)</td>
<td>Karok, Shasta, P Pal.,</td>
</tr>
<tr>
<td><strong>ʔxʌ</strong></td>
<td></td>
<td>P Pomo., Ess., P Yuma,,</td>
</tr>
<tr>
<td><strong>ʔakʰa</strong></td>
<td>Shasta, P Pomo., Teq.,</td>
<td>P Pal., Washo, P Yuma,</td>
</tr>
<tr>
<td><strong>kʰv</strong></td>
<td>Sub., Tlapan.</td>
<td>Seri, Chim. (?) , Yana (?)</td>
</tr>
<tr>
<td><strong>ʔakʰa</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ʔaʔa</strong></td>
<td></td>
<td></td>
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</tbody>
</table>

The distribution of these three proto forms encompasses all of the Hokan superfamily almost with exception. This argues for three Proto Hokan words all of which could be glossed 'tree'. The geographic distribution by meaning is so diverse as to show no trends as to whether the gloss be 'tree', 'wood' or 'stick'. Any statement as to clustering trends would be most long and involved. The #1, high front vowel and bilabial stop, seems to be the most pervasive form and the most purely Hokan. Numbers 2 and 3 have so little representation in non-Hokan neighbors as to suggest that they did the borrowing from Hokan. The Proto Uralic forms make for interesting speculation.

The plant species and parts sets indicate several Proto Hokan forms composed of more than one element. At least one of the elements in each is one of the above three Hokan 'tree' forms, part of one or some of them in combination. 'Sugarpine' could be of the shape **ʔasawa.** That is, the first element of **ʔaʔa** plus an unique element, -sa-, and then -wa as some kind of class marker. P Pal. and Chim. use a reflex of this to denote 'tree'. Chim. suffixes still another element, part of 'tree' #1, to form 'sugarpine' (the lexeme shown here). The gloss 'sugarpline' is carried on this etymon only in the area where the species of tree occurs.

The 'manzanita' set suggests two proto forms. One of the shape **pat-kʰ-e** and the other **kʰ-waʔay-1.** Each again carrying elements of Proto 'tree', here #1 or #3, compounded with other stems and, perhaps, grammatical elements added. Only Teq. glosses it 'tree'. There are Penutian similars with the meaning 'manzanita'. P Pal. daughter languages each use a different form in this set. At. uses a reflex of one form and Ac. uses a reflex of the other. This situation frequently occurs in the proto language making then so dissimilar and reflecting their long separation as has been indicated in the work of Baumhoff and Olmsted. The Chum. and Washo evidence give some doubt as to the borrowing of either form from some non-Hokan language. On the other hand, The Yukut and Proto-Miwsk-Wintun evidence argue otherwise.

The set glossed 'willow' again indicates two words. One of the form **ʔaʔa** and the other **ʔaʔa**. These with elements of the basic
'tree' forms compounded with unique stems. P Pomo, Yana and Sal. show overlapping of the two forms. Washo evidence seems to indicate more than one kind of 'willow' and this is the most persuasive explanation. The Tokut example is not very cognate 'looking' but the P Ural. is again very interesting.

A proto HOKAN 'buckeye' of the form **paxis/fil seems reasonable but the semantics are a problem. This example carries elements of both 'tree' #1 and #2. The Seri etymon means 'tree' only.

The set for 'acorn' is a good example of the difficulties that arise with sorting out the different varieties of one culture item that is a very important item in the lives of the people. My material for 'oak' is still quite confused. Even more than this for 'acorn'. I suggest several proto shapes from the data probably indicating acorns from different kinds of oak trees. **xan-po-, **ta--pV with metathesis frequent, **cuxVx-. These are formed as have the others we have been discussing and the semantics in general are constant in the areas where the tree grows.

An 'edible root' of the shapes **sipuxvl- and **sipu-ma- can be postulated from the set here.

V. Conclusion. The evidence assembled and displayed here while confining itself to a single cultural domain demonstrates vigorously the relatedness of the languages that have been grouped in a postulated HOKAN superfamily. It argues well in support of a Proto HOKAN language hypothesis. Further, it suggests ways that some lexemes were formed. Forms or parts thereof that denoted a range or domain were combined variously with specific elements and syntactic markers to make words or names to signify particular items or parts thereof within that semantic area.

Patterns and/or trends of the spread of developments and therefore of degrees of relatedness among the various daughter members does not seem to be advanced by this material. Likewise intersection of these languages with geographical neighbors is only weakly illustrated by this evidence. Hopefully more work will elucidate to some extent these problems.

P. and S. Turner. "Dictionary: Chontal to Spanish-English, Spanish to
"The Hokan Affinity of Subtiaba in Nicaragua". A. A. n.s. 27:402-35.
B. Collinder. 1955. "Fenno-Ugric Vocabulary". Almqvist and Wiksell,
and the Pos. of Tlan" SLL 55.
The particle /pé/ occurs in direct and indirect questions and shows irritation, frustration, or puzzlement.

1. Nadine kâ ŋû || Where is Nadine?
   (Nadine where is)

2. Nadine pê || Where is Nadine anyway? Where in the heck is Nadine?
   (Nadine ???)

3. wa m-wi-č kë yô || Where is your house?
   (house 2-have-nom. where be-located)

4. wa m-wi wo-c pê || Where is your house anyway? Where in the heck is your house?
   (house 2-have that-nom. ???)

5. nióó pê kâ wî pê yûkyûk-yu # He's wondering just what I'm going to do with it anyway.
   He's wondering just what in the heck I'm going to do with it.
   (he ??? what do ??? wonder-be)

Sentences 1 and 3 are the usual way of asking questions, using an interrogative, such as /kë/, where, and a verb. Sentences 2, 4, and 5 illustrate the use of /pé/.

/pé/ contains the bound morpheme /-ô/, which means place, and occurs in many words, e.g. /vë/, here, and /wë/, there2, and the negative-directive reversion /p-/, away from, lacking, or absent2. /pé/ indicates that the person or thing referred to is or was very recently close by, but for some reason cannot be found immediately even though close at hand a very short time ago and expresses the speaker's aggravation at not being able to find the person or thing immediately. The usual form of interrogatives, such as sentences 1 and 3, give no indication of nearness or distance.

One way of indicating the immediate past is by a secondarily-stressed /-ã/ suffixed to the verb stem. The /+/ preceding the /-ã/ is realized as a glottal stop.

6. kwê má-k-we # He's eating (right now).
   (thing eat-3-do)

7. kwê má+ã-k-ve # He has just eaten.
   He just ate.

8. kwê v-má-m-ta-m va-k-yu # I had just eaten when he came.
   (thing intense-eat-with-imperf-DS arrive-3-be)
9. kwâ v-mâ+â-m-ta-m vâ+â-k-yu # I had just eaten when he came.
   (thing intense-eat-just-with-imperf.-DS arrive-just-3-be)

The /+â/ seems to be the verb /-â/, move, go/come, and literally would mean go/come from verbing. Sentence 7 refers to the immediate past before the present. Sentence 9 is also an immediate past before the present, meaning he just entered the door an instant ago, and I had been eating until the instant before he arrived. Sentence 8 refers to some 15 to 20 minutes before the present.

The use of /-â/ is a clear case of older and younger speakers using different grammars. Older Hualapai also have other uses of /-â/ which have not been analyzed yet.

/ôô/ or /ôô/ indicates that something certainly happens. It may translate for sure, certainly, only, just.

10. ôô ni-ê-k-a-m wi-ê-ay-wi # We will/can do it tomorrow for sure.
   (for-sure subord.-tomorrow-the-D/DS/during do-pl.-fut.-do)

11. ôô vâm vâ-k-yu # He arrived just now.
   (for-sure now arrive-3-be)

12. ôô va-ôâ-m wi-ê-ay-wi # We can do it (only) today.
   (for-sure intense-day-DS/during do-pl.-fut.-do)

13. vâk n-ô-k ôô yê-v-ay-k-wi # If he is here, he will fix it.
   (here subord.-be-3 for-sure make-this-fut.-3-do)

14. ôô vâ+ôâ-k-yu # He just came and left.
   (for-sure arrive-move-3-be)

15. péô wi-k-yu-k ôô vâm ni-yâm yâm-ay-u # If I had some money, I would go.
   (money have-3-be-SS for-sure now subord.-go go-fut./want-be)

16. mâk-ô-pâ-m yâm-a-ôâ-k ôô # He could/should have gone yesterday.
   (back-day-DS/during go-tns.-pl.-be-SS for-sure)

In sentences 13 and 15, if the stated condition obtained, then the result was certain. Sentence 10 is presented as certain even though it is future. Sentences 11, 12, and 16 are presented as facts. Sentence 14 is also presented as fact, but the idea is You just missed him.

There is an /-n/ suffix that is quite rare and means something like a lot, a good deal, in general, to a general extent.

17. yâk nâ-ôâ vá-yu # This is where I (am) sit(ting).
   (here 1-nom. sit/live/be-be)

18. yâk nâ-ôâ vá-n-yu # This is where I live.
   (here 1-nom. sit/live/be-n-be)
19. māt+n kwē-v-ĉ wā-k-yu # There’s something on the ground. 
(ground-n thing-this-non. sit/live/be-be)

20. hā-n wē ŝám-we # I'm pouring all the water out. 
(water-n there pour/throw-do)

21. i-tiqiáta yá-m 1 taqā-v-k-we # He's splitting wood with an axe. 
(wood-splitter this-with wood split-here-3-do)

22. i-tiqiáta yá-m 1-n taqā-v-k-we # He's splitting wood with 
an axe. 
(wood-splitter this-with wood-n split-here-3-do)

The verb /wā/ can mean sit, live, be/hung around. When it has the /-n/ suffix, it can only mean live, dwell, reside. Without /-n/, it usually means sit. Compare sentences 17 and 18. In sentences 19 and 20, a lot of is indicated. Sentence 19 referred to a lot of blood that had been spilled on the ground. If only a small amount of blood had been on the ground, /-n/ would not have occurred. Likewise, sentence 20 has to refer to a large container such as a barrel or tank. Sentence 21 shows that only one piece of wood is being split, whereas sentence 22 shows that more than one, no doubt several pieces of wood are being split.

There are two ways of indicating or, /mī/ and /naťp/, but both may occur in the same sentence.

23. kūl mī kwālyāu má-hi-we # I will eat rabbit or chicken. 
(rabbit or chicken eat-fut./want-do)

24. kūl má-hi-we na-ō-p-k-yu kwālyāu o-vi-hi-we # I will eat rabbit 
or chicken. 
(rabbit eat-fut./want-do subord.-no-never-3-be chicken 1-do-fut./want-do)

25. ňā-ĉ kwē má-hi-wi mī na-ō-p-yu || Am I eating or not? 
(1-nom. thing eat-fut./want-do or subord.-no-never-be)

Sentence 23 states that either rabbit or chicken will be eaten without giving any indication that one or the other is more likely to be eaten. Sentence 24 indicates that rabbit is expected; but if for some reason the expectation is not realized, then chicken will occur in place of the rabbit. The speaker in sentence 25 expects to eat, but apparently something has happened to raise some doubt.

None of the above items except possibly /eG/ and /eG/ occur with great frequency. One of the reasons for doing this study is to spur other Yumanists and Hokanists to look for these rather rare items in their languages.

FOOTNOTES

1 Redden, James K, Walapai II: Morphology, p.162.
The Structure of Nominal Modifiers

by

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0. Prologue

In Hualapai, an Upland Yuman language, we find several ways to form noun phrases: 1) a noun followed by a nominalized verbal, 2) a noun followed by a definitized verbal, and 3) a noun followed by a verb stem. Nominal modifying phrases always follow the nominal element.

1. Nominalizing prefix /g-/ [k-]¹

The nominalizing prefix /g-/ may appear on the verb and can generally be translated as "the one who; the thing which."

1. a. g-vso
   Nom-take=care=of 'the one who takes care of (animals)/ herder'

   b. g-thye'
   Nom-cure 'the one who cures/doctor'

   c. g-qech
   Nom-be=little 'the little one'

2. a. mi-g-vdé
   foot-Nom-be=big 'the foot-the one that is big/big toe'

   b. sal-g-vdé
   hand-Nom-he=big 'the hand-the one that is big/thumb'

3. a. waksi-g-wi
   cow-Nom-possess 'the one who possesses cows/cattleman'

   b. waksi-g-nyi-haá(-a)
   cow-Nom-Rel-pet(-Def) 'the one who pets cows/cattleman'

The prefix /g-/ "may appear on the main verb or verbal auxiliary of a fully expanded sentence modifying a noun, so long as the noun being modified is the subject of the prefixed verb" (Kendall 1974:90; emphasis ours). The nominalization of this form seems to be a general characteristic of Yuman languages, e.g., /kw-/ in Diegueno; /kw-/ in Cocopa, Mohave; /k-/ in Yavapai, Havasupai; etc. That the noun being modified must be the subject of the prefixed verb is illustrated by the following examples 4.
4. nya-ch waksi: g-séy-ya si'f-m 1-ha:m-yu
   I-Subj cow Nom-brown-Def one-DR 1-see-Aux
   'I see one brown cow.'

5. a. waksi: g-séy-ya vo:-k ya:m-k-yu
    walk-SR go-SR-Aux
    'A brown cow is walking away.'

   b. waksi: g-sey-ch vo:-k ya:m-k-yu
      Nom-brown-Subj
      'A brown cow is walking away.'

6. waksi:-h-ch séy-k-yu
    cow-Dem-Subj brown-SR-Aux
    'The cow is brown.'

Note that when there is one nominal element in the sentence, the
subject marking is optional. In place of the subject marker the
definitizing suffix may appear as in sentence 5.a. When there are
two or more nominal elements in a sentence, the subject is usually
overtly marked as in 7.

7. a. nya-ch waksi: g-se:y-ya hwa'g-m ba 1-ha:m-yu
    1-Subj cow Nom-brown/pl-Def two-DR all 1-see-Aux
    'I see two brown cows.'

   b. nya-ch waksi: g-se:y-ya ñe-m (ba) 1-ha:m-yu
      he=numerous-DR
      'I see lots of brown cows.'

In a natural speech, the term ñey 'be brown' among the color
reference terms is the only one which utilizes the construction of the
form [noun + g-Verb-[Definitizer]] most consistently.

   Case Marker

2. For other terms, we often find the construction of the form [noun
   + Verb-[Definitizer]] as we see in the following examples.

8. a. nya-ch 'wa: nyimsa:v-a 1-u:yu
     house white-Def 1-see-Aux
     'I see a white house.'

   b. 'wa:-h-ch nyimsa:v-k-yu
      house-Dem-Subj white-SR-Aux
      'The house is white.'

9. a. 'hað nyi-j-msa:v-{ch} viya:m-j-k-yu
     dog -pl- run-pl-SR-Aux
     'White dogs are running.'

   b. 'hað-v-ch nyi-j-msa:v-k-yu
      dog-Dem-Subj -pl-
      'These dogs are white.'
However, some speakers consider sentence 9.c. better than 9.a. Note that in 9.c, the prefix /g-/ appears before /nyi-j-msa:v/. 

c. ʰaːɡ g-nyi-j-msa:v-ch viyaː:m-j-k-yu
dog Nom-nyi-pl-white-Subj run-pl-SR-Aux
'White dogs are running.'

10. a. nya-ch ʰaːɡ nyaː:-ja ʰu:-yu
Black-Def 1-see-Aux
'I see a black dog.'

b. nyiwa ʰaːɡ-ch nyaː-k-yu
that dog-Subj black-SR-Aux
'That dog is black.'

11. a. ʰaːɡ qwanyimaː:-j-ja (ba) ʰu:-yu
grey-pl-Def
'I see grey dogs.'

b. nyiwa ʰaːɡ(-j)-ch qwanyimaː:-j-k-yu
dog(-pl)-Subj grey-pl-SR-Aux
'Those dogs are grey.'

Note that when the verb phrase is clearly marked in respect to plurality, the subject noun is optionally marked by the plural suffix as in 11.b. Sentence 12.a. shows that the nominalized phrase is marked with the subject marker:

12. a. ʰaːɡ qwanyimaː:-j-ch viyaː:m-j-k-yu
grey-pl-Subj run-pl-SR-Aux
'Grey dogs are running.'

b. nyiwa ʰaːɡ-ch qwanyimaː:-j-k-yu
grey-pl-SR-Aux
'Those dogs are grey.'

3. The most commonly found form which the color reference terms employ in the formation of the noun phrase is [noun + verb-Case Marker].

13. a. nya-ch nyigwayliːliː:j'ja hwaːd ʰwː-yiː:-wi
sweater red 1-have-Aux
'I have a red sweater.'

b. nyiwa nyigwayliːliː:j'ja hwa'd-k-yu
that red-SR-Aux
'That sweater is red.'

14. a. nya-ch 'waː hwaːd-1 ʰwː-yå-yu
house red-in 1-live/sit-Aux
'I live in a red house.'

b. 'waː:-h-ch hwa'd-k-yu
house-Dem-Subj
'The house is red.'
15. a. nya-ch nyigwayli:li:ỉ'ja hwa:đ 'wi:-wi
   'I have red sweaters.'
   red/pl 1-have-Aux

b. nya-ch nyigwayli:li:ỉ'ja hwa:đ de-m 'wi:wi
   'I have lots of red sweaters.'
   be=numerous-DR

16. a. meri-ch he' qwath wi:-k-wi
    Mary-Subj dress yellow have-SR-Aux
    'Mary has a yellow dress.'

b. he'-v-ch qwáth-k-yu
dress-Dem-Subj yellow-SR-Aux
   'This dress is yellow.'

17. a. meri-ch he' qwa:th (de-m) wi:-k-wi
    Mary-Subj yellow/pl 1-have-SR-Aux
    'Mary has yellow dresses.'

b. he'-j-v-ch qwa:th-k-yu
   'These dresses are yellow.'

18. a. nya-ch nyigwáy vasu: 'gaga:v-wi
    shirt blue 1-buy-Aux
    'I am buying a blue shirt.'

b. nyigwáy-h-ch vasu:-k-yu
    shirt-Dem-Subj
    'That shirt is blue.'

The plural is again formed by vowel lengthening, but with subsequent changes [vasu: + length $\Rightarrow$ vasu:w + vowel increment] as shown in 19.

19. a. nya-ch nyigwáy \{vasu:wa\} 'gaga:v-wi
    \{va-j-su:wa\}
    'I am buying blue shirts.'

b. ba:-h-ch 'wa: vasu:wa-1 'wa:-k-yu
    man-Dem-Subj house blue/pl-in live/sit-SR-Aux
    'The man lives in blue houses.'

4. We have observed three cases of nominal modification processes. The examples included one-argument verbals referring to colors, [i.e. each verb required one noun--subject]. From what we have seen in those examples, we can generalize that they represent a simple case of relativization; for example, the sentence 'the dog is black' is embedded into the sentence 'John has a dog' to form a new complex
sentence 'John has a dog that is black/John has a black dog.'

When we look at the three processes carefully, we find a hierarchy of cohesiveness of the noun-verb combination in which the noun is the semantic head. The cohesiveness-hierarchy from tight to loose is: i) Noun + g-Verb-(Definitizer) {Case Marker}, ii) Noun + Verb- (Definitizer) {Case Marker}, and iii) Noun + Verb- {Case Marker}.

1) The nominalizing prefix /g-/ often participates in the formation of compounds. See examples 1. through 3, and also the following examples 20. and 21.

20. jí1q-g-ló:h-ya hla:
   bowl- Nom-break-Def month
   'bowl-breaking month/January'

21. hla:-g-sma:-v-a
    month- Nom-sleep- dist-Def
    'always sleepy-month/May'

Among younger speakers, the nominalizing prefix /g-/ tends to be dropped as shown below:

22. gwe(-g)-viyám
    thing (-Nom)- run
    'thing that runs/car'

23. gwe(-g)-j-kwán
    thing (-Nom)- cause- kill
    'one who kills/trapper'

This may reflect that the traditional nominal compound formation is being simplified. Younger speakers tend to use the second type ii) over the traditional first type i).

ii) Nominal compounds may be formed by adding the definitizing suffix, thus keeping the verbness in the construction.

24. bés-a-sí’d-a
    money- Def-one-Def
    'one dollar bill'

25. miyál-sý-ya
    bread- fry- Def
    'fried bread'

iii) In the formation of NP, the third type optionally takes the relational marker /ny(V)-/. The relational marker occurs most often with the verb in the subordinate clause, thus marking the subordinate status of the clause overtly as shown in 26. and 27.
26. a. jon-ch gweiyamm gwa:m-k banya:nyiwa:-1 wa:m-k-wi
car drive-SR Phoenix-into take-SR-Aux
'John drives a car and takes it to Phoenix.'

b. jon-ch gweiyamm nyi-gwa:m-k banya:nyiwa:-1 wa:m-k-wi
'John, driving a car, takes it to Phoenix.'

27. a. jon-ch malinda bæq-m mi:-k-i-ny
hit-DR cry-SR-Aux-perf
'John hit Malinda and she cried.'

b. jon-ch malinda nyi-bæq-m mi:-k-i-ny
'Because John hit Malinda, she cried.'

The optional occurrence of /ny(V)-/ with the verb within the NP seems to indicate that the verbness is most strongly retained in this construction in comparison with the other types i) and ii). Observe the following:

28. a. ba:-h-ch nyi:-'wa: (nyi)-vasu:-1 'wa:-k-yu
'The man lives in a blue house.'

29. a. meri-ch nyi-hé' (nyi)-hala'e: wi:-k-wi
'Mary has a bright dress.'

30. a. waksi: ba:v-a ma:-j-m wi:-j-k-wi
cow bake/roast-Def eat-pl-D do-dist.-SR-Aux
'They regularly eat roast beef/meat.'

b. waksi: nyi-ba:v-j-k ma:-j-m wi:-j-k-wi
-pl-SR
'When they roast beef/meat, they eat it.'

The occurrence of /ny(V)-/ within the NP seems relatively infrequent in Hualapai. The prefix /ny(V)-/ appears more often in a clausal construction as in sentences 30.b. above or 31. below:

31. viyál nyi-nyú'-j-k ma:-j-m wi:-j-k-wi
mescal Rel-bake-pl-SR eat-pl-DR do-dist.-SR-Aux
'When they bake mescal, they eat it.'

The relational marker /ny(V)-/, however, does appear in some lexicalized forms as in 32, 33, and 34.

32. waksi:-nyi-máy
cow-Red-breast
'milk'

33. haiku-nyi-wá'
whiteman-Red-house
'town/city'
34. wambo:d-nyu-v-nya(-a)
   train-Rel-Dem-make=tracks(-Def)
   'railroad tracks'

5. Summary

Nominalization is seen as a special case of the relative formation. The prefix /g-/ not only nominalizes the verb but also states explicitly the cohesion of the verb and the noun it modifies. The prefix /g-/ also describes that the noun being modified is the semantic head (or subject) of the prefixed verb.

The use of /g-/ seems to have become less productive in Hualapai, especially among younger speakers. More often used alternative processes include the following: 1) A verb is placed after the noun to be modified, and the definitizing suffix is attached to the verb if the resulting Noun Phrase functions as the object of the matrix verb. Otherwise, the Noun Phrase takes other case markers as appropriate. 2) A verb-stem is simply placed after the noun it modifies without the nominalizing prefix nor the definitizing suffix if the resulting Noun Phrase functions as the object of the matrix verb.

In these alternative processes, the verb in the Noun Phrase complex seems to retain its verbness more strongly than in the /g-/ nominalized noun phrase.

Footnotes

*We extend our special thanks to Professor Margaret Langdon who has been our constant inspiration and support. Without her and also Leanne Hinton, our on-going research could not have reached the stage they are in.

1. Examples given below are written in accordance with the Hualapai writing system. Special symbols employed include the following:

   p = fortis or aspirated p
   b = lenis p
   t = fortis or aspirated dental t
   d̂ = lenis interdental voiceless stop
   k = fortis or aspirated k
   g = lenis k
   ch = fortis č
   j = lenis č
   v = labial voiced fricative
th = interdental θ
ny = palatal nasal ŋ

\[ d = \text{alveolar ř} \]

2. In the actual writing of the Hualapai text, the following rules have been adopted.

The plural marker is written as $j$; the subject marker $ch$; and the same reference marker (SR) $k$. The following sentences illustrate these:

i) \( \text{he':-j-v-ch qwa:th-k-yu} \quad \text{dress-pl-Dem-Subj he=yellow-SR-Aux} \)
   'These dresses are yellow.'

ii) \( \text{waksi: nyi-ha:v-j-k ma:-j-m wi:-j-k-wi} \quad \text{cow Rel-roast-pl-SR eat-pl-DR do-dist.-SR-Aux}. \)
   'When they roast beef/meat, they eat it.'
An Integrated Account of the Morpheme Θ in Tolkapaya

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As has been noted on numerous occasions, the Yuman languages enjoy a fair amount of what has been called "apparent homophony". That is, a small set of phonemes appears to do multiple duty in representing a wide range of syntactic and semantic functions. In many cases it is possible to provide a unified description of these various occurrences in such a way as to establish a single, common identity—one morpheme. In other cases, identity is not so easy to demonstrate and, in fact, may not exist synchronically.

In Tolkapaya, and other Yuman languages as well, this isomorphic relationship holds between certain nominal morphology and verbal morphology. In particular, the set of demonstrative stems and suffixes shows a high percentage of overlap with suffixes of verbal modification. The identity of one such suffix in Tolkapaya, Θ, is the concern of this paper.

As a demonstrative suffix in Tolkapaya, Θ has a fairly narrowly defined semantic function. Clover (1977) has described its basic features as being "previously mentioned" and "very far". Specifically, in contrast to h, which is also distal (and often "invisible" as well), Θ refers to a previous situation that no longer obtains; i.e., Θ means "formerly present, but no longer here". h, on the other hand, makes no reference to any previous state of affairs, as the following pair of examples shows:

1a) v-ya kθar-ha 'this dog' (the one we're talking prox.pre.-stem dog-suff about that's there now)

1b) v-ya kθar-tha 'this dog' (the one that used to prox.pre.-stem dog-suff be here, but went off)

The semantics of Θ are further illustrated by the following examples that show the features "formerly" and "far away", which don't necessarily coincide.

2) nyahmi ny'-wiy-tha hmi wiyv-ch yu-m
   husband Rel-l-have-suff belt own-sj be-impf
   'That belt belonged to my dear departed husband.'
3) ny-vu-tha 'the dearly beloved (deceased)'
pref-stem-suff

Ω also functions in a number of temporal expressions:

4a) kur-tha 'long ago'
distant-suff

4b) kur-m 'far away'
distant-loc (dir.)

Compare also the next two examples with contrasting demonstrative stems:

5a) ny-tha-m 'then'
pref-stem-loc(time)

5b) ny-va-m 'now'
pref-stem-loc(time)

Some time expressions are apparently verbal constructions:

6) ny-yek-ktho 'tomorrow'
when-be today-Mod

The demonstrative morpheme Ω(a) has cognates in many Yuman languages and has been reconstructed by Langdon (1968) as deriving from Proto-Yuman *s 'far'. I will try to show here that the morpheme of verbal modification Ω has its origins in the distal demonstrative ω and that the basic meaning of Ω has been preserved in the verbal usage, as well as having been naturally extended. For convenience, Ω will be referred to as a morpheme of modality (Mod) when a verbal suffix. In fact, its semantics and usage range across the categories of aspect and modality, making Ω difficult to classify. Perhaps "modality" is the more accurate term, since the use of Ω is strictly determined by the speaker's view of the epistemology of the situation being described.

Several semantic features can be offered that best characterize the verbal morpheme Ω. Ω is essentially contrastive, nonfactual, and temporally prior. In demonstrating how these features are consonant with the demonstrative meanings, we will look at a wide array of syntactic constructions and semantic functions.

Let us first consider syntactic types which perhaps emphasize the temporal (or aspectual) relationships, rather
than the modal. Several facts characterize these distinctive constructions. The situation expressed in each of the clauses marked with θ is temporally prior to the other situation expressed (or implied) in the sentence. In addition, the situation expressed in the θ-marked clause is (at the time of the utterance) nonfactual or nonexistent. Furthermore, the presence of θ implies a state of epistemic contrast which has the functional result of setting up a background for the assertion of present facts. These features will be further explained as the examples are examined.

The first construction we will consider here involves primarily the expression of temporal priority in a contrastively marked situation. Specifically, the construction temporally orders two future-time situations or one counterfactual situation with respect to a past situation. The former is illustrated by example 7, the latter by example 8.

7) Bob-ch ny-he-k-th-k yuw-a-k unuu-k yu-m
    Bob-sj 3/l-call-dir-Mod-SS leave-Irr-SS Prog-SS be-impf
    'Bob will call me before he leaves.'

8) nya-ch 'ich-'-maa-th-k 'yu-am-a-ch 'yu-th-ch yu-mo
    l-sj s.t.-l/3-eat-Mod-SS l-go-Irr-Sj l-be-Mod-sj be-Dub
    'I should have eaten before I left.'

The semantics of the unrealized expression is best captured by considering it to be a future perfect; i.e., in (7), as "Bob will have called me at the time he leaves." Note, however, that the semantically parallel construction in the factual present/past is temporally ordered with a different morpheme, the "temporal pivot". θ is used only with semantically nonfactual situations.

A similar construction is found in future and counterfactual conditionals. The most common form of the future conditional is to suffix the final verb of the antecedent clause with the compound suffix -ktho; the consequent clause is marked as any unrealized independent clause. This compound suffix formula indicates a strong implication of the type "if...then".

9) m-yaam-ktho ny-'uu-ha
    2-go-Mod 1/2-see-Irr
    'If you go, I'll see you.'
An alternate construction for a future conditional, not surprisingly, is identical to simple temporal priority as in (7).

10) m-yaam-th-m ny-'uu-ha
     2-go-Mod-DS 1/2-see-Irr
     'If you go, I'll see you.'

The difference is in the degree of contingency obtaining between the manifestation of the first situation and the consequence.

The formula for a counterfactual conditional is somewhat different. The canonical construction marks the antecedent clause as a nominalization with a behavioral auxiliary (usually yu 'be') suffixed with a demonstrative; the consequent clause also involves an auxiliary construction where the main verb is suffixed with -h 'irrealis', followed by the cognitive auxiliary yi suffixed with θ(a).

11) m-vaa-k m-yu-va ny-'uu-h  'yi-tha
     2-come-SS 2-be-Dem 1/2-see-Irr 1-Aux-Mod
     'If you had come, I would have seen you.'

The auxiliary construction yi-tha is the usual means of expressing the counterfactual sense of "would have, could have, or should have been" and will be discussed in detail later. Since the antecedent clause in (11) is a nominalization, it might be more appropriately translated "Had you come, . . ." (as the speaker often does). An alternative version of the counterfactual conditional employs θ in the antecedent, as well, to indicate temporal priority.

12) m-vaa-th-m ny-'uu-h  'yi-tha
     2-come-Mod-DS 1/2-see-Irr 1-Aux-Mod
     'If you had come, I would have seen you.'

Note that for past conditionals, even though events are temporally ordered, θ cannot be used, since the events are factual and have been realized.

These constructions, then, use θ to indicate that certain presently nonfactual situations are temporally ordered and that their relationship is a marked one. It requires little metaphysics to relate the verbal semantics to that of the demonstrative suffix. Further examples will make this point even more forcefully. However, we can observe here that the demonstrative refers to a situation
that is not a part of the reality of the present (is presently nonfactual), but that once was in the past (temporally prior to the present situation).  Θ is also specifically associated with temporality, as we saw earlier. Furthermore, demonstrative Θ marks anaphoric, previously mentioned things (topics); verbal Θ marks a whole situation as background that is provided for purposes of contrast with the situation that is being commented on.

The close semantic relationship can be seen more clearly in the next construction we will consider. This construction expresses a condition which formerly obtained, but which no longer does. As in English, where this sense is often expressed by the adverbial form "used to", the Tolkapaya form will often involve a habitual construction, as shown in (13).

13) Jack-ch qwaqta maa-m wi-ch-th-k vam 'wil-havasu
    Jack-sj meat eat-DS do-pl-Mod-SS now 'vegetables'

    maa-k wi-ch-k wu-m
    eat-SS do-pl-SS do-impf

'Jack used to eat meat, but now he only eats vegetables.'

In this example the fact that Jack formerly ate meat provides a background of information for the present comment that he is a vegetarian and serves to contrast the two situations. Although this construction usually takes the form of Θ suffixed to the habitual auxiliary construction followed by simple switch reference, the alternative that we saw for conditionals where the frozen form -ktho was suffixed to the stem can also be used—wichktho as well as wichthk. The habitual aspect serves to keep this type quite distinct from conditionals.

In (13) the present situation is actually expressed by a full clause. One clause marked with Θ is sufficient to state by implication that a certain situation once obtained, but no longer does. The present state of affairs does not need to be expressed.

14) ma-ch m-se-ch m-yu-th-k m-yu-m
    you-sj 2-be fat-sj 2-be-Mod-SS 2-be-impf

'You used to be fat.'

The former state of affairs does not have to have been habitual either; a previous incident, now concluded, that has relevance to a present situation may be expressed.
15) 'ima-th-k 'tlahv-k 'yu-m
   l-dance-Mod-SS 1-be tired-SS 1-be-impf
   'I was dancing, but now I'm tired.'

In all of these constructions one of the primary concerns is with the temporal relations of events. More specifically, the morphology is concerned with the aspect of the whole situation—"the internal temporal constituency of a situation". Beyond that, however, is the speaker's view of the whole situation as being inherently contrastive and nonfactual— a modality issue. In these cases which relate two situations temporally, the canonical form has been to suffix the verb of the backgrounding clause with θ and normal switch reference (except for the frozen suffix -ktho). The other clause determines the "real time" of the situation. The exception to this formula is the past perfect construction which seems to require a predicate nominal type construction, suffixing θ to the verb, which is then subject marked and takes the auxiliary yu 'be'.

It is quite common for past perfect constructions in languages to have the characteristics of stative copular-like constructions and this tendency may override the canonical verbal form for these types of utterances.

16) m-neh-th-ch m-yu-ma
2/3-kill-Mod-Sj 2-be-Assr
   'You had killed it.'

17) Lynn-ch Joe chqam-ch yu-th-mo
    Lynn-sj Joe hit-sj be-Mod-Dub
   'Lynn might have hit Joe.'

Example (17) shows that θ may be suffixed to the auxiliary rather than the lexical verb. Of course, the perfect construction manifests the semantics of θ beautifully in representing a past (or prior) event with immediate relevance.

Another verbal construction involving θ emphasizes the contrastive nature of the morpheme. θ used in this way conveys an exclusive quality to the assertion. Suffixied to the numeral verbs, θ means "only N, no more, no less".

18) 'sit-th-k 'yaam-k 'yu-m
    1-be one-Mod-SS 1-go-SS 1-be-impf
    'I went by myself.'
Ø can impart a sense of exclusive identity in existential sentences.

19) 'nya-th-v-ch 'yu-m  
    l-be me-Mod-Sta-sj l-be-impf  
    'It's only me.'

20) tu pahmi-th-ch yu-ma  
    just man -Mod-sj be-Assr  
    'He's only a man.'

Suffixed to a verb in this construction, Ø refers to the uniqueness of an event.

21) m-yaam-th-k m-yu-m  
    2-go-Mod-SS 2-be-impf  
    'You should only be going.'

In this contrastive construction, Ø serves to establish a set of expectations as background for the assertion. These are highly marked, affective utterances in which Ø carries a great deal of modal force and contrastive sense. A sentence such as (20), in effect, calls to mind all possible attributes of the referent, then excludes them all as being nonfactual—except the attribute that is being predicated.

The final type of modal expression we will consider is also contrastive and nonfactual. This construction requires the use of an auxiliary. The morpheme Ø is suffixed to the auxiliary, not to the lexical verb. It is used to express such nonfactual notions as failed attempts and unfulfillable wishes. For these meanings, the set of behavioral auxiliaries is used.

22) 'wil 'yoov-a-k 'wi-th-k 'yu-m  
    money 1/3-make-1rr-SS 1-do-Mod-SS l-be-impf  
    'I tried to make money.'

In this example, the only indication that the action (making money) has not been accomplished is found in the Ø suffixed to the auxiliary.

23a) pahmi-v-ch 'yu-th-k wal 'yii-m 'yu-ch-k 'yu-m  
    man-Sta-sj l-be-Mod-SS * 1-want-DS 1-be-pl-SS l-be-impf  
    'I wish I were a man.'

In this case the desire is potentially unfulfillable—what is desired is nonfactual and ineluctable. Compare (23a) to the identical sentence without the Ø suffix.
23b) pahmi-v-ch 'yu-k wal 'yi-m 'yu-ch-k 'yu-m
man-Sta-sj l-be-SS * l-want-DS l-be-pl-SS l-be-impf
'I wish I were like a man.'

This sentence, on the other hand, expresses a potentially
gratifiable desire—to "be like" something. Nothing in (23b)
 overtly expresses the meaning "be like" (which is another
verb, vlwl)—this must be interpreted from the absence of
θ which affords a possibility of the desire being realized.
The final type of construction to be considered is
specifically counterfactual. In other words, this modal
expression is used to state what "could, would, or should
have" obtained, had circumstances been otherwise. Since
this feature is purely a matter of the speaker's opinion
or thoughts about the situation, it is not surprising that
the auxiliary that is used for this construction is yi,
the cognitive auxiliary. This verb, as an auxiliary or main
verb, is used to refer to mental activities such as thinking,
wanting, liking, and so on. The construction requires that
the lexical verb be marked as irrealis and not take switch
reference. The auxiliary yi itself either ends in the
incremental vowel -a following θ or may take switch reference
if followed by a second clause.

24) ny-tope-h 'yi-th-a
1/2-help-Irr 1-Aux-Mod-Incr
'I should have helped you.'

The next two examples show the possibilities with two
clauses:

25) 'myal-ch-h yi-th-a mwar-ch pem-k yu-m
1-make bread-pl-Irr Aux-Mod-Incr flour-sj be gone be-impf
'We could have made bread, but the flour's gone.'

26) Jeni-ch vak yu-h yi-th-k 'ich-rav-k 'i-k 'i-m
Jeni-sj here be-Irr Aux-Mod-SS s.t.-sick-SS say-SS say-im
'Jeni would be here, but she's sick.'

In examples (24) and (25), we can see that the special
marking on the consequent clause of the counterfactual
conditionals discussed earlier is merely this contrastive
counterfactual statement. When an antecedent clause is
expressed, it simply states the condition that would have
been necessary for the counterfactual event to have been
fulfilled.
The cases we have been considering show how one morpheme with highly marked modal properties can be used to express a wide range of meanings. The essential semantic nature remains constant throughout. However, the interaction with the auxiliary system and other modal and aspectual markings allows the morpheme to function in a variety of settings. The basic semantic features of θ—contrastive, nonfactual, and temporally prior—have been shown to derive naturally from the basic meanings of the demonstrative suffix—"distal" and "previously mentioned." The verbal morpheme θ is essentially contrastive; one of its primary functions is to establish a cognitive distance between some situation and the reality of the present. This conception of θ is the metaphor linking the modal usage of θ to the distal demonstrative suffix.

The historical connection is certainly clear. Since some of the modal constructions are arguably nominalizations, it is not difficult to imagine how the deictic suffix became adapted to the verbal morphological system. There are precedents in other languages for just such things happening. However, since the demonstrative usage of θ is more complex than suggested here and since many of the modal constructions are indisputably verbal, it seems that the most conservative approach is to call these two occasions of θ separate morphemes in the synchronic grammar of Tolkapaya.
Notes

1 Tolkapaya Yavapai or Western Yavapai belongs to the subgroup Pai of the Yuman language family. Grateful thanks goes to Molly Fasthorse, as always, for her hours of hard work at helping me learn her language. Thanks also to Pam Munro and Lynn Gordon for endless discussion on this and other matters. Special thanks to Philip Davis sharing his viewpoints on this as an "outsider"--non-Yumanist.

Examples are written in the orthography developed by the UCLA Tolkapaya group. In this orthography, the phoneme ŋ is written as the digraph th, but I will refer to it in the body of the text as ŋ. Abbreviations used here in glossing morphemes are as follows:

<table>
<thead>
<tr>
<th>Asr</th>
<th>Assertive</th>
<th>Mod</th>
<th>Modal suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aux</td>
<td>Auxiliary</td>
<td>Neg</td>
<td>Negative verb</td>
</tr>
<tr>
<td>Dem</td>
<td>Demonstrative</td>
<td>Perf</td>
<td>Perfective</td>
</tr>
<tr>
<td>DS</td>
<td>Different subject</td>
<td>Pl</td>
<td>Plurality</td>
</tr>
<tr>
<td>Dub</td>
<td>Dubitative</td>
<td>Rel</td>
<td>Relative clause marker</td>
</tr>
<tr>
<td>Impf</td>
<td>Imperfective</td>
<td>sj</td>
<td>Subject case marker</td>
</tr>
<tr>
<td>Incr</td>
<td>Vocalic increment</td>
<td>SS</td>
<td>Same subject</td>
</tr>
<tr>
<td>Irr</td>
<td>Irrealis</td>
<td>Prog</td>
<td>Progressive Auxiliary</td>
</tr>
<tr>
<td>Loc</td>
<td>Locative case suffix</td>
<td>*</td>
<td>1st part of separable verb</td>
</tr>
</tbody>
</table>

2 Kendall (1975) uses this term, but anyone working on a Yuman language has had to deal with the problem

3 The habitual construction inserts one of the behavioral auxiliaries after the verb and before the final auxiliary construction. The behavioral auxiliary is suffixed with the suffix -ch 'Pl.', which corresponds to the "plurality" or distributivity of the action. The verb preceding the behavioral auxiliary always takes the -m 'different subject' switch reference marker. The entire construction is: Verb-m Behavioral Aux.-ch-k Behavioral Aux.+Aspect

4 Comrie (1976), p. 3.

5 The predicate nominal construction in Yuman is discussed in detail in Munro (1976). Langacker and Munro (1975) discuss the relationship between passive-like constructions and perfects in language.
The Development of the Pai Vowel System
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University of California, Los Angeles

0. The vowel systems of the various Yuman languages present a number of interesting and challenging problems in terms of their synchronic description and from an historical perspective as well. The thesis of this paper is to propose an historical explanation for the synchronic vowel system of the Pai subgroup of the Yuman language family. Specifically, the problem that will be addressed is the origin of the mid vowels in the Pai five-vowel system, given that Proto-Yuman had a three-vowel system (i,a,u). The direction of the investigation will be to consider the Pai vowel system and hypothesize as to its historical origins in Proto-Yuman and its relationship to the other contemporary Yuman vowel systems.¹

1. Only stressed vowels will be considered, since the synchronic facts are the most straightforward for stressed vowels. Grounds for this selectivity lie in the nature of Yuman roots, which consist of one vowel nucleus (optionally preceded and/or followed by a single consonant); the root vowel is assigned the primary stress of the word.

1.1 A brief caveat is in order at this point regarding the problem of vowel length. Length is a difficult problem to treat adequately within Yuman for a number of reasons. It is clearly reconstructable as a feature of Proto-Yuman and minimal pairs exist for all languages. In addition, length is involved in morphological alternations to indicate plurality and related concepts.² However, for most of the languages length bears a relatively light functional load and is frequently variable. This is often the case for mid vowels and diphthongs in some of the languages. For instance, Tolkapaya has very few instances of long diphthongs and those that do exist appear to be mainly derived forms. Reconstructing length in particular cases is sometimes problematic due to the synchronic variation and the varying degrees of reliability for reported forms. However, both Cocopa and Diegueño forms are quite useful for comparative purposes as a diagnostic for original length, providing certain variables are taken into account. For Cocopa, what must be kept in mind is a process of final glide deletion after long vowels--this phenomenon has provided a number of forms with final long vowels in Cocopa that correspond to forms in the other Yuman languages that may vary in the length of the diphthong. The
Cocopa form is crucial in order to determine that the Proto-Yuman form was a long diphthong. Diegueño is quite similar to Cocopa in having best preserved the Proto-Yuman system, except for the fact that it has neutralized the length contrast for vowels in root-final position—a fact which is of no significance for determining length of diphthongs. I will attempt to deal with the question of length on a case by case basis as the paper progresses, since it appears to be a major factor in the development of the mid vowels in Pai.

1.2 The method to be employed here integrates structural evidence internal to the Pai vowel system with comparative evidence from the other Yuman subgroups. The inspiration for this paper lies in the landmark work on the Proto-Yuman vowel system by Margaret Langdon in which she reconstructs a three-vowel system (i, a, u) plus length and diphthongs (iy, iw, ay, aw, uy, uw, and their long counterparts). This basic configuration of the Proto-Yuman vowel system will be assumed here. Langdon's approach relies most heavily on an internal analysis of the structure of the languages for which she had data (Yuma, Walapai, Paipai, Cocopa, and Diegueño), in order to reduce the need for cognates. At that time (1970), this was unquestionably the soundest methodology, given the limitations of the available data. In recent years, more complete descriptions of other Yuman languages have become available and will be brought to bear on the problem at hand. I will utilize synchronic alternations and dialect variation within Pai and comparative evidence from correspondences with the non-Pai languages. Since morphological alternations of vowel quality to indicate plurality are not productive in Pai, more attention to the comparative situation is required here than was necessary in Langdon's analysis of the River vowel system.

In the process of demonstrating that Proto-Yuman had a three-vowel system, Langdon proposes a set of rules to account systematically for the five-vowel system found in the River languages. The analysis is primarily based on internal structural comparison of the synchronic vowel alternations found in Yuma, which has a highly developed system of morphological alternations to indicate plurality. Langdon suggests that these rules represent processes that reflect some of the tendencies of the Yuman languages and finds evidence for this in the limited data presented for Walapai and Paipai (Pai subgroup); Cocopa and Diegueño provide interesting counterparts as synchronic three-vowel systems (California-Delta subgroup). Langdon's discussion, then, is oriented toward
the type of five-vowel system that is exemplified by the River languages. She states that, synchronically, the Yuman family exhibits three types of vowel systems: a three-vowel system \( (i, a, u) \) with length and numerous diphthongs—Cocopá and Diegueño; a five-vowel system \( (i, e, a, u, o) \) with length, numerous diphthongs and mid vowels and a prolific morphological process of vowel alternations—the River languages; and a five-vowel system plus length, having significantly fewer diphthongs and mid vowels and a mere handful of relic forms involving vowel alternations—the Pai languages.

1.3 I will provide new data in this paper that suggest a different characterization of this third type of vowel system exemplified by the Pai languages: that is, a five-vowel system with length, very few diphthongs (that are not involved in older alternations or in derived forms), a significant number of mid vowels (but few long ones) and a fair number of vowel alternations involving quality (as well as the length alternations that are common throughout Yuman). This characterization requires an analysis of the development of the Pai vowel system that is distinct from that of the River group, though certainly related to it.

1.4 We will be concentrating on the mid vowels in Pai, which will be shown to have been produced by two primary means—monophthongization and the raising or lowering of short vowels in Proto-Yuman. Fortunately, as I will show, the synchronic data that are relevant to the relationship between mid vowels and diphthongs account for many more forms than had previously been supposed. The comparative evidence, however, is essential to the task of relating the (non-alternating) mid vowels to diphthongs or to other Proto-Yuman vowels and for determining the processes that led to the creation of these relationships. We will be directing our attention, then, to three types of data: 1) synchronic (singular/plural) ablaut alternations within Pai (giving cognates elsewhere, when available) 2) non-alternating mid vowels in Pai corresponding to (high or low) monophthongs elsewhere 3) non-alternating mid vowels in Pai corresponding to (high or low) monophthongs elsewhere. Since our main concern is with Pai \( e \) and \( a \), we will only briefly mention the correspondences for \( i, u, a \) for the sake of completeness. For the most part, Pai \( i(1) \), \( a(a) \) and \( u(u) \) show an isomorphic relationship to their cognates in other Yuman languages and correspond directly to what must be established as \( *i(1) \), \( *a(a) \) and \( *u(u) \), respectively, although length, as mentioned, is often variable. Most cases of the non-mid vowels in Pai are identical to the corresponding vowels in Cocopa and Diegueño (the most conservative languages...
with respect to vowels) and have not varied in quality from
the vowel that must be established for Proto-Yuman. Many
Proto-Yuman vowels developed mid vowel reflexes in Pai under
conditions that will be discussed later. These processes
primarily involved assimilation and, in conjunction with the
monophthongization of Proto-Yuman diphthongs, they account
for all the mid vowels in Pai for which available cognates
make an analysis possible.

2. We will now consider the relationship between mid vowels
in Pai and the Proto-Yuman diphthongs. The data that will be
presented include: 1) a set of forms with mid vowels in Pai
that do not have ablaut alternations, but that correspond to
cognates elsewhere having diphthongs and 2) a set of forms
showing synchronic morphological alternations (singular/plural)
between mid vowels and diphthongs that are much more prevalent
in Pai than had previously been thought.

2.1 Approximately thirty examples have been found which show
a relationship between (non-alternating) mid vowels in Pai
and diphthongs in either (or both) the California-Delta branch
and River. Of these thirty cases there are slightly more of
the type o corresponding to a(a)w than of the type e corresponding to a(a)y. Consider the following examples showing
the relationship o(o): a(a)w.

(1) EAT MEAT, TO
   P soo; Ya φoo; H φo;
   Ma sooo; Mo iφoo; Yu sooo;
   C τa; Di saaw

(2) RABBIT
   Ya hloo; H hlo?o;
   Ma xaλy?aw; Mo haλy?aw; Yu xaλy?aw;
   C xaλy?aa; Di haλyaw

For all available examples, the Pai languages developed o(o)
wherever Cocopa and Diegueno have the long diphthong aw. A
number of cases of o(o) in Pai can be assumed, then, to be
derived from *aaw; this conclusion also explains the few
examples of synchronic aw existing in the Pai languages, which
can be shown to correspond to short aw in the non-Pai languages.
The two cases of aw in Pai for which cognates are available
occur after *t— which is lost in the Pai languages. The crucial
cases are both verbs:

(3) CHILD, TO BEAR A
   P saw; Ya θaw; H θaw; W θaw;
   Ma sa?aw; Mo iQ?aw; Yu s?aw;
   C s?aw; Di s?aw; K s?au
SON'S CHILD, TO CALL  
M AY; Mo aYa; Yu aYa;  
C aYa; Di aYa

The latter example is particularly revealing when compared to the cognate set for FIRE, which has historically a long diphthong aaw.

(5) FIRE, EMBERS  
P oYa; Ya oYa; H oYa; W oYa;  
Ma Ya; Mo aYa; Yu aYa;  
C aYa; Di (?a)aYa

Throughout this discussion we have been assuming that the Diegueño and Cocopa forms reflect the original length of vowels in Proto-Yuman most accurately (keeping in mind the earlier discussion of loss of final glides after long vowels in Cocopa). The remaining few cases of aw in Pai have no cognates in California-Delta and are also assumed to derive from short aw.

2.2. We will now consider examples of the type e(e):a(a)y which are not involved in alternations in Pai. The following two examples are illustrative:

(6) SAND  
P sile; Ya sile; H sile;  
Ma sile; Mo sile; Yu sile;  
C sile; Di maaYa (Ca), maaYi (LR)

(7) DAUGHTER-IN-LAW, TO CALL  
Ya unYe; H unYe;  
Ma unYe; Mo unYe; Yu unYe;  
C unYe; Di unYe

In all of these cases the Pai vowel is always e (or more rarely ee).

Numerous cases of this thorough-going monophthongization process exist for forms that are long or short a(a)y diphthongs in Cocopa and Diegueño and were therefore presumably of both types in Proto-Yuman. How this developmental process might have occurred in Pai can be determined by considering the following facts: 1) most Pai verbs with root vowel e having cognates elsewhere with a(a)y show synchronic alternations in Pai of e (sg.)/ay (pl.); 2) all nouns in Pai with e (or ee) correspond to cognates with aay.

Let us then consider the Pai verbs with synchronic alternations of the type e/ay, which indicate the singular/plural forms of the verb. Of the approximately thirty verbs in Pai with such alternations, about half have been found to
have cognates in the non-Pai languages and the cognates in River or California-Delta show either ay or aay. The following examples are representative:

(8) COVER, TO  
Ya čpe/čpay

(9) DIRTY, STICKY  
TO BE  
Ya qe/qay

(10) BIG, TO BE  
P Bte, Btaiy; Ya vte/vtay; H vte, vtee;  
W vte; Ma vatay/vta; Mo vaḷtay;  
Yu vatay; C ptay; Di tay

The number of alternations of the type o/ay is strikingly less than for e/ay—only three cases and only two of these with cognates. The examples are exhaustive:

(11) FIGHT, TO  
Ya čo-(v)/čaw(v); H čo-(v)/čaw(v);  
P čov/čaw

(12) RAIN, TO/ 
STORM (N)  
Ya kwivo/kwivav; P Bok; W kwivo;  
Ma uV?aw; Mo kuv?aw; Yu uuV?aw;  
C p?aa; Di kwi iy-paV?aw

(13) TAKE, GRAB, TO  
Ya yoV/yaw; P yo; H yo;  
Ma daaw; Mo iVaw; Yu yaa  
Di yuV/yaw (MG)

An interesting observation can be made at this point that seems to warrant a slight digression from the main topic at hand. It is apparently the case that all Pai alternating verbs and forms that correspond to cognates with diphthongs outside of Pai occur only in roots with open syllables; that is, roots of the shape (C)V (C). For all these data, any consonants occurring post-stress are segmentable morphemes (e.g. the -v suffix found above in TO FIGHT). The basic structure of the Yuman root is always described as (C) V (C), where the stressed vowel can be short or long, but is usually unspecified as to whether it can include the complex vocalic peak VG. The data here support a description which is restricted to exclude roots of the shape *CVGC.

2.3 We have now seen examples with mid vowels in Pai—both non-alternating and those that alternate with diphthongs—that correspond to diphthongs in other languages. I propose the following explanation for the distribution of forms containing e(e), a(a)y, o(o) and a(a)w across Yuman.
Let us start by assuming that vowel alternations to indicate plural and related notions can be reconstructed as a characteristic of Proto-Yuman. All the daughter languages show such alternations to some degree. It appears that Proto-Yuman must have had as a regular type of verb alternation the forms *aay/sg./ay/pl. and *aaw/aw. Some alternations of the type *V/VV and *ay/aay probably also existed; the former, in particular, is a preferred alternation for some of the modern languages. Reflexes of the alternation *VVG/VG still flourish in some of the languages. Consider, for instance, the following examples from Cocopa:

(14) EAT MEAT, TO C ʂaay/ʂaw
(15) BE AFRAID, TO C mʃyaa/mʃɔyay

These examples demonstrate the alternations aaw/aw and aay/ay (keeping in mind the Cocopa glide deletion rule).

I propose, then, a set of events involving monophthongization of long diphthongs to mid vowels, which, in conjunction with analogical levelling, resulted in the present Pai vowel correspondences and accounts in part for the differences between Pai and River with respect to their vowel systems. Perhaps because of their length, long diphthongs were unstable, subject to variation and tended to be reduced to e or o. The short diphthong for the plural remained, producing the present alternation for Pai alternating verbs. This process also affected nouns with long diphthongs by reducing their diphthongs to e or o. Examples of nouns affected in this way include the following:

(16) DOCTOR Ya kɔye; H kɔye=e; W ki=ie;
Ma kʷiside; Mo kʷaʔiidee; Yu kʷasʔiidee;
C škwiya; Di kusyaay
(17) WILLOW P (?)yo; Ya ?yo(o); H ?yo(o); W ?iyoo(?);
Ma iyo; Mo ?iido; Yu ?iido;
C ?aya, ?aayaaw; Di ?yaaw; K ?yhaaw

In addition, there is a set of verbs of the type e/ay in Pai that correspond to verbs with short diphthongs in River and either short or long diphthongs in Cocopa and Diegueño. Some of these are derived by the addition of the -y suffix postulated by Langdon as a suffix in Proto-Yuman which derives verbs from nouns.10 The rest of this set of verbs (if, in fact, they are not all derived) probably had the Proto-Yuman alternation ay/aay. These two types of alternation
patterns (aay/ay and ay/aay) resulted in a situation which apparently inspired regularization in Pai. Long diphthongs were regularly reduced to e and came to be reinterpreted, for these forms, as the singular; short diphthongs were regularly associated with the plural, as was the case with the aay/av diphthong alternations. Examples from this set of verbs include the following:

(10) BIG, TO BE (see page)

(18) FAT, TO BE
Ya se/say; H se; W se/saay;
Ma şay/ga; Mo ?isay/uusaa; Yu aşay;
C sa; Di şay

(19) LIVE, INHABIT TO
Ya n²wev (Tolk.), n²wayv (Pres.);
H n²wev; Ma n²vay; Mo n²vay;
Yu n²vay; Di n²waayp

Under the above interpretation, one would expect nouns with short diphthongs to have been unaffected by this process, since no alternation patterns exist for nouns to set the stage for analogical levelling to take place. This is in fact the case and such nouns are included in a small set of lexical items having -ay for a root vowel in Pai. The list here is exhaustive; the Cocopa and Diegueño forms are indeed short and the River vowels show an unexpected -aa in 20, 21, and 22.

(20) BREASTS
Ya n¹may; H n¹imay; W n¹imay;
Ma ma; Mo n¹amaa; Yu n¹maa;
C n¹may; Di n¹imay; K. n¹mayu

(21) HEART
P yiway; Ya iway; H iway; W yiway
Ma iwa; Mo iwa; Yu iwa;
C [iwa]; Di [iwa] (SJ), [eywa] (MG)

(22) SMOKE
P ox³way; Ya ?oh³way; H okh³way; W oh³way;
Ma x³wa; Mo ?ah³wa; Yu ?ax³wa;
C [x³wa]; Di ?uxu, iuxy

(23) FAT, GREASE
P sa; Ya sa; H sa¿a; W sa;
Ma (Ç) šay; Mo (?)isay; Yu sa;
C sa; Di sa

There are approximately five verbs in Pai that contain roots with -ay that were not regularized by this process. Most of these are derived forms and apparently do not have cognates outside of Pai (and River).
To recapitulate, the claim is that the regular pattern for Proto-Yuman verb alternations with low vowel diphthongs was _aay/ ay_ (and some _ay/_aay_) and _aw/aw_. The long diphthongs were monophthongized to _e_ and _o_, respectively, in Pai in all cases; in the River languages, about half the diphthongs became _e_ and _o_, about half of them not. This diversified situation necessitated the set of rules postulated by Langdon to account for the Yuma vowel system.  

As noted by Langdon, these rules leave a number of forms unaccounted for, particularly those forms with _o_(a). Fortunately, it is not my task here to explain why the River languages did not carry the monophthongization process to its extreme. As for Cocopa and Diegueño, they seem to have been exempt from these particular mechanisms of language change and still evince some of the original alternations.

The alternation type _i/uy_ will not be discussed here, since too few cases exist to allow anything conclusive to be said about the relationship of _i_ to _uy_.

The only quality alternation that remains to any degree in Pai as a remnant of the older morphological process of pluralizing through vowel ablaut is the alternation _e/sy_. The only productive means of indicating plurality by altering vowels in Pai is an alternation in quantity (i.e. a vowel is lengthened to indicate plural). The Pai languages are continuing to regularize the system to the degree that, more often than not, the _e_ plural suffix is the only mark of plurality on verbs. The River languages, however, still show a preponderance of quality alternations and pure length alternations are in fact rare—a factor which certainly contributed to their divergence from Pai with respect to the development of the vowel system.

3. Processes other than monophthongization account for a number of forms with mid vowels in Pai. These will only be briefly mentioned without exemplification due to lack of space. These are phonological processes of assimilation—the main type being that of lowering high vowels in certain environments. Some instances of raising (a→e) do exist as well. Based on the correspondences I have found, the most general statement that can be made regarding the lowering process is that short high vowels were lowered in the presence of a typical lowering environment; that is, following *q or *x or preceding *q or *x (or both). These processes cannot be demonstrated to be synchronic in such a way as to eliminate the need for establishing a phonemic five-vowel system.

To illustrate the problem, I have compiled a list of approximately fifty examples with mid vowels in Yavapai alone.
(which is certainly not exhaustive) for which I am unable to find cognates and for which no alternations exist. As in the River languages, a fair number of mid vowels have derived from the lowering of high vowels.

Instances of sporadic raising of short vowels after a palatal occur in various of the Pai languages.\(^7\) Compared to the raising process in River, which is very regular and thorough-going, the Pai process appears random and spotty indeed.

In summary, the greater number of mid vowels in Pai created through monophthongization is counterbalanced in the River languages by much more generalized and productive raising and lowering rules. Since some degree of application of both phonological mechanisms is apparent for each group, the typological difference between the two types of five-vowel systems must be explained by considering the extent to which the processes were implemented. The Pai languages levelled most of the diphthongs, retaining only a few short ones and these mostly involved in older verb alternations. This process, in addition to some lowering operations, produced the present set of mid vowels and was responsible for the present-day scarcity of diphthongs in Pai. The River languages, under conditions that are not completely clear, selectively monophthongized diphthongs to mid vowels. Retaining quite a few, however, and continuing to use morphological alternations of vowels, the River languages derived the bulk of their mid vowels through generalized lowering and raising rules.\(^8\) This description of the development of the Pai vowel system in the context of the evolution of the other Yuman vowel systems accounts for a number of what would otherwise appear to be odd and disparate facts about the respective developments of two types of five-vowel systems in Yuman.
Notes

1 Yuman has four main branches: Pai (Yavapai (Ya), Havasupai (H), Walapai (W), Paipai (P)), River (Maricopa (M), Mojave (Mo), Yuma (Yu)), California-Delta (Cocopah (C), Diegueno (D)) and an isolate, Kiliwa (K). The primary source for the Pai data is from Yavapai (largely Tolkapaya, the western dialect)—the language with which I am most familiar—but include data from most available sources for Havasupai, Paipai and Walapai. This reliance on Yavapai is necessitated by the greater accessibility of the data and is facilitated by the fact that the vowel system is largely homogeneous throughout Pai. Where there is any significant difference among the Pai languages with respect to the vowels in a particular form, the facts will be noted.

My knowledge of Tolkapaya Yavapai is based on extensive work with a speaker, Ms. Molly Starr Fasthorse, to whom I am deeply indebted. Most of the information for Maricopa cited here comes from work done with Ms. Pollyanna Heath by myself and Lynn Gordon, Pamela Munro and Bonnie Clover. Much thanks goes to Pamela Munro for her help and to Margaret Langdon, Alan Timberlake and Lynn Gordon for their comments and discussion.

Other sources of Yavapai data include primarily the dictionary section from Alan Shaterian, "Yavapai Phonology", unpublished ms. (which was immensely useful) and some work I did with a speaker of the Prescott dialect, Ms. Winona Russell Durant. All sources were supplemented by material from the Yuman archives at UCSD and the use of the comparative Yuman 100 word list prepared by Pamela Munro—these were the primary sources for the Walapai data. Contributors to the Yuman word list include: S. Chung (Yavapai); J. Redden, A. Yamanoto, and R. Lieber (Walapai); E. Kozlowski (Havasupai); J. Joel (Paipai); P. Munro (Mojave); R. Harwell (Maricopa); C. Slater, A. Halpern, and D. Crook and S. Norwood (Yuma); J. Crawford, and T. Nevers and C. Nevers (Cocopah); M. Langdon (Diegueño--Mesa Grande, Campo, San Jose and La Huerta) and M. Mixco (Kiliwa).


3 Langdon (1977).
Langdon (1976).

I will use the abbreviation V(V) to indicate a short or long vowel (VV = long, V = short).

In the examples that follow citations represented in brackets cannot strictly be judged to be cognate, but appear to bear some relationship to the other members of the set. Cognate judgments for the words from the Yuman 100 word list are from Pamela Munro. Where two forms are given for a particular language, either both variants are possible or different forms were given by two distinct sources. Words in parentheses are from Wares (1968) and have no independent verification from a more current source. In a few cases, more than one dialect of Diegueño and Yavapai are cited separately and designated by the appropriate abbreviation where a comparison of the forms might be revealing. In most cases, the Diegueño form will be from the Mesa Grande dialect, the Yavapai from the Tollkachaya dialect. In all cases, the cited form will be the singular unless the plural is available (and is formed by vowel quality ablaut).

Actually, in example 12, the relationship between RAIN and STORM might just as appropriately be viewed as another instance of singular/plural—considering "storm" to be a distributed, intensified function of "rain".

For example, see Langdon (1968), Langdon (1976), and Langdon (1977). Margaret Langdon has pointed out to me that the vocalic peak has not actually been assumed to include diphthongs, however.


This -y suffix was first identified by A.M. Halpern for Yuma.

Compare this example to the derivationally related set for the noun (23) FAT, GREASE.
n^ywayv = LIVE, INHABIT consists of the morphemes
n^y + wa + y + v = Possessive + house + -y suffix + stative -v.

Margaret Langdon has suggested to me that some of these nouns may in fact be derived, a fact which would, in itself, be some motivation for preserving the diphthong.

Langdon (1976).


For a discussion of this problem as it pertains to Yavapai see Shaterian, n.d.

Also, Shaterian mentions some free variation between _a_ and _e_ for some words, following a palatal. Paipai and Walapai have _e_ where Yavapai has _a_ following a palatal in a few words (e.g. CUT and SHOOT).

REDUPLICATION IN MOJAVE--AND YUMAN

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Reduplicated forms have thus far been largely ignored in Yuman comparative work, though they are usually given a brief nod in grammars. My recent study of reduplication in Mojave has suggested to me, however, that these words may turn out to be a rich mine of archaic data on phonology and even morphology. This paper will serve first to present some of the Mojave reduplicated words I have discovered (primarily in the course of my lexical research with Nellie Brown and Judith Crawford), with commentary. At the end of the paper I will suggest some of the generalizations that we may in time be able to make about reduplication in Proto-Yuman. Rigorous comparative work cannot, however, be begun without more information on all the languages of the family. 2

Reduplicated stems in Mojave, and Yuman generally, are usually of the shape CVC-CVC or, more frequently, CVCCVC. (As far as I can tell for Mojave, there is no easy way to predict when a connecting schwa will occur. Margaret Langdon has confirmed that this is also the case for Diegueno.) Generally both reduplicated parts have roughly equal stress, sometimes so much so that they sound almost like separate words. Uncommonly, the reduplicated element will be augmented, giving patterns like CVCCVCVC or CVCCaCVCC. Occasionally the second vowel will be lengthened or (very rarely) ablauted, but otherwise a strict similarity is preserved between both parts of the word. In my discussion below, I will refer to the reduplicated elements of this type as "reduplicands".

Yuman reduplicated words are essentially verbal. The most common ways they are used, both in Mojave and generally, are alone (with suitable verb morphology) or with the auxiliary verb 'say' (usually in its shortest form). Sometimes there is no difference in meaning between these two syntactic types (as in (1)), but often there is (as in (2)):

(1a) tulykatulyk-k 'it's uneven'
    b) tulykatulyk i-m 'it's uneven' (literally, 'it says uneven')
(2a) yenayen-m 'it's circular'
    b) yenayen i-m 'his flesh shakes as he walks' 3

These examples are unusual, because most reduplicated verbs can only be used in one of the two ways. (The 'say' construction has been studied by Langdon (1977).)

Like any other Yuman verb root, reduplicated verbs may be used with additional derivational morphology, forming derived (primarily causative) verbs or (rarely) derived nominals or nominal modifiers. I distinguish this sort of morphological augmentation from the augmentation of the CVC reduplicand referred to above, because these added derivational morphemes only occur once in a word (that is, they are not themselves reduplicated).

There is often a clear semantic relationship between a reduplicated word and a simple unreduplicated word containing the same element.
Often (but by no means always) this relationship is one of intensification, as exemplified in (3-4):

(3a) ?alay-k 'it's bad'
   b) ?alay?alay-m 'it's a mess'
(4a) ichpel i-m 'he sticks his tongue out a little bit'
   b) ichpelichpel i-m 'he darts his tongue in and out'

Frequently reduplicated verbs refer to sounds or to other physical descriptive qualities. Many do not seem to occur unrepeated.

Occasional CV.CV reduplications occur, which do not seem to fit the basic patterns described above. Many of these are baby talk words (in Mojave), e.g.

(5) mini 'cry' (adult imii)
   kaka 'grandma' (adult nakav 'mother's mother')
   chu'chu 'cold' (adult hachuur)
   tata 'parent' (adult intay 'mother')
   tutu 'hot' (no known adult correspondent)

There are also CVCCV baby talk words, such as

(6) pishpish 'suck' (adult ipith)
   hat-hat 'dog' (adult 'ahat 'pet', hatchoq 'dog')

I think it is not unreasonable to assume that these baby talk formations need not fit exactly into the standard reduplication pattern of the language. Another source of CV.CV reduplications is animal names, which might be onomatopoetic:

(7) kuku 'small dove sp.'
   qoqo 'kit fox'

(Again, there seems to be an association of this type of reduplicated word with smallness.) I know of only one Mojave word containing a CV.CV reduplication which is neither a baby talk word nor an animal name:

(8) chiriri-m uukwe 'ring (of an alarm clock)'

Stress is marked here to highlight the reduplicated part of the word. It is easy to suggest that this word is onomatopoetic and reflects smallness, but it is strange that this sort of word is so uncommon.

I present below several hundred Mojave reduplicated words, arranged according to the reduplicand (standard CV.CV reduplicands are listed first). To save space, I have listed only one form of any given word, unless the reduplication (as opposed to other affixation) changes.

<table>
<thead>
<tr>
<th>Table 1. Mojave Reduplicated Words</th>
</tr>
</thead>
<tbody>
<tr>
<td>'al 'al'al i run wild, act crazy</td>
</tr>
<tr>
<td>'ala'al i hang down too far, hang down and sway in the wind</td>
</tr>
<tr>
<td>'aly nya'aly'aly sinews in the neck</td>
</tr>
<tr>
<td>'an 'ana'an i move back and forth in wind or water</td>
</tr>
<tr>
<td>ta'ana'an look down</td>
</tr>
<tr>
<td>'ar 'ara'ar deep, of water</td>
</tr>
<tr>
<td>'as 'as'as i nod the head yes</td>
</tr>
<tr>
<td>'en 'ena'en i move</td>
</tr>
</tbody>
</table>
'er  amat qa'era'er  a place near Needles
'ey  chuuch'eyu'ey  negotiate
'on  'ona'on  be just one (sticking up or standing out)
'oq  'oqa'oq  be dome-shaped
'oy  'oya'oy  spherical
cha'oya'oy  roll dough balls
ta'oya'oy  make round, curl
'us  ii'we  'usa'usny  meat part of the buttocks
kam'ito  'usa'us  cantaloupe (var.)
'uth  'utha'uth  fuzzy
chily  chilachily, chilyachily  stick out, stand out (of hair)
mat  kachilyachily, mat sachilyachily  bristle (of cat's tail)
chuk  tachukachuk  crouch, squat
dol  doladol  i  hunch up
dor  dohador  walk along bent over, looking for something
chuudorador  bend down to hide while stalking game
duly  'a'ii tuudulyaduly, 'a'ii kwachaduluyaduly  termite
suudulyuduly  dip one's hand in
duny  tunadyaduny  make a hole in the sand with one's buttocks
tahuudunyaduny  be too weak to get up or walk
dur  duradur  i  be itching to do something
hal  'akyes halhal  grass sp.
halhal  i  make a hollow sound
halhal  yellow beetle sp.
hap  hapahap  slanted, with a low hump
hath  hathahath  smooth off, sand
hathahath  i  make noise while going through the brush
haw  hawahaw  crumble (intr.)
hay  hayahay  be smooth
ahayahay  glide, slide
tahayahay  slide down
hel  helhel  i  flow gently over
hen  henhen  i  fly off together all at once
hes  heshes  i  chatter, gossip
ho  ho  ho  ho  ho  ho  ho  puff up, bloat
hong  hoonghoong  i  make a hollow noise
hop  iisaly chahopahop  hollow the hand
uuhopahop  make something stick up in a hollow cylindrical shape
hwal  suhwalyahwaly  scratch
hwar  hwarhwar, tiinyam hwarhwar  noisy insect sp.
hwarhuwar  what tiinyam hwarhwar says
salwarhwar  scrape hard
hway  chuuchhwayuway  talk in whispers (multiple pl.)
hwech  hwechahwwech  name of an old song
'ahwechahwech, hwechahwech  oriole
hwep  suhwepehwep  build a temporary shelter of mud, arrowweeds
hwey  chachhweyahwey, chuhueyahwey  talk in whispers (dual)
hwich  mat ahwichahwich  sit up straight to aid digestion
hwiny  hwinyahwiny  have one big curve
tahwinyahwiny  carve something out, make a curve
hwir  tahwirahwir  turn, spin (tr.)
thahwirahwirv  turn one's body to look
hwiv  uuwivahwiv  pull out gradually (tr.)
hyol  hyolahyol  hunch up
hyor  hyorahyor  walk along with bent back
kal  kalakal  skinny, thin (e.g., of mesquite beans)
kalkal 'ahwe duuch-vé  place name
kan  takanakan  squat down
kap  kapakap  'have a big hole, crack, or wound
nuuviil kapakap  pickup truck''
kar  karakar i  be trimmed with lace at the edge; tremble
kas  kaskas i  chatter (of teeth)
kel  kelakel i  rattle
kik  kikakik i  crack (of an old house)
kol  kolakolyv  be piled up log-cabin style
chuchkolakolyv  pile up log-cabin style
kong  koongkoong  make the sound of an unripe melon
kuh  chakuhakuh  knock, tap
kul  takulakul  be piled up, one on top of each other
kwer  kwerekwer  be soupy, not thick
kwerakwer  sharp (of pointed object)
takwerakwer  sharpen to a point (sg.)
kw in  achkwinkwin-ve  screwdriver
kwin  achkwinkwin  go round and round
kwir  'ahnchet kwirawir  barley
takkwirawir  sharpen to a point (pl.)
kyen  kyenakyen i  make a barely audible hollow sound
kyeng  kyengakyen  ring (of a bell)
kyengakyen i  ring, toll (of a bell)
lany  lanyalany  trot
lap  lapalap  flat
chuulapalap  flatten (for instance, a tortilla)
talapalap  flatten
las  alasalas  space feathers out on a lance
lath  lathalath  make the sound of raindrops on a mud house
kalathalath  smash repeatedly with the feet
lav  lavalav i  flutter
law  lawlaw i  shake head around to look at everybody
lep  lepalap  not fit right, fit loosely (of clothes or skin)
lev  levalev i  tremble; be flabby
lik  likalik  be a very small protuberance
loch  lochaloch i  be dripping
loy  loyalooy  be in a row
taloyalooy  put one next to another in a row
luy  'utis taluyaluy  30/30 rifle
lyah  chulyahulyah  pat on the back, using both hands alternately
lyap  chuulyapalyap  flatten with the hand
lyep  lyepalyep  flattened out
dalyepalyep  step on something to flatten it (e.g. stomp grapes)
lyik  likalik  yiik  flake off
lyom  chuulyomalyom  crumple up (tr.)
lyum  taalyumalyum  crush paper into a ball
man be lying in a bunch (e.g. melons)
chamanaman roll (tr.)
kwichchamanaman, kwichmanaman cocoon
mar kamaramar level off grave to hide it
mel melamel football-shaped (sg.)
men menamen long and thin, cigar-shaped (sg.)
mer meramer true, straight
tameramer straighten
mich michamich be a little cracked
nil milamiiil football-shaped (pl.)
'amat milamil be covered with mud
nin minamiin long and thin (pl.)
tadiich minamin corn on the cob
mir miramir straight (of hair)
mith mithamith i have leprosy
moq moqam oq i growl
muk nyamukumuk rub wheat on canvas to remove the seeds
muny munyamuny i rotten clear through
mur muramur i crumble (intr.)
su sumuramur crumble with the fingers
nam tanamanam fold over
nap hunapnap butterfly
napanap flattened
iisaly suumapanap have webbed fingers
naq naqanaq stop or end unexpectedly or inconveniently
nat natanat i sound the way a ripe melon does when it's plunked
nun 'ahnumunanun darr
nyem nynemnynem i shining, light, silky; flash
nyep nyepenyep i soft, spongy, squeezable
nyik nyikanyik i caught, tangled inside
pach chupachapach dust off one's clothes with the hand
paq paqapaq i make a popping noise
paqapaq firecrackers
pel pelapel very dirty
pik pikapik short and fat
piny piinyapiiny i "love" a pet
por porapor narrow (of a strip or edge)
kaporapor shove dirt into a ridge
pot potapot i come out (of lots of small subjects); snag (of stockings)
puly pulypuly i move around while covered with a sheet or blanket
qal tatqalaqal notch (tr.)
qaly qalyaqaly i very soft
qam chaqamaqam knock, bang
qany qanyaqany i long
qap qapaqap flat
qar qaraqar i gelatinous; feeble
qaw qawaqaw really hard
tatuqawaqaw run into one another
qay qayaqay i shake like jello
qer qeraqer i thin, watery
qes qesaqes i rub
qes (cont.) taqesaqes all tied up in knots
qoh qohqoh i sound like pounding
qol qolaqol i rattle inside (e.g. canned goods)
qoly qolyqoly i swallow up
qony qonqony i shake, bounce (of body fat)
qwai 'ahaly qwalqwal was for fun
qwaw modily chuqwawawqawaw biscuits
qwel qwelaqwel i make the sound of someone flopping around in water
qwer taqweraqwer sharpen to a point (sg.)
qwev qwevaqwev long and straight
qrir tarqwiraqvir sharpen to a point (pl.)
rarp raparap washed smooth
raq 'aharaqaraq, 'araqaraq mesa on the side of Fort Mojave
rath ratharath rough
rem chuurmarem flick finger at something repeatedly
rep reparep i very thin, transparent
rev revarev i thin, shiny
rik rikarik i fall, pour out
rith rithariith speckled, freckled
roq roqaroq long and narrow (sg.)
roy royaroy i gradually spill or sift out (pl.)
runya runyaruny i sink under the feet
'amath runyaruny quicksand
ruq ruqaruq long and narrow (pl.)
ruy kataryuury horned owl
ruyaroy i gradually spill or sift out (sg.)
sich siichasich i drip, drop (of rain)
sil silasil stick out further (than the rest of a group)
sip sipasip long and sharp
tasipasip sharpen
sir sirasir having very small branches
sup siiyany chuusupasup pucker up the mouth
shap kwashapashap badly faded
sheng shengasheng i ring
shengsheng i jingle, ring
shik shikashik scary creature (baby talk)
tah iisaly chuhtahataclap the hands
taly talytaly ichaa play an instrument
tath chuhtathataclap on the hand or back; clap
taw tawataw i flash on and off
tem tematem i sparkle, shine
teq teqateq i scratch; lick, lap
tik tiktek i, tiktek i minute, second
sutikutik type (on typewriter)
tikatik be well-dressed
tiv ativativ shake (tr.)
'tamayk vuutivativ shake (tr.) at someone
uutivuvu ativativ shake out (tr.)
tivativ i very cold, chilling
tor torator small and round (sg.)
tuk satukatukv plough straight through the water (of a boat)
tuly  'avii tulytuly  place name
tuny  tunytuny  roll (intr.)
tunytuny ima  roll, dance (like tumbleweed)
tup  iiyany chatupatu  pucker up the mouth
tupatup  stick out, pucker (intr.)
tur  turatur  small and round (pl.)
tus  'aqwath kwatusatusny  orange
tusatus  cantaloupe
thal  thalathal  full of little holes
thany  thanyathany  move up and down in the air
thap  kwathapathap  badly faded
thaq  thathaq  i  feel uncomfortable while being tickled
iwyanych thqathq  i  be excited
thar  tharathar  i  be in long strips or boards
'akyas  kutharathar  place name
thay  thaythay  i  drizzle
thel  thelathel  i  pitted, perforated
thev  thevarhev  i  move in the breeze
thich  thichathich  be dotted, speckled all over
inyoork  thichathich  i  be mottled in color
thily  thilyathily  rustle
tuuthilyathily  shake a bush or tree to make fruit fall
thir  athirathir  clean out one's nose or ear
thiv  'aqwaq thivthiv  young or small deer (story word)
thol  tholahol  i  hang down
thon  thonathon  i  burrow; be weak, of a plant
thor  thorathor  i  have many wrinkles
thuk  thukathuk  i  feel weak
thuly  thulyathuly  itch
thup  thupathup  i  soft, over-ripe, old
val  valaval  i  roomy
savaval  make pretty big holes
valy  iisaly avalyavaly  wave the hand
vap  vapavap  i  wave in the breeze (of something very fine)
var  vararav  i  have hair cut at uneven lengths
vel  velavel  i  overcooked
ven  venaven  i  too weak to get up
ver  veraver  i  be in a hurry
viny  vinyaviny  i  very soft, wiggly
vul  vulavul  stick out (of something round, like eyeballs)
vuly  vulyavuly  i  bubble (like a boiling liquid)
wan  awanawam  rub quickly together (tr.)
chuuwanawam  rub onto the skin
tawanawam  rub together (tr.)
wan  huwaaly awanawan  railroad tie
war  tadiich warawar  second crop of corn--small and skinny ones
was  iisaly wasawas  wave the hand
wel  welawel  i  swing back and forth
tawelawel  throw hard
wen  wenawen  short
wenawet  i  wag the tail (of a dog)
wil  willawil  musical instrument
wil (cont.) wilawil i  hang down
wily  wilyawilyi  be loaded, heavy with fruit
       wilyawil i  slobber
win  winawin  move around flabbily (of a woman)
winy  winyawinya  shake the head no
wir  wirawir i  hang down, ready to fall
wis  wiwis i  push swing back and forth (between two people)
wit  kawitawit  kick repeatedly
yan  'achii yamayan  perch
       'ahmat yamayan  round pumpkin sp.
       yanayan, yanayaan  circular (pl.)
yar  yarayar  small, flat, circular; have hair cut even all around
       (pl.)
       yarayar i  move fast while in a hurry
yek  yekayek i  come apart at the seams, come open
yen  yenayen  circular (sg.)
       yenayen i  shake; shake flesh as one walks
tayenayen  make a circle
tuuyenayen  make into a circle
yep  aayepayaap  flap wings when taking off
yopayep i  hang loosely (of clothes)
yer  aayerayer  lie around all day long
       yayerayer  small, flat, circular; have hair cut even all around
       (sg.)
yil  yilayil  round (e.g. neck of bottle)
yir  yirayir  circular
tayirayir  throw a Frisbee or curve ball
aayirayir  cut one's hair off even all around
yoh  yohayoh i  walk with bent back
       ayohayoh  bend over to walk through a narrow place
yol  yolahol i  favor an injured part of the body
yoq  yoqayoq i  cool, pleasant, refreshing (like a breeze)
yuk  yukayuk  odd-shaped
       sayukayuk  saw (tr.) back and forth
yuly  yulyayuly  uneven

In Table 2 I present a list of Mojave reduplicated words with reduplicands longer than CVC. These are analyzed as C-CVC, CVC-C, etc. (In all but one case, I have treated the vowels which appear in the listed orthographic forms [see footnote 3] as non-organic—the exception is uu-‘in, which contains a reduplicated prefix uu.

Table 2. Mojave Reduplicated Words with Non-CVC Reduplicands

'-h-nar  'ahnar'ahnar  water turtle sp. (name refers to wavy motion)
'-k'-oy  'ik'oy'ik'oy i  bob up and down
'-lay  'alay'alay  be a mess
'-s-kar  'askar'askar  have notched edges
chov-th  choovthachoovth i  explode repeatedly
ch-peh  ichpelichpel i  dart tongue in and out
h-chuch  ichuchichuch i  shuffle along
hit-k  chuuhitkuhik  rub (tr.) together to make fire
h-lok  ihlokihlok  linked together (cf. l-hok)
k-'an-s ik'ansik'ans lame
kok-th kokthakoth bounce (tr.); be bumpy
k-roy ikroyikroy curly
k-thath-k ikthathkikthath k bounce on bedsprings
kwen-p kwenpakwenp i roll around in the water
kyuk-v talakyukvickyukv real crooked
l-ep il'epil'ep i burn out of control
l-tom al'oomal'oom crumple up
lay-m tu'ulaymalaym really ruin
l-hok ilholililoh linked together
ilholililoh i empty, hollow
l-hok ilhokililok linked together (cf. h-lok)
l-kyuk ilkyukilkyuk crooked
l-puk ilpukilpuk i wiggle
ly-choq ilychoqilychoq bumpy
ly-num alynumalynam wrinkles (tr.)
ilynumalynam wrinkled
ilynumalynunk, ilynumalynumv wrinkled
ly-num-p alynumpalynump wrinkled
ly-qach sulqachilyqach tickle
ly-ton ilytonilyton curly
ly-vinyq ilvyinyqilyvyinyq i feel weak
m-chur-k idony idonichurichurk i roll the eyes
m-huth-k samhuthkamhuthk smooth out lumps with fingers
m-kwel-k imkwelkimkwelk i roll
num-p numpanump have wrinkles
p-'uny ii'anych ip'unyip'uny be confused
qom-th qomthaqomth i bob up and down in the water
ser-q serqaserq i ache all over
s-kar 'a'ii tuskaraskar bullroarer
s-kily taskilyashkily have a tattoo of little lines going out from
the mouth toward the ears
s-kwem askwemaskwem i soft to the touch
s-kyel taskyelaskyel striped (like certain melons)
s-qwem isqwemisqwem i soft to the touch
s-wem-k swemkaswem very smooth to the touch, like marble
s-wem-k swemkaswem very smooth to the touch, like marble
t-oh it'oht'oh i hop along
tap-m atapmtam make a repeated diamond design; do really fast
tar-k tarkurtark grunt; rough, bumpy
tiy-q tiytiyq i scratchy
t-k-vek takaveetakavek hesitate; have trouble deciding where
to go
t-nyum tanyumtanyum bible (refers to lots of pages)
t-yaq tiyaqtyaq have pins and needles (after limb has been
"asleep")
tuly-k tulykatulyk, tulykatulyk i uneven
th-kwil chathkwilathkwil i flake off (of skin)
th-paq ithaqithpaq i blink repeatedly
th-voq ithvoqithvoq i wiggle one's bottom while walking
th-vuq ithvuqithvuq i walk slowly while wiggling one's bottom
uu-'in tuu'innu'in shake big tree to make fruit fall
vat-k savatkavatc scratch in dirt
wam-k  tawamkawank  swing round and round
yor-s  yorayors  i  come up here and there when the wind blows
        (of dust)

Consideration of the data in Tables 1 and 2 reveals a number of
interesting facts about Mojave reduplication. Metathesis has been
shown to be important in other areas of Yuman phonology (Langdon
1972), but examples like $\text{iilokihok/iilokihlok}$ above show that it
can be involved in reduplication as well. Different parts of a
morphologically complex word like $\text{k-kyuk-v}$ may be reduplicated,
as shown by the doublet $\text{iilokyukilkyuk}$ 'crooked'/talakyukvikyuky
'real crooked'. The pair $\text{tyqtiyiq}$ i 'scratchy'/tiyatiyiq 'have pins and
needles' (compared with $\text{tagateq}$ i 'scratch') show one of the only
cases I have ever seen of apparent stress shift onto an original
schwa.

Often comparison of a reduplicated word with some unreduplicated
counterpart is productive: $\text{chathkwilathkwil}$ 'flake off (of skin)',
for instance, is reduplicated from $\text{chathkwil}$ 'skin', which otherwise
appears to be an unanalyzable word in Mojave—yet the whole word
was not copied.

Reduplicated words of the simplest type appear to be quite
archaic. Trivially, they do not contain loan phonemes like Mojave
$\text{f}$ [f]. More interestingly, however, they appear to preserve relics
of some of the controversial sound shifts which Mojave shares only
with the other languages of the River branch of Yuman, Maricopa and
Yuma—the change of prestress Proto-Yuman $\text{v}$ and $\text{w}$ to $\text{d}$ and $\text{y}$. In
standard spoken Mojave these sounds never show any alternation,
but consider sets like (8) and (9):

(8a) $\text{doladol}$  hunch up
    b) $\text{hyolahyol}$  hunch up
    c) $\text{yolayol}$ i  favor an injured part of the body
(9a) $\text{iisaly awasawas}$  wave the hand
    b) $\text{iisaly avalyaly}$  wave the hand

Sets like these suggest interesting questions concerning the possi-
bility of considering some reduplicated forms as conservative "is-
lands" immune to various phonological processes. A related issue
is how to explain the fact that grammatical affixes are sometimes
reduplicated along with a CVC root (though more often not). Consi-
der, for instance, $\text{talakyukvikyuky}$ (cited above) with reduplicated
mediopassive $\text{-v}$, vs. words like $\text{satukatuky}$, with a simple suffix $\text{-v}$.
Table 2 shows, in addition, several cases of a reduplicated suffix
$\text{-u}$, which is postulated to be the earlier form of the same suffix
—apparently another archaism.$^5$

Another thing which demonstrates even more effectively the
phonological conservatism of reduplicated words is the fact that
a fair number of them appear to be reconstructable for Proto-Yuman.
I made a very limited pilot search for reduplicated cognate sets,
comparing the Mojave words just presented with reduplicated words
from Diegueño (from Couro and Hutcheson 1973), Cocopa (from Craw-
ford 1966), and Yavapai (from Shaterian (n.d.), reheard and with
some additions from Molly S. Fasthorse, a speaker of the Tolka-
paraya dialect. The sets I feel reasonably sure of are presented
below (in the orthography of the source, except that the Yavapai
examples are all normalized to Tolka-paya practical orthography).

Table 3. Reduplicated Cognate Sets

|/*?in | D | 'inn 'inn wii moves around |
| Mo | 'ena'en i move |
| Ya | ch'in'in shake (e.g. a tree) |
|/*?ir | D | 'ir 'ir wii is rough, trembles |
| Ya | 'ir'ir stick up by itself |
|poss. | Mo | 'ona'on be just one sticking up or standing out |
|/*?uS | Mo | 'usa'us seems to mean 'round, fleshy' |
| Ya | 'oya'oy spherical |
| *SiS | D | chirrechirr stiff |
| Mo | chilyachily stick out, stand on end |
|*kaS, or specifically *-kaS | D | hekalhekal scalloped |
| Mo | 'a'iituskarakar bullroarer |
| 'askar'askar have notched edges |
| tatqalaqal notch (tr.) |
| C | ka'kak' m'ayi you nod your head indicating yes |
| kany'kany' i be bumpy |
|poss. | Mo | karakar i be trimmed with lace, tremble |
| kaskas i chatter (teeth) |
| kelkel i rattle |
|*xul | C | qugul qugul i stack |
| Mo | kolakolv piled up log-cabin style |
| takulakul piled up one on top of another |
|*kwar | D | kwarkwar talk loudly, a lot |
| C | kwarkwar i I talk |
|*kwis | D | kwirrkwirr revolves |
| kwilwil is dangling |
| eyay kwilwil wii feels very weak (heart goes round) |
| Mo | kwempakwemp i roll around in the water |
| imkwelkikwelk i roll |
| akwinakwin go round and round |
| Ya | kwirkwir go all around |
| kwirkwir 'i spin |
|poss. the same set: |
| Mo | kwerekwer, qweraqwer sharp (on the point) |
| Ya | hu kwirkwira beak, bill |
|*lap | D | llapellap flat |
| C | laplap i, laplap i flat |
| Mo | lapalap flat |
| chulyapalyap flatten with the hand |
| lyepalyep flattened out |
| Ya | laplalap flat |
| rapraap small and flat |

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*las Mo lathalath make sound of raindrops on mud house
   kalathalath smash repeatedly with the feet
Ya vlathvlath 'icha sound of thunder
*laS D kullali kullali goes up and down
   C mcalilli you shake (e.g. a tree)
   Mo lanyalany trot
*lip D liplip wii flutter eyelids
   Mo lavalav i flutter
   lapalep not fit right, hang loosely
   levalev i tremble, be floppy
Ya vliplip i wing flutters
*mar Mo kamaramar level off grave to hide it
   Ya rub out traces
*miS C mimir i be straight
   Mo meramer true, straight
   miramir straight (of hair)
Ya mimir straight
*mVS D semilemilp is rolling like a log
   semilymilyp rolls over
   seminminnp tosses and turns
C milmil, minmin be long and thin
Mo tadiich minamin corn on the cob
   chamanan roll (tr.)
   melamel football-shaped
   milamiil football-shaped (pl.)
*paq C paqpaq i it makes a popping noise
   Mo paqpaq i make a popping sound
Ya paqpaq 'i sharp cracking sound
*pil D pilpil flickers, flares
*qV8 Mo ichpelichpel i dart tongue in and out
   Mo sulyqachilyqach tickle
   Ya ndyqochqoch 'ichkyum he tickled me
*qis Mo qesqaqes i rub
Ya qisqis i rub hard against
*ris Mo rithari ith speckled, freckled
Ya kwath rithri ith, yuu rithri ith freckles
*sak D eyay sakesak wii is anxious, nervous (heart is
   itchy)
   C gaqqaq i be itchy
   Mo thaqathaq i feel uncomfortable when being tickled
   iiwanyoch thaqathaq i be excited
*suly Mo thuliyathuly itch
   Ya thulithul, thulthuul, thurthur itch
*šil C šilyšily i be long and thin
   Mo silasil stick out further than the rest
   Y selsel stick up, be raised
*tam C tamtkamk i it flashes intermittently
   Mo tematem i sparkle, shine
*tas Mo iiisaly chuulahatata clap the hands
   Ya tahthath i tick
*tuS D tulitull wii is bumpy
   tulytuly wii hops along
*tuS (cont.) Mo tu'lykatulyk, tulykatulyk i uneven'avi tu'lyatuly place name (descr. 'rock')

*wiS D wirewir, wirewir wing
C pceavy wincy I shake him
Mo wiiswiis i push swing back and forth
winywiny i shake the head no
Y wilwiil i shake in order to make something sit properly
wirwir flutter poss.
Mo iisaly aavyaly, iisaly aawsawas wave the hand

*xal D hahall halli makes a rattling or rustling noise
Mo halhal i, halhal i make a hollow sound

*xil D hilhiil gradually, barely moving
Mo helhel i flow gently over

*xyač D shaahwachwhach oriole
Mo 'aixweahwec, hweahwec oriole

*xWay C x'ayWay m'i you whisper
Mo chuuchwayuhwah talk in whispers (multiple pl.)
chuuchwayehwah talk in whispers (dual)

*yVS D yareyar circular, round, and flat (large object)
yarreyar circular, round, and flat (small object)
Mo yenayen circular (sg.)
yanayen, yanayen circular (pl.)
yirayar circular
yilayil round like the neck of a bottle

Undoubtedly, many more such sets will be discovered when more extensive data is examined. Even at this stage, though, it appears that whole reduplicated words may be reconstructed in some cases. Also, the idea that reduplicated forms may resist the River glide friction process seems to be supported (consider *wiS and *yVS). It also is clear that study of reduplicated forms will provide new data on the subject of sound-symbolic alternations in Yuman—in the chart above, an indeterminate sound-symbolic alternating consonant is represented simply as S.

Footnotes
1. A preliminary version of A Mojave Dictionary by Munro and Brown was privately printed in 1976. A revised and expanded version with Crawford as co-author is now in preparation. All the words in this paper have been checked recently with Nellie Brown; many of them were brought to my attention by Judith Crawford. The work was supported by the Academic Senate of the University of California, Los Angeles. Thanks to all.
2. So get going, Yumanists.
3. All Mojave forms are presented here in the Mojave Dictionary orthography: ' = [?], ch = [k], d = [t], hw = [h], kw = [kw], ky = [k''], ly = [l''], ny = [n''], qv = [q'], sh = [ʃ], th = [θ]; hy = [h''], which I am treating here (at least) as a unit phoneme. All poststress t's in these examples are nondental. Doubled vowels are long. A hyphen separates two sounds which would otherwise be
interpreted as a digraph: t-h = [th]. Stress is as described in the
text (equally on the vowels of both CVC's). In general, unstressed
short vowels are probably inorganic, but there are particular prob-
lems with this statement for Mojave which are beyond the scope of this
paper. Initial vowels and their source are another, related problem
which I won't go into further here.

4. The hedge here is "word", of course--I don't mean simply "dic-
tionary entry", but rather something like "stem". Specifically, verb
plurals not derived by reduplication are not listed, and complex nomi-
nals including reduplicated modifiers are not listed unless they con-
tain an otherwise unattested reduplicated stem or seem (in my judg-
ment) to shed additional light on the meaning of the basic reduplica-
ted element.

In listing the reduplicands, I have neutralized vowel length
distinctions (preserved in the words themselves, of course). The
great majority of stressed vowels in reduplicated forms are short.

'Sg.' in glosses, of course, means 'nonplural' (to save space).

5. I have wondered whether this word could reflect not only
the idea of a truck with a large hole in it but also something of
the sound of the English word. However, this would then be an extreme-
lly rare case of loan reduplication (but cf. tik below).

6. Another conservative grammatical element that shows up in an
expectedly large number of reduplicated forms is the "passive" suf-
fix -k, hitherto attested only in Diegueño, but which I have found
examples of in a number of lexical items in Mojave and Maricopa.

7. In this table, V represents some indeterminate vowel and
S represents a consonant involved in sound symbolic alternation
(primarily coronal sonorants, also y and s). I have tried to be
reasonably conservative, but obviously some will like some of these
sets better than others. Space did not present discussion of the
semantics of what the starred forms might be, but it's fun to puzzle
it out--some of the more difficult correspondences improve with
thought, I think. There also appear to be some k/q alternations
which need attention (also possibly sound-symbolic?).
AN EXPLORATION OF THE AFFINITY
OF WAPPO AND SOME HOKAN AND PENUTIAN LANGUAGES

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Ever since the initial outlining of the Hokin and Penutian stocks (Dixon and Kroeber, 1913), the two, although geographically intermeshed, have been classified apart, cut to the level of such wide-ranging speculative groupings as Sapir's (1929) six North American superstocks, in Hokin-Siouan and a much expanded Penutian. Only when the speculation ranges even farther out to networks encompassing almost all the languages of North America are the two linked (as in the work of Swadesh, for example, 1959). Yukian, too, has been kept distinct at the stock level; but it has been joined to others at the more remote superstock level: to Hokin, on the one hand (for example in Hokin-Siouan, Sapir, 1929): to Penutian, on the other (as suggested in Radin, 1919, and Shipley, 1957). At this point, I should inject a word of caution for those who might be unfamiliar with the type of evidence that supports the postulated groupings Hokin, Penutian, and Yukian (to say nothing of the more far-ranging proposals)—it is skimpy. The divergence between the branches of Hokin, and of Penutian, is much greater than that typical of the branches of Indo-European. The two branches of Yukian--Wappo in the south, and the Yuki-Huchnom-Coast Yuki dialect cluster in the north—are considerably more alike lexically (about like Finnish and Hungarian), but still not so close as to be incontestably related (Sawyer, in press, argues against a genetic relationship).

However, it is not my intention here to review the proposals of others but rather to offer an exploration of the affinity among representatives of the three stocks, employing explicit procedures for measuring lexical similarity.

The deepest exploration is among the following four:

Wappo (Yukian). The first 100-word list is from Sawyer (1962), the second 100-word list from Sawyer (1965), with segmentation, mostly to CVC roots, helped by personal consultation with Sawyer.

Proto-Western Pomo (= PWP, Hokin). The reconstructions are based on my field notes in the four most closely related Pomo languages: Kashaya, Central, Southern, and Northern Pomo. Many of the reconstructions could also be projected back, with no change, to Proto-Pomo.
Proto-Western Miwok (=PWM, Penutian). The forms were compiled from Callaghan (1965, 1970, and personal communication). Many are also good for Proto-Miwok.

Maidu (Penutian). The forms are principally from Shipley (1962), but some effort was made to use Proto-Maidu by taking into account the forms in the closely related Misewan (Uldall and Shipley, 1966).

For each of the above four linguistic entities, two distinct lists of 100-words were compiled, in order to test the replicability of the results from one sample of vocabulary to another. Both word lists were relatively "basic" because I wanted any affinity discovered to be more likely to reflect a genetic relationship than a recently diffused one. The first 100-word list is the Swadesh short list (given, for example in Hymes, 1960) and is relatively universal and culture-free. The second 100-word list is my own selection and contains kinship terms, body part terms (additional to those in the first list), common adjectives and verbs, and some terms for flora and fauna (acorn, deer, etc.) which, although not of world-wide distribution, are common and basic in the area under investigation. To a certain extent I was guided by what I could reconstruct.

In addition to the results with the above entities, there will be presented findings from earlier investigations, based on the Swadesh 100-word list alone, for comparisons of Wappo with Tonkawa, a "Hokan-Coahuiltecan" language of Texas (data from Hoijer, 1949), and the four Hokan languages Washo (data from William Jacobsen, Jr., personal communication), Karok (from Bright, 1957), Cocopa (from James Crawford, personal communication), and Kashaya, a language also involved in the Western Pomo reconstructions. The findings on the interrelationships of these languages which do not concern Wappo will appear in a separate publication (and were also discussed in Oswalt, 1965, 1966).

As stated earlier, any affinity among Wappo, Hokan, and Penutian (and even within Hokan and Penutian) would be at a very distant level, beyond that of conventional proof: any possible cognates would be too few in number, and the sound changes too great, to permit setting up a comprehensive interlocking scheme of sound correspondences. In such situations, there have been, in North America and the rest of the world, speculations on relationships among diverse languages, with the "proof" being a listing of vocabulary similarities. However, such similarities can be found between any two languages, related or not, and the number may depend less on the degree of relationship than on the volume of material available to the investigator and on what he is willing to call sufficiently similar, semantically and phonetically; factors which are usually left unexpressed and variable.
The method employed here goes beyond a mere search and listing of vocabulary resemblances: The criteria of similarity are standardized and explicit. The number of similarities thus found are then tested for significance by being projected against a background of the number and range of similarities that can be found by chance.

The criterion of semantic similarity is simple: the word employed should be the most common one for the meaning given. There are occasional difficulties in the selection of the proper word, especially when a dictionary must be used rather than a native speaker or a linguistic expert in the language (dictionaries rarely state which of several words translated the same is the most common and general), but in these particular cases no crucial problems arose. All forms were segmented as much as possible, consistent with retaining the desired meaning. I would now, in principle, eliminate from any particular comparison those forms which, in one language or the other, require more than one morpheme to attain the desired meaning, but that procedure was not followed here. Thus I used a few bimorphemic forms like Maidu wono-ti 'die-cause' for the Swadesh gloss 'kill'.

The determination of phonetic similarity is more complex:

1. In order for paired forms to be counted phonetically similar, a threshold number of consonants and vowels must match. In all the cases presented herein, the number of required consonant matches is two if the forms in each language have two or more consonants. If the form in one or the other language has only one consonant, then only one consonant match is required. There are no cases of no consonants. In the comparisons in this paper, vowels are not considered; this is not for theoretical reasons (although I do believe that vowels are of less utility than consonants in judging cognacy), but because of temporary technical factors (discussed in Oswalt, 1966, 1970).

2. For two consonants to match, they must share

   A. a point of articulation.

   B. a threshold number of articulatory features.

The point of articulation (Criterion A) can be interpreted broadly or narrowly: Since some of the languages dealt with herein make a phonemic differentiation of alveolars from dentals, but most do not, I usually interpreted these points broadly and equated the two—and similarly for the velars and uvulars. However, in the case of FWP and Wappo, the languages both contrast voiceless stops (but not n and d) at the dental and alveolar positions; I treated these points narrowly, allowing matches, for voiceless stops, of only dental to dental and alveolar to alveolar.
Both the articulatory features to be considered and the threshold number were varied in different trial comparisons. A typical Criterion B is that the two consonants share two of the three features of voicing, nasality, and friction (this last is a plus feature for fricatives and aspirated stops). The consequences of these simply stated criteria are illustrated below; for each of PWP labials listed at the left, there are given at the right all the Wappo consonants that would be accepted as matches:

\[
\begin{align*}
  b & \quad p, \hat{p}, m, \hat{m}, w, \hat{w} \\
  p & \quad p, ph, \hat{p} \\
  p^h & \quad p, ph, \hat{p}, w, \hat{w} \\
  \hat{p} & \quad p, ph, \hat{p} \\
  m & \quad m, \hat{m}
\end{align*}
\]

There were various niceties of application which will not be gone into; one example applies in PWP: \(h\) and \(\hat{v}\) before a vowel are counted as consonants (laryngeals), but before a consonant (as in \(\hat{t}i\)\(\hat{i}d\)u 'acorn') are nonconsonants.

When the first 100-word lists in PWP and Wappo are lined up, semantically matched, 12 pairs of words are found to pass the above stated criteria for phonetic similarity. The question then is, "Is 12 out of 100 sufficient to claim a special affinity between the two languages?" In order to determine this, a SHIFT TEST can be performed; that is, the first word in PWP can be compared to the second in Wappo, and the second in PWP to the third in Wappo, and so on down the list until the 100th word in PWP is brought around to be compared to the first in Wappo. When this is done, under exactly the same criteria of similarity, a score of 7 is obtained. Since the words are no longer semantically aligned, this score is one measure of the number of chance resemblances that can be expected between the two languages, A BACKGROUND SCORE. A further question is, "How reproducible is this background score?" The test can be performed again by shifting the lists two places relative to each other, and a third time by shifting three places, and on up to a maximum of one less than the length of the lists (99 in this case). Such a procedure is quite time-consuming, mind-numbing, and fraught with human error, when done by "eyeballing"; a rather complex computer program was developed to perform the job and used for the findings reported herein.
The results from a comparison of Proto-Western Fomo and Wappo, under the criteria described, for 99 shift tests are plotted in Figure 1. Each x represents one shift test. The position of an x on the horizontal axis indicates its score; the height of a stack of x's gives its frequency, the number of times that the particular background score occurs. For example, the score 2 occurs 2 times; the score 3 occurs 9 times. The BACKGROUND MEAN, the average of all the background scores, is 6.06, located by the vertical arrow near the high point of the plot. The GROSS SCORE, the score obtained when the lists are compared semantically matched, is 12, marked by the vertical arrow toward the right of the plot. One estimate of the significance of a score of 12 is given by its RANK: Of the 100 scores, 12 lies in third place; two background scores are higher, 97 are lower. This is moderately strong evidence that there is some kind of special affinity between the two vocabularies but that some caution is called for--illustrated graphically with two chance background scores higher than the gross score. More refined ways of estimating the significance will be given later, but first there will be plotted the results with this same pair of languages and vocabularies, under different criteria of similarity.
In Figures 2 and 3, wappo and PWP are compared under the same conditions as before, except for Criterion 2B: in Figure 2, the consonants must match in 3 of the 5 features: voicing, stoppage, nasality, friction, and laterality; in Figure 3, they must match under the stricter criterion of 4 of those same 5. Since only one of the many different consonants in these languages is plus on laterality (namely, l), this feature is infrequently brought into play and, in most instances, the requirements are to match 2 of the first 4 features, and 3 of 4, respectively.

Under the less stringent criterion of Figure 2, the gross score of 14 ranks highest, above all 99 background scores; this is even more powerful evidence of a special affinity between the two languages than was displayed in Figure 1. In Figure 3, under much stricter conditions for passing the threshold of similarity, the background scores are lowered, as should be expected, but the gross score is lowered relatively more, so that it does not stand clearly above the majority of the background scores—and this is the situation that often prevails among languages which are, at best, only remotely related.

The difference between the gross score and the background mean is the GROSS DEVIATION; in Figure 2, it is $14 - \frac{6.2}{7.6}$. Certain adjustments can be calculated for the gross deviation to yield the NET SCORE, an estimate of the number of words in the list whose similarity cannot be attributed to chance and for which an historical explanation should be provided (the calculation is explained in Oswalt, 1966, and will not be described here, as the discussion herein will be based on other measures of affinity).

In Figures 1-3, the x's fall into a normal distribution about as well as most natural data. In Figure 4, the plots are converted into a standard normal curve in which the horizontal axis no longer represents numbers but STANDARD SCORES, with which the unit of measurement is the STANDARD DEVIATION (the square root of the mean of the squares of the deviation of each background score from the background mean).
The standard deviation in Figure 1 is 2.29, in Figure 2 it is 2.35, and in Figure 3 is 1.65. The gross deviations in the three cases can be converted to standard scores by dividing by the standard deviations of their respective comparisons:

1. \( \frac{(12 - 6.03)}{2.29} = 2.61 \)
2. \( \frac{(14 - 6.22)}{2.35} = 3.31 \)
3. \( \frac{(5 - 2.60)}{1.65} = 1.45 \)

These three scores can now be located on one graph, Figure 4, in comparable terms. The background means, lying at the peak of the curves, are set at zero, regardless of what they were in Figures 1-3; the standard units along the horizontal axis correspond to different word scores in each of the three cases.

For each location along a normal curve there is an associated probability represented by the ratio of the area under the curve that lies to the right of the given location to the total area (the information is available in many books in tables of areas under the standard normal curve). For Case 1, the probability of getting a standard score of 2.61 or higher, by chance, is 0.0045, that is, four and a half in a thousand. For Case 2, the probability of a score of 3.31 or higher, by chance, is 0.0005, only five in ten thousand. The minuteness of these probabilities is graphically illustrated in Figure 4; the points 2.61 and 3.31 lie to the right of almost the entire area of the curve. These probability measures are so low that it would be wise to discard an hypothesis of chance as the explanation for the resemblances found between Wappo and PWP and propose some kind of historical relationship, either genetic or diffused. This proposition will be explored later in this paper, but first I should give a few words on the effect of varying the criteria of similarity.

A great deal of effort has been expended on an investigation (which will not be detailed here) of the effect of varying the criteria of similarity; one example is the series 1 to 3 above. This effort was partly to test an hypothesis that the procedure would help find the basic sound correspondences among distantly related languages, correspondences which are not obvious because possible cognates are so few and are hidden in a mass of chance resemblances. I cannot now say that the procedure will prove to be feasible, although it does work between languages that are closely related--there than is peak in the standard score (= a minimum in the probability measure) when the criteria of similarity closely approximate the true sound correspondences.

There is a difference between closely related languages, as others, in response to strictness of the criteria of similarity. With closely related languages, the sound changes are relatively slight and a high threshold (such as requiring matching of 4 of 5 features, rather than 3 of 5) causes
rejection of false matchings to a greater degree than it causes failure to detect true cognates; that is, the background is lowered more than the gross score, and thus the gross deviation and its associated standard score are raised (this is illustrated for English-German and Persian-Hindi pairings in Oswalt, 1970). With more distantly related languages, the effect can be the opposite; the sound changes may be great enough that a high threshold will cause the rejection of true cognates as much as, or more than, it lowers the background. And the latter pattern is apparently the one that the Wappo-PWP comparison falls into (judgment is withheld for now on whether the large number of resemblant forms are true cognates or diffused forms); the high threshold case (3) has a markedly lower standard score than the low threshold case (2). Case number 1 is intermediate in threshold and standard score, but it focuses on a smaller number of features, three (voicing, nasality, and friction in this case; different selections of three in other cases not presented here), and thus is more subject to the idiosyncratic characteristics of particular word lists.

Now that the method has been described in a limited, but what I hope is sufficient, way, the results of the remainder of the comparisons can be presented in a compact form. In Figures 5 and 6, the graphs are essentially the same as in Figure 4, the difference being that the normal curve is omitted and the bottom line alone retained, a line in which the zero in the middle is the background reference point and the standard scores (of the gross deviations) for each comparison are placed in their proper location.

Figure 5 contains the comparisons for the first 100-word list (the Swadesh list) for all possible pairings of Wappo, Proto-Western Pomo, Proto-Western Miwok, and Maidu, plus pairings of Wappo with Washo, Karok, Kashaya, Cocopa, and Tonkawa. The criteria of phonetic similarity are the same as for Figure 2, the least stringent of those exemplified earlier.

An easy decision that one can make on the basis of Figure 5 is that there is no discernible affinity between any pair of languages that displays a negative score (occurring when the gross score is less than the background mean). It is harder to decide how large a positive score should be before it deserves to be deemed significant. A commonly employed significance level is 5 percent, that is, the investigator is willing to be wrong 5 times out of 100 in claiming the results are not due to chance. This level corresponds to a standard score of 1.645. I consider it somewhat low for proposing linguistic relationships and in this opinion am influenced by the -1.86 in Figure 6 (and by similarly large negative scores obtained in comparisons not introduced here). Since, in the 17 comparisons displayed here, -1.86 is reached by chance (and I cannot imagine a reasonable historical explanation for a negative relationship), I would expect 1.66 to be as easily attained by chance. I am still acquiring experience toward a good, working significance level for
Figure 5. First 100-Word List

Figure 6. Second 100-Word List
linguistic comparisons and at the present take a conservative position that the standard score should be greater than +2.00 before suggesting a relationship and above +2.50 before making a strong claim. In this paper, the point is moot as there are no scores in Figures 5 and 6 between 1.645 and 2.00.

In Figure 5, in the suggestive range 2.00 - 2.50, there are three pairings of Wappo: one with the neighboring PWP and two with distant Hokan languages, Washo and Cocopa. Lying far above these is the strong score with the neighboring PWP (and its member Kashaya, not geographically adjacent to the Wappo).

In order to test these findings, a second set of 100-word lists was prepared and run under the same criteria of similarity. The results were different; no pairs of word lists were found to be significantly alike (Figure 6). This is perhaps not so surprising in the less strong case Wappo-PWM (Matt Maka 3) but it is striking for the Wappo-PWP case. The Wappo-PWP and Wappo-Kashaya scores with the first 100 words are so strong that they require some historical explanation regardless of the lack of affinity evinced with the second 100 words. The scores of 3.31 and 3.48 can perhaps be given some perspective by a comparison: they are higher than any score obtained between branches of Hokan (Oswalt, 1966) and are in the range of scores between modern representatives of separate branches of Indo-European, such as German and Russian (Oswalt, 1970).

The two word lists are not randomly drawn from a large vocabulary pool, nor are they even a random splitting of a 200-word list—if either had been the selection procedure, the discrepancy between the two results for Wappo and PWP would have been more extraordinary. The two vocabularies were chosen for "basicness" in order to minimize susceptibility to borrowing, but they are not equally basic, and therein may lie the explanation.

I have long had the goal of being able to arrange a large semantic list, say of 500 items, in order of relative stability. If, when batches of this graded vocabulary are taken in sequence for comparison, a trend should show up such that the relatively more stable batches exhibit significantly more affinity than the less stable batches, then one might infer that the paired languages are genetically related; if the trend runs in the opposite direction, one might infer that the affinity has resulted from borrowing. This hypothesis would, of course, have to be tested with languages known to be related and with languages known to be not genetically related but to be influenced by one another. A start in measuring the relative stability of various semantic items was made in Oswalt (1971, 1975) but the project is so immense that it cannot be expected to progress far in one lifetime.

Of the two vocabularies employed here, the Swadesh list must be considered the more basic and stable overall (but not so for certain items); it, after all, was first choice, and the second list contains leftovers. Now, the Wappo-PWP comparisons follow the pattern that the supposedly more basic list shows the stronger score and the supposition could thus be that the
affinity between the two is genetic. However, I withhold any such strong claim because the results with the two word lists are so disparate, two batches seem too few to establish a trend, and the hypothesis is insufficiently tested as yet. It would also be wise to bring Yuki into a similar comparison (See Note 1), for a claim to be extendable from Wappo to Yukian.

Since PWP and PWM are geographically close to Wappo (although Kashaya is not in direct contact with Wappo), it would be reasonable to suspect a certain amount of diffusion among them. Perhaps an examination of the actual resemblant forms will lead to an understanding of the source of the high scores. Below are given the sets of forms from the first 100-word list that figure most prominently in the resemblances between Wappo and PWP (plus Kashaya), and in the other pairs that score over +2.00 (PWM, Washo, and Cocopa) if they fit into these sets, otherwise forms from these other languages will not be cited beyond the first four sets.

(. . .) encloses forms found similar to some of the others in the set, but not to the Wappo form.
[. . .] encloses forms that are not similar to any others of the set.
* marks reconstructions to the level named at the left: PWP or PWM.
** marks reconstructions good to a deeper level:
Proto-Pomo or Proto-Miwok.

<table>
<thead>
<tr>
<th>BIRD</th>
<th>EAR</th>
<th>THOU</th>
<th>ROUND</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wappo</td>
<td>či ča</td>
<td>čéma</td>
<td>mi*</td>
</tr>
<tr>
<td>PWP</td>
<td>*šihta</td>
<td>**šima</td>
<td>(*šima)</td>
</tr>
<tr>
<td>Kashaya</td>
<td>šihta</td>
<td>šima</td>
<td>ma</td>
</tr>
<tr>
<td>PWM</td>
<td>*[méle]</td>
<td>*[šálok]</td>
<td>*ši-</td>
</tr>
<tr>
<td>Washo</td>
<td>si-su</td>
<td>pisew</td>
<td>ma</td>
</tr>
<tr>
<td>Cocopa</td>
<td>šá</td>
<td>š mál</td>
<td>(mapú)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DOG</th>
<th>SKIN</th>
<th>SUN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wappo</td>
<td>háyu</td>
<td>chíla</td>
</tr>
<tr>
<td>PWP</td>
<td>? háyu</td>
<td>**ši?da</td>
</tr>
<tr>
<td>Kashaya</td>
<td>háyu</td>
<td>ši?da</td>
</tr>
<tr>
<td>PWM</td>
<td>**šáhu</td>
<td>*šú luk</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DRINK</th>
<th>I</th>
<th>LONG</th>
<th>WOMAN</th>
<th>DRY</th>
</tr>
</thead>
<tbody>
<tr>
<td>PWP</td>
<td>**hóŋqo</td>
<td>**ha?a'</td>
<td>**ahqol</td>
<td>**hima’ta</td>
</tr>
<tr>
<td>Kashaya</td>
<td>?qo</td>
<td>?a'</td>
<td>?ahqol</td>
<td>?ima’ta</td>
</tr>
</tbody>
</table>
BIRD. The similarity of these forms could be due, in part, to onomatopoeia, by a mechanism analogous to an English speaker calling a small bird a tweet, peep, cheep, chirp, etc.

EAR. This is one of the very few sets of resemblant forms widespread in Hokan. See below for a comment on glottalization.

THOU. m- in the second person pronoun is widespread in Hokan and Penutian. In this set, the parenthesized forms do not match with the Wappo because the two-consonant criterion applied. I would now, on the basis of information internal to the languages, segment the two-consonant forms down to the one consonant, plus the vowel. This action would increase the scores among the three affected languages over that reported here. In the Proto-Pomo form, for example, the initial syllable *-ʔa- can be considered a separate morpheme marking pronouns and deictic forms. Compare also Proto-Pomo *-ʔaʔa in the 'I' set.

ROUND (spherical rather than circular, if a particular language makes a distinction). Similar forms are widespread in central California, and no one language or family can be said to be the source or the recipient of a borrowing for the term. Since a word ROUND cannot be reconstructed for PWP, one might suppose it to be a loan into Kashaya, but I think not; it can be explained as arising from a vast complex of symbolic forms (many of which occur in other Pomo languages): lo:lo 'cylinder', ko:lo 'concave', to:lo 'dimple', do:lo 'mortar basket', do:lo - 'to make a depression', polo:ša 'oak ball', polopolo- 'to bubble', and a host of verb roots like -ʔo:, -ho:ol-, -ʔo:ol-, -bo:om-, -bo:o:-, -ho:-, -po:o:-, etc., all having something to do with swelling up and becoming spherical, or being hollowed out and becoming round on the inside. Furthermore, there are the roots -ʔo:lo- 'to move spherically, to roll (of a ball)' and -ʔoli- 'to move circularly'. And the root -ʔoli- leads us to pilili 'circle, hoop', the analog of our starting point polo:lo.

Insofar as the dictionaries and vocabularies of the languages of central California go into sufficient detail, they also attest to similar symbolism (and the symbolism goes pretty far in the rest of the world too): Wappo polok 'oak ball', Lake Miwok pololo, pówolo, pówwulo 'round'; polóolo 'ball, dry oak ball'. Maidu pylým 'round', pylýlympe 'spherical', polopol 'bubble, boil, steam'. Nisenan pylýly 'spherical', polo 'buckeye ball', molmol 'to boil'. Washo mólim 'to boil'.

Much further to the south, in Cocopa and many Yuman languages, the forms for ROUND are merely tantalizingly close. Taking C1Vc0 as the canon of the core of the symbolic form (pol in central California), we find in Yuman that C∞ is coronal, varying symbolically for size and intensity (Langdon, 1971). Since C∞ is often a lateral, it would match the C∞ of pol; however, the C1's are usually different and thus the total forms fail to match: Yuma ʔoraʔor 'to be spherical'; Tipai
yaryar, yaiiyiy, 'to be round'. Closer phonetically is a Diegueño complex for 'roll': mul, mil, miliy, mip (I have extracted what I judge to be the core, I hope correctly, from entries in Courc and Hutcheson, 1973); mulamul wi' 'is round like a ball'.

It should be noted that the Wappo form álbul failed to match the others in the ROUND set, although it fulfills the criteria of phonetic similarity, and this is due to BLOCKAGE. The consonants of the Washo form are taken in sequence to compare with the consonants of the other forms (Wappo -pól-, for example) also considered in sequence. The first l in álbul is found similar to the l of the Wappo form; then the b in the Washo must find its match after that matching pair, and there is none in -pól-. If the first l in álbul were then eliminated from consideration, the -bul sequence of Washo would fit very well with the Wappo -pól-. Consonant blockage causes the rejection, on average, of about one and a half suitable matches in a 100-word list. This lowers both the gross and background scores about the same so that the net effect is small, but it is a factor in the reduction of the sensitivity of the method (blockage was eliminated from the program but could not be applied to these data before computer use).

DOG. This is a widely diffused form in the region; I am not sure of the source, possibly Penutian (compare Toltechi Yokuts xalú 'coyote', cited in Shipley, 1957:271). It probably did not exist in Proto-Pomo (there are aberrations in the sound correspondences); nevertheless I did use hayu in PWP comparisons. Omitting the word from the vocabulary would lower the scores slightly.

SKIN. I would now segment the final -k of PWMáolk, as well as of Proto-Miwok *kálok 'ear', as a noun-formative. Doing so would not change the gross scores but would lower the background means and thus raise the gross deviations.

DRINK. There is a fair chance that this originated as an imitative of the action and sound of noisily swallowing a liquid, that is, of gulping. In Kashaya, *dô- 'to drink' is connected in a symbolic and echoic set with dô- 'sound of a gulp' (and also the root in a verb *dô 'to gulp'), dô- 'sound of gurgling (also in the verb dô- 'to gurgle'), and dô- 'sound of lapping water'. It may well be no accident that English gulp, gurgle, gurgle, etc. are similar to these Kashaya forms. In any case *dô can be reconstructed for Proto-Pomo with perfect sound correspondences.

Historical reasons, other than genetic relationship, have now been suggested for the resemblances in some of the above sets, namely: onomatopoeia with strong elements of universality (BIRD, DRINK), a diffused symbolic system with a slight element of universality (ROUND), and plain borrowing (DOG). As evidence for a genetic relationship, these sets are thereby weakened, but they cannot be totally ignored--these possible, even probable, alternative origins are not certainties.
Even if these four sets be eliminated from consideration, there still remain resemblant sets in somewhat greater number than expected by chance. A goal might be to separate out the stronger candidates for cognacy. As one attempt, it might be argued that those sets which rely on glottalized consonants with unglottalized in an unsystematic way are vulnerable. However, we are dealing here with a tremendous time-depth, during which many changes have taken place—and glottalization can arise other than through some obvious phonological development; it might result from morphological affixation and a blending of consonants (this has occurred with some stem-final consonants in Kashaya); it might result from a symbolic alteration in a sound. I might add that in a more "classical proof" of cognacy it is quite easy to find recurrent sound correspondences between Wappo and PWP (or Kashaya):

<table>
<thead>
<tr>
<th>EAR</th>
<th>THOU</th>
<th>WOMAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wappo  m</td>
<td>déma</td>
<td>mi-?</td>
</tr>
<tr>
<td>Proto-Pomo m</td>
<td>***šima</td>
<td>***a-ma</td>
</tr>
</tbody>
</table>

Wappo has no voiced stops (except in Spanish loans) and it is thus also reasonable to postulate that PP **b (or Kashaya b) corresponds to Wappo m. For examples of this it is necessary to go to the second 100-word list:

<table>
<thead>
<tr>
<th>ACORN</th>
<th>SHORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wappo  m</td>
<td>mé l</td>
</tr>
<tr>
<td>PWP    **b</td>
<td>***bi?du</td>
</tr>
<tr>
<td>Kashaya b</td>
<td>bi?du</td>
</tr>
</tbody>
</table>

In parallel fashion one could postulate that PP**d; Wappo n, but for this there is in these lists only one example SUN PP **na?da; Wappo hin; while for an equally reasonable correspondence of PP **d; Wappo l, there are two good examples, the above cited ACORN and SKIN PP **di?da; Wappo chila

If we allow the correspondence to go slightly beyond the criteria of similarity employed herein, we could have

<table>
<thead>
<tr>
<th>EAT</th>
<th>FATHER'S MOTHER</th>
<th>FATHER'S SISTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wappo  p</td>
<td>pá?-</td>
<td>-pápa</td>
</tr>
<tr>
<td>Proto-Pomo **m</td>
<td>***ma?a-</td>
<td>***-ma-</td>
</tr>
</tbody>
</table>

More examples could be brought forth and many could be made to fit into some sort of system by ad hoc, environmentally conditioned rules or by devising new proto-symbols. However, given the great divergence of the languages treated herein and the masking effect of the chance resemblances, which are about as numerous, in the Wappo-PWP comparison, as the expected number of forms historically related from all causes, it is doubtful that it will ever be possible to assemble a
reasonable, convincing, encompassing, multiply-attested system of reconstruction.

The approach in this paper is quite different; it does not depend upon being able to separate potential cognates from chance similarities and borrowings and so to reconstruct. It depends on a statistical analysis of semantically paired vocabularies in order to test whether the phonetic similarities found between them are significantly greater than can be attributed to chance. The statistical analysis cannot of itself distinguish an affinity arising from a common genetic origin from an affinity resulting from other historical causes, but proof of a historical connection of any type would be a worthwhile advance in our knowledge of the interrelationships of American Indian languages. With the pair showing the strongest affinity, Wappo-PWP, an attempt was made, through an investigation of the individual sets of semantically and phonetically matched forms, at a partial separation of the resemblances due to different historical causes.

No significant affinity between PWM and Maidu shows up in these comparisons, a reflection of the problematic status of Penutian. There is a tilt of Wappo towards the languages called Hokan, especially the Pomo family, more so than towards the two languages called Penutian; but a strong claim of a genetic relationship between Wappo and the Pomo family is held in abeyance pending a deeper exploration with more vocabulary. Any more comprehensive claim that the grouping known as Yukian is related to another stock, family, or language must rest on comparisons that also include a vocabulary representative of the Yuki-Huchnom-Coast Yuki dialect cluster, as well as the vocabulary of Wappo.
1. This paper was presented orally at the 1977 Hokan-Yuman Languages Workshop held at the University of Utah. The comparisons involving PWP, FWM, and Maidu were done in 1966; the others date from 1963-1965. Both sets of work were done through the facilities of the Computer Center of the University of California, Berkeley.

Occasional reference is made throughout the paper to courses of action that would clarify the results or improve the procedure technically, sometimes with a referral to this note, sometimes not. Sample suggestions are

Better segmentation of the forms.

More batches of vocabulary.

Inclusion of more putatively related languages: Hokan, Penutian, and especially Yukian.

More detailed investigations of the effects of varying the criteria of phonetic similarity.

Refinements in the machine program.

A lot of additional data have been assembled and processed to run, including word lists in Yuki, but all work with the computer came to an abrupt halt in 1968, when the Computer Center replaced its earlier generation machine with a more advanced model. The program was developed over a period of years, in assembly language, to run on the IBM 7090 and will not work on the later machines. It will be a long, expensive, complex task to rewrite the program and, for the past ten years, I have not had sufficient access to a computer powerful enough to handle the projected program. With the great improvements in microcomputers, and their dramatic drop in price, the situation may change in the near future. Pending the resumption of that line of endeavor, I must present the results "as is" regardless of the ways I see to make technical improvements. Others are welcome to try their hands at the method.
Introduction

This is a report on preliminary findings from a study of the rhythmical structure of Cocopa in spontaneous narratives (1). The data is drawn from a narrative related by Sam Miller to Professor James Crawford in 1957. Crawford's published syntactic and morphological analysis (Crawford, 1975) is preserved (although a slightly different notational system is used). In addition, a phonetic transcription (in IPA) was made marking pause and syllable boundaries.

Crawford has claimed (1956, p.28-29) that Cocopa is 'stress timed', i.e., that sentences having the same number of stresses have approximately the same duration. (2) As an example, he cites the following sentences: (Hyphens in the Cocopa sentences indicate syllable boundaries.)

1. nyá:c c-nyár la-ká:ym á:c yuş
   I=8 yesterday town l-go-c l-exist-evid
   "I went to town yesterday"

2. a-yá:-pìny şáy c-cxá:-cm ş-nya:ya:m
   tree-dem there l-pl-plant-sr dem-then-happen-m
   "We planted the trees over there.'

3. nyá:c wáły mén spác
   I=8 house-in l-get-up l-go-out-prf
   "I went out of the house".

Each of the above sentences contains four stressed syllables, and, hence, by the stress timing principle, they have approximately the same duration. As Crawford notes, the sentences differ in the number of unstressed syllables they contain. Sentence 1 has three unstressed syllables, 2 has six unstressed syllables, and 3 has no unstressed syllables. The presence of unstressed syllables, thus, should not affect sentence duration.

Crawford's stress timing claim describes the rhythmical structure of Cocopa in terms of the number of stresses in a
'sentence'. It is difficult to isolate 'sentences' in spontaneous Cocopa narratives -- partially because of the narrative speech style which links phrases with connectives; and also because the concept 'phrase', a verb phrase or a noun phrase, is a more easily identifiable structure in Cocopa syntax.

In this analysis, the sentence boundaries noted by Crawford are presented in the phonemic transcription. In the discussion of the rhythmical structure, the term 'sentence' will be avoided in favor of the more general concept of 'semantic topic' comprising one or more phrases which express a unitary semantic concept, e.g., a paragraph.

Stress timing, in its more general usage, describes listener perception of a special type of speech rhythm -- listeners hear stress as occurring at regular intervals. The isochronous interval between stresses remains at present a perceptual judgement, one that has not been verified by acoustic analysis. The present analysis of Cocopa narratives seeks to define some phonetic and phonological bases for the perception of stress timing.

The Basis of Speech Rhythm

Stress timing is one type of rhythmic structure. What is rhythm? 'Rhythm' refers to the temporal structure of speech utterances. It deals with the relative durations of units at many levels: the segment, the syllable, the word, the sentence and the paragraph. Phonology has traditionally acknowledged the distinctiveness of duration at the level of the segment, i.e., the phoneme. Poetic meter is based on duration of syllables. Speech production views syllables as the minimal articulatory programs used in temporally (and articulatorily) structuring an utterance.

How is an utterance temporally structured? The question of speech rhythm has been studied in the field of speech production by Kozhevnikov and Chistovich (1965) and Fowler (1977). Their description of speech production follows.

The abstract string generated by the grammar is a linear concatenation of abstract segments (i.e., phonemes) which still must be translated into motor commands for articulation. The abstract string is stored in Short Term Memory (STM) while it is parsed into articulatory programs. (A 'program' is the set of instructions which are sent to individual muscle fibers in the speech apparatus to initiate the articulation of a given speech unit.) The Central Nervous System does not have rapid enough control of muscle activity to permit segmental control of speech. The articulatory programs comprise integrated motor commands for syllable production. Each articulatory program also contains one stress. The
stress is the organizational focus around which the motor commands for the syllable are organized.

The motor commands within each articulatory program do not follow the linear sequence of segments in a syllable. Differences in the length of the cranial nerves innervating the speech muscles, and the different inertias of the speech articulators themselves, i.e., how much effort is involved in moving them, require that the neural command be of a rather different linear order than that of the segments of the word. This requires that the abstract string produced by the grammar undergo a restructuring before articulation. Thus, at the time of temporal structuring, the linear sequence of phonemes in the abstract string is 'lost'.

The articulatory programs that are created in the Central Nervous System result ultimately in the production of syllables. These articulatory programs must be sequentially ordered to follow the intended sequence of syllables in the word and utterance. The articulatory programs are sequentially sent out to the vocal tract musculature for production. The rate at which the programs are sent out corresponds to the rate of speech, i.e., speech rhythm.

As was noted above, the temporal structuring of an utterance occurs while it is stored in Short Term Memory. STM has a limited storage capacity, it can hold approximately seven (stressed or unstressed) syllables at a time. An abstract string that is too long to be stored in STM as a unit must be entered into STM in seven syllable chunks. 'Left-over' material in the abstract string is loaded into STM after the preceding seven syllable portion has been sent out to the vocal tract.

Stress is the organizational focus around which motor commands are structured within the articulatory program. On the speech production level, i.e., outside the grammar, the stress internal to each articulatory program is synchronized with the beats of a 'neural rhythm generator'. (The neural rhythm generator emits pulses at regular intervals. All rhythmic motor activity, tapping a finger or speaking, is temporally coordinated with these rhythmic beats.) On the level of speech perception, linguists assign stress to syllable peaks, usually vowels. The implicit claim of the above speech production model is that stressed vowels are synchronized with the rhythmic beats of the neural rhythm generator. An unstressed vowel will not constitute an independent articulatory program because it has no stress. Remember that all articulatory programs require stress so that they may be rhythmically coordinated with the neural rhythm generator. Unstressed syllables, then, are appended to a preceding or following stressed syllable's articulatory program.

According to Fowler (1977), the phonetic reduction
observed in unstressed syllables derives from their 'second class' status in speech production. Articulation is targeted from stress to stress. Unstressed syllables are 'deflections' from the major articulatory path. Similarly, pre- tonic consonants should have more precise articulation than post-tonic consonants because they are directly on route to a stressed vowel. Post-tonic consonants are more reduced because they occur after the goal, i.e., the stressed vowel, of the articulatory program has been achieved.

What are the implications of the speech production model for the surface phonetic form of an utterance?

I. Co-articulatory phenomena (assimilation, simplification, etc.) are viewed as artifacts of the changes brought about when an abstract string is restructured for speech production in STM. The articulatory programs will integrate the motor commands associated with each syllable into those of neighboring syllables. Successive articulatory programs will similarly be integrated into one another. Maximum efficiency will cause the greatest simplification to occur in unstressed syllables or post-tonic consonants. These predictions are borne out in the Cocopa data. (See Nasal Merger, Nasal Deletion, and Consonant Cluster Simplification below.)

II. The theory outlined above divides speech production of a linguistic utterance into the seven syllable 'chunks' that can be stored in STM at a given moment. As seven syllables are stored together for restructuring into articulatory programs, co-articulation phenomena will obtain within these seven syllables. An utterance containing more than seven syllables will be restructured in successive seven syllable chunks. The speech production model predicts that no co-articulation phenomena will occur at the juncture between successive seven syllable chunks. The possibility of pauses separating each group from the next is left open. This is the norm in the Cocopa data.

III. The speech production model describes stress timed languages when it synchronizes stresses with the impulses of a neural rhythm generator. The synchronization of stresses with rhythm impulses explicitly attempts to account for isochrony between stresses. Note that this explanation of stress timing does not consider rhythmic structure to be specified in the grammar. (Segmental length and the location of stress are, of course, permitted.) Stress timing is not linguistic because it is created outside the grammar while the utterance is stored in STM. The rhythmic structure of language is assigned in the same fashion as other rhythmic behavior—by coordinating it with rhythmic beats from a neural impulse generator.

Phonological and Phonetic Aspects of Stress Timing
In the introduction Crawford's description of stress timing was summarized. The second part of the paper described a proposed model describing the physiological basis for stress timing in language. In this last section, I would like to return to Cocopa and examine Cocopa stress timing.

The speech production model explains the rhythmic aspects of stress timing as deriving ultimately from the rhythmic impulses of the neural impulse generator. Yet, as I noted in the introduction, 'stress timing' remains a perception on the part of listeners that has not been verified by acoustic analysis. I would like to suggest that listeners 'reconstruct' the intended speech rhythm. They are able to interpret the acoustically varying intervals between stresses as isochronous with the aid of accompanying phonological and phonetic cues. These cues are the overt co-articulation phenomena accompanying stress timed speech production and the location of pauses within the larger utterance. The idea of a speaker 'reconstructing' a speech rhythm parallels the familiar 'analysis by synthesis' model of speech perception wherein a listener can comprehend an utterance despite speech errors, false starts, or extraneous external interference.

Pauses

Three types of pauses occurred in the data: major pauses, minor pauses and syllable-internal pauses. Generally, a pause separated each 'chunk' of speech temporally structured in STM. This does not mean that a pause occurred at seven-syllable intervals, but rather that the amount of material between pauses was in fact surprisingly regular, occurring at 4- to 7-syllable intervals. The documentation for this observation is included in the discussion of the semantic function of the individual pause types.

Major and minor pauses are intervals of silence separating two successive speech utterances. A major pause is at least twice as long as a minor pause. The absolute duration of major and minor pauses varies across speakers, but their relative durations remains constant.

Major pauses occur at the boundaries between semantic topics. Major semantic junctures occur at the beginnings and endings of direct quotes, or between direct quotes from different persona in the narrative. Major pauses usually occurred at these points throughout the narrative. For example: (3) ("/" marks a major pause boundary, "/" marks a minor pause boundary.)
4. [ / p³-kat pa-wí:--1Ý t // mō: nÝ-xš:1 / ]
ppukát pa:wí:c 'ac "mu: nyxu:1
p-p-u-kat pa:-wí:-c 'a-c mu: nyxu:1
3o-*-3-meet 3o=3-see-c 3=say-c well younger=brother
(Coyote) met up with him, looked at him, and said, "Well, younger

[ m³ká-má:x myú:w³ // hí: / nÝ-ad-g- ]
makám ma:x myu 'a "¿¿, nya:c
makam m-a:-x m-yu 'a nya:-c
where 2-go-irr 2-exist 3=say uh=huh I-s
where are you going," he says "Uh huh,

[ mém / nÝ-ad-g-ma:m-p³-ly má:m-p³-'a:m-pniv: ]
ma:m nya:c má:m maply ma:m pa-'a:m-piny
ma:m nya:-c má:m maply ma:m pa-'a:-m-piny
now I-s now now now dem-l=go-from-dem=a
[as for] my going along now,

[-ve-rá:r nÝ: p³-'a:m$ ]
nyawi: 'ará:r nyay pa-'a:m$ , :::
nyawi: 'ará:r nyay pa-'a:-m-$
thing work 1=look=for dem-l=go-m-adv
I am on my way to look for a job, ...

Major pauses also occur at boundaries between semantic
topics. In 5, a major pause precedes the introduction of a
new persona, Coyote:

5. [ / nÝ-ad-g-ma:m / pÝ-ad-g-ma:m / ]
nya'á:c ma:m pnya:c ma:m
nya'-a-c ma:m p-nya-a:-c ma:m
then-3=say-prf now *-then-3=come-c now
When he said it, he then went on his way,

[ nÝ-ve-rá:r u-nÝ:-pá:m // xq-p³-p³-c ]
nyawi: 'ará:r unyay pa:m x̣pa pl:c
nyawi: 'ará:r u-nyay pa:-m x̣pa pl:-c
thing work 3=look=for 3=go=along-m coyote dem-s
As he was on his way looking for work, this Coyote

[ bi-nÝ-a-wé: / p³-kat pa-wí:--1Ý t // ]
pya:yí:c ppukát pa:wí:c 'ac
p-nya:-yí:-c p-p-u-kat pa:-wí:-c 'a-c
dem-then-3=come-c 3o-*-3-meet 3o=3-see-prf 3=say-c
was coming, met up with him, looked at him, and said,
Minor pauses, '/', usually separate phrases. Minor pauses are not phrase boundary markers. Almost any word in Cocopa can constitute a phrase. This is especially true in narratives where long strings of concatenated verbs tend to appear with few intervening nouns. (Note that the Cocopa verb is inflected for pronominal subject and object.) A minor pause occurring after a 'chunk' of (STM-structured speech is very likely to occur at a phrase boundary. Minor pauses, '/', occur at phrase boundaries. Not every phrase is bounded by minor pauses. In long semantic topics, minor pauses occur frequently in the initial portion of the topic. They gradually include more and more phrases, reaching a maximum (of about 10-11 syllables) at the end of the topic. This gradual increase in the number of syllables per 'chunk' in long semantic topics is called 'accelerative timing'.

An example of the 'accelerative timing' found in long semantic topics is presented below:

6. [ // nyo-l-m: / ə-nyo-l-kær / m:1 / ]
   pnyavm      ma:m, nya nyakuir      mu:1
   p-nya-wa-m   ma:m nya nyakuir      mu:1
   dem-then-1=sit-dr now day long=ago Mule
   I'm here now, so one day long ago, Mule,

   [ m:1 vas-t"f: / k:i-yu-mov / // pnyavc ]
   Mu:1 pa:'ás,     pi:c     xymovk      pnyavc
   mu:1 pa:-'a-s     pi:-c     xymovk      p-nya- :c
   Mule 3+3-call-pl  dem-s *-3-grow=up then-3=go-c
   they called him, he kept on growing

[ mam múr-l-vl / nyo-á:dz ma: -nyv-vč-rá:r ]
   ma:m     Mu:1-pc      pnyav'á:c ma:m nyawí: 'ará:r
   mam       mu:1-pc      p-nya-p-á:a:-c ma:m nyawí: 'ará:r
   now Mule-dem-then-*-3-stand-c now thing work
   and then he stood -- a [full grown] mule. "I'm going to look

[ nyo-l-m: / // ]
   nyavmx     yu'g      'ac.
   nyav-x-m    yu'g      'a-c
   l=look-for-irr-sr exist-evid 3=say-c
   a job," he said.

A second example of 'accelerative timing' is presented below. Perceptually, the rate of speech appears to increase,
and a greater degree of phonetic compression (i.e., phonological simplification) is found:

7. [ // hĩ: / n'yā:dz-mam / n'yadz-ma:m-mp'iy-mā:m ]
"hĩ: nya:c ma:m nya:c (ma:m) mapily ma:m
n'yā: c ma:m nya:c ma:m mapily ma:m
"Uh huh, [as for]

pa'ā:m-pīng nyā:vi: 'arā:r nyā:y yā:i:ma:m
pa- 'a:m-pīng nyā:vi: 'arā:r nyā:y pa- 'a:m-s
[ mak* / k∂-ve-rā:r m∂-kē n'yī-ve-rā:r ]
dem-l=go-from-dem=o thing work l=look=for dem-l=go-sr=adv
my going along now, I am on my way to look for a job, and

[mak*] (4) nyā:vi: 'arā:r makāy nyā:i:ma:m rār
(makāy*) nyā:vi: 'arā:r makāy nya-ya:i:ma:m rār
(where*) thing work where then-locate-sr l=work
wherever there happens to be work, I will work

[k∂-yōx-If / n'yī-ve-rā:r n'yē:i: ]
[ nyā:i:ma:m k-yum, nyā:vi: 'arā:r nyā:y
ka-yu-x 'ic. nyā:vi: 'arā:r nyā:y
indef-exist-ivr l=say-prf thing work l=look=for
at anything. I am my way looking for a job, whatever it is,

[p'ā:m gīm-ne / n'y-v-rar n'yē:i: ]
p'ā:m kyum, nyā:vi: 'arā:r nyā:y
pa- 'a:m- k-yu-m nyā:vi: 'arā:r nyā:y
[ pny'ā:m / m∂-p'iy n'y-ve-rar n∂-kē ]
dem-l=go-m indef-exist-m thing work l=look=for
I am on my way looking for a job

[pny'ā:m / m∂-p'iy n'y-ve-rar n∂-kē ]
pny'ā:m mapily, nyā:vi: 'arā:r (makāy)
p-nya-'a:m- mapily nyā:vi: 'arā:r makāy
[ y'm-vél- /]
yā:m rarlly 'ic. nypuny nykwiny
yā:m rarl-s-l 'ic. nypuny nykwiny
locate-sr l=work-ivr-des l=say-prf dem be=all
I want to work. That's all now,
Short semantic topics are more evenly divided by pauses, i.e., the number of syllables between pauses is more regular, and the rate of speech remains relatively constant. An example of this occurs in 3:

   "... nyxu:1. nya:c nya:wi: 'arâ:r
   nyxu:1 nya:c nyawî: 'ara:r
   younger=brother I=s thing work
   "...younger brother. I know where

   [ wi-yâ:m wi-yâ:-drj // pwi-ya m ]
   puyá:m u:yi:c yu:š puyá:m
   pu-ya:m u:yi:c yu-š pu-ya:m
   dem-locate-sr 1=know-c 1=exist-evid dem-locate-m
   there is a job.

   [ ki-nyí:st // nyí-ki-nyá:-ṿm-ka / k̩-wi: ]
   yú-k nya:c nyknya:wpkm, kâ:k
   nyawî:
   exist-k I=s 2o=1-tell-k-sr impv-go-impv thing
   When I tell you where it is, go and

   [ k̩-ra:r // hř: xũe // nyí-a-ẉw-ŋ- ]
   krark." "q, pxway." "nysawîwm
   k̩-rar-k qa pxway ny-sawîw-m
   impv-work-impv oh all=right 2o=1-show=pl-sr
   work." "Oh, all right." "When I show it to you,

   [ wi: / wi-yâ:-ṿc // n̄yâ:m xũe' // ]
   mwi:xm puyâ:c yu:š' n̄yâ:šm "pxway."
   m-wi:-x-n pu-ya:-c yu-s n̄yâ:-a-m pxway
   2-see-irr-sr dem-locate-c exist-evid when-3=say-sr all=right
   you will see it." When he said it, [Mule said], "All right."

There is no immediate explanation for the 'accelerative timing' observed in long semantic topics. One might conjecture that the accelerated rhythmic structure reflects production pressures stemming from the storage limitations of Short Term Memory. Semantic topics represent a linguistic unit on some level of hierarchical organization. If the linguistic generation of all the phrases in a semantic topic is 'linked', then one could conceive of semantic topics being derived as a unit before being sent out of the grammar. Once
the entire semantic topic is expressed as an abstract string, the entire string is sent out to STM for temporal restructur-
ing. In the case of long semantic topics temporary storage problems might be encountered as the string is 'held' between the grammar and STM. (It would have to be 'held' while it is being fed into STM in seven-syllable chunks.) Temporary storage might become problematic if the grammar sends out new semantic topics. I am suggesting that in the 'ideal' situation, the rate at which the grammar produces semantic topics corresponds to the rate at which Short Term Memory sends chunks out to the vocal tract musculature for production. If the grammar produces more (or longer) semantic topics than STM can handle then a temporary 'overload' situation is created where too much material is held in temporary storage between the grammar and STM. 'Accelerative timing' occurs in the 'overload' situation -- STM increases the rate at which abstract strings are temporally structured by crowding longer abstract strings into each chunk. 'Overcrowding' leads to increased phonological simplification due to the invariant mechanical limitations of the vocal tract musculature, i.e., although STM can increase its rate of chunk production, the rate at which vocal tract musculature can move (in articula-
tion) has mechanical limits.

'Accelerated timing' would not be encountered in short semantic topics where presumably the rate of the grammar's production of semantic topics corresponds better to the rate at which 'chunks' are temporally structured in STM. There is a two-fold difference in the number of syllables per chunk between short and long semantic topics: 4-5 syllables between pauses in short topics and 10-11 syllables toward the end of long semantic topics.

The number of syllables per STM 'chunk' is of theoretical interest in the evaluation of speech production models. These theories, which hold that the temporal structure of an utter-
ance is superimposed on articulatory programs stored in short term memory, predict that the average number of syllables per STM 'chunk' is seven. This value reflects the storage capacity of Short Term Memory. In the Cocopa text, several timing units contain more than seven syllables. In these timing units, an interesting phenomenon is observed in one of the middle syllables -- a middle syllable is overlong, that is, it appears to contain an internal pause (cf. pre-pausal lengthening). The internal pause is marked by underlining a long syllable in the phonetic transcription. A syllable contain-
ting an internal pause may represent the transition between STM-structured chunks. For example:

9. [ /ˈkədʒ-ˈmɑːm-ɔ̃-m-piptables-ˈkɑːm-ɔ̃-m-piptables- ]
nyaːːc (ˈmɑːm) maːpɪly maːm paːˈdimpinya
nyaːːc maːm maːpɪly maːm po-ˈaːm-pinya
I-5 now now now dem-1=go-from-dem=0
[as for] my going along now.

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I am on my way to look for a job, and wherever there happens to be work, I will work.

Syllabification is determined during STM storage when an abstract string is temporally structured into articulatory programs. In Cocopa, syllabification in narratives differs from careful pronunciation in that word boundaries are frequently located within a syllable. This change usually reflects a word-final consonant being pronounced as the syllable onset to the next word. The relocated (word-final) consonant may be a stem-final consonant, a syntactic suffix, or an aspectual suffix. The relocation occurs when the following word begins with a vowel, glide, or nasal.

I suggested above that much linguistic information is lost during the temporal structuring of abstract strings in Short Term Memory. Relocation provides evidence for this hypothesis: the location of word boundaries does not control syllabification (whereas the articulation-based maximum efficiency principle does). Processes of phonological simplification (Consonant Cluster Simplification and Nasal Deletion below) and co-articulation (Nasal Merger) also show little regard for linguistic information. This situation should be contrasted with the location of major and minor pauses—which normally co-occur with word boundaries. The grammar, then, has some control over how much material is entered into an STM chunk, i.e., where the chunk begins and ends, but it has little control once the string has entered STM.

Examples of phonological simplification and co-articulation are presented below under Nasal Merger/Deletion and Consonant Cluster Simplification.

In Nasal Merger, two identical nasals separated by a
word boundary 'coalesce' to form the onset of the following word:

10. pnyaw agree oki: 'while I sit here now'  
    \[ny^\circ o-\text{w}^\circ -\text{m}^\circ \text{a}^\circ \text{m}\]  
    \[-m \text{ switch reference}\]

11. makam agree tem: 'where you will go'  
    \[m^\circ ^2 \text{k}^\circ \text{a}^\circ \text{m}\]  
    \[-m \text{ direction away from}\]

12. pa'ampany, nyawi: 'araar 'my going along here,  
    work'  
    \[p^\circ \text{a}^\circ \text{m-p}^\circ \text{ny}:\text{-ve-r}^\circ \text{a}^\circ \text{r}\]  
    \[-piny \text{ object case marker}\]

13. uyunxan: nyawi: urar: 'he is very much, he works  
    but'  
    \[k^\circ \text{a}^\circ \text{y}^\circ \text{m}^\circ \text{a}^\circ \text{n}^\circ \text{y}^\circ \text{-ve-r}^\circ \text{a}^\circ \text{r-r}^\circ \text{a}^\circ \text{r}\]  
    \[-xany 'be very much'\]

In Nasal Deletion, a word-final nasal is deleted before  
a word beginning with a non-identical nasal. This process  
applies with few exceptions to all nasals within an STM  
chunk. Occasionally, nasalization occurs on the vowel preced-  
ing the deleted nasal:

14. ma:m 'nyawi: arar 'now "work ..."  
    \[ma:m-ny^\circ \text{y}:\text{-ve-r}^\circ \text{a}^\circ \text{r}\]  
    \[ma:m \ 'now\]

but 15. ma:m nyawi: 'araar 'now. "work'  
    \[ma:m / ny^\circ \text{y}:\text{-ve-r}^\circ \text{a}^\circ \text{r}\]

16. ma:m numak  
    \[ma:m \ nu-m\text{ak}\]

17. upi:m sawa:m nunamak ma:m  
    'from now on when I fire you'  
    \[b\text{inj}:\text{-ma}^\circ :\text{-y}^\circ \text{a}^\circ \text{-na-m}\text{ak-k}^\circ \text{a}^\circ \text{m}\]  
    \[-m \text{ switch reference}\]

Consonant Cluster Simplification

In tri-consonantal clusters occurring within STM chunks,  
the medial consonant is dropped. This process occurs most  
frequently when the consonant is word-final, i.e., CC\text{}C. Bi-  
consonantal clusters in word-initial position seem more  
protected. The pattern of consonant deletion supports Margaret  
Langdon's description of post-tonic consonants being weaker  
than those occurring in pre-tonic position. (Langdon, 1975.)  
It is also predicted by Fowler's (1977) suggestion that  
speech production is targeted from stressed vowel to stressed  
vowel and, hence, that pre-tonic consonants are more precisely  
articulated than post-tonic consonants.
The deleted consonant may be stem-final, a syntactic suffix, or an aspectual suffix. The suffix -\( \ddash \text{u} \), 'assertion; but', is the primary exception to this rule. It never undergoes deletion. Perhaps -\( \ddash \text{u} \) carries emphatic stress. This would explain its behavior with respect to this rule, and the fact that an epenthetic vowel is frequently inserted before this suffix. Examples of consonant clusters are presented in 18:

18. nyay\( \text{xm} \) yu\( \ddash \text{u} \) "'ac
  [n\( \text{ye}:-\text{ma}-\ddash\text{let}/\)]
  1=look=for-irr-sr exist-evid 3=say-c
  -x intensive irrealis
  -m switch reference

19. ma:\( \text{mk} \) pxway\( \text{xm} \) puy\( \ddash \text{a} \)m
  [m\( \text{m} \) \( \ddash \text{u} \text{c} \) y \( \ddash \text{p} \) tu-\( \ddash \text{a} \)m]
  be=all-def-adv be=good-irr-sr dem-locate-m
  -k dependent future (coordinated with -x, irr)
  -\( \ddash \text{u} \) adversative 'but'
  -m switch reference

20. say\( \ddash \text{uk} \) pa\( \ddash \text{a} \text{m} \)k mak\( \text{m} \)
  [\( \ddash \text{ai} \)-\( \ddash \text{y} \)\( \ddash \text{a} \)k m\( \ddash \text{a} \): m\( \ddash \text{a} \)-k\( \ddash \text{m} \)]
  dem-exist-k dem-1=go-m-k where
  I-will be there while -I-will-be-going-away-from-here where
  -k dependent future, or uncertainty

21. ma:\( \text{m} \), ksp\( \text{ak} \) ka:\( \text{mk} \) makay
  [ma:\( \ddash \text{m} \)-\( \ddash \text{p} \)\( \ddash \text{a} \)k-\( \ddash \text{k} \): m\( \ddash \text{a} \)-k\( \ddash \text{ey} \)]
  now impv-leave-impv impv-go-from-impv where
  "Now, go-out! go-away! where ever"
  k\( \ddash \)--k discontinuous imperative

22. say\( \ddash \text{a} \)m nyku\( \ddash \text{m} \)
  [\( \ddash \text{se} \)-\( \ddash \text{y} \)\( \ddash \text{a} \)m g\( \ddash \text{m} \)-n\( \ddash \text{a} \)s]
  dem-locate-sr 3pl=arrive
  "it-was-there they-arrived"

Below, counterexamples with -\( \ddash \text{u} \) are indicated:

23. ma:\( \text{mk} \) pxway\( \text{xm} \)
  [m\( \text{m} \) \( \ddash \text{u} \text{c} \) y]
  be=all-def-adv be=good-irr-m
  "that-will-be-all-but it-will-be-fine"

24. pa\( \ddash \text{a} \)m\( \ddash \text{a} \) (makay)
  [p\( \ddash \text{a} \)-\( \ddash \text{a} \)-\( \ddash \text{m} \)-k]
  dem-1=go-m-adv (where)
  "I-go-along-here-but (where) ...

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25. nyawì: urárš mə:m
   [n*1-ve-rar-rí'-mə:m]  
   thing 3-work-adv now
   "he-works-but now"

   Tri-consonantal clusters across pause boundaries rarely
   show deletion. The pause boundary, rather, is the most common
   environment for vowel epanthesis:

26. pnyuyú:wc nyawì:
    [mi:n'-yé::-wit/ n*1-ve]          
    dem-then-3-arrive=pl-c thing.

27. Mú:lpic pnypu'á:c
    [má:r*2-vi:t / p*1-n'ą-n'á:dʒ]
    mule-dem=s dem-then-3-stand-c

28. nys:ć nyknya:pnk
    [n*y:1-k*1-n'á:-vam]  
    I-s 2o=1-tell-k-sr

29. rark pā:k pā:xm puyá:m
    [rárk / pā:k / pā:x-m pú-yá:m]
    l=work-df l=go=along-df l=go=along-irr-sr dem-
    happen-m

   One final difference in the phonological structure of
   Cocopa free narratives versus careful speech should be noted.
   There is a distinction, in free speech, between 'real' glottal
   stops -- those which always appear in the surface phonetic
   form, and 'quasi' glottal stops -- those which rarely (if
   at all) occur in spontaneous narratives. The presence of a
   glottal stop in a word was determined by Crawford's phonemic
   transcription and by personal elicitation with an informant.
   The glottal stop in p*a, 'to stand', and a, 'to go',
   always occur. They are 'real' glottal stops:

30. pnypu'á:c
    [p*2-n*yu'-á:dʒ]  
    'then he stood here'

31. pā'á:k
    [p*2-'a:k]  
    'I will go along here'

32. pnyā'á:m
    [pñ*2'-á:m]  
    'then I go along here'

33. pā'á:npiny
    [p*2'-á:m-pn*1']  
    'my going along here'

   The glottal stop in a, 'he says', is 'quasi':

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34. nyá'ác
   [n'á:dz]
   'then he said'

35. pa:'šs
   [vas]
   'they call him'

The glottal stop in 'a', 'to go', occasionally appears as an amplitude drop.

Conclusions

I. The Cocopa narrative is 'punctuated' at regular intervals by pauses. The interval, i.e., the time elapsed between pauses, appears to correspond to the storage capacity of STM. (This is apparent on a physical recording of speech, e.g., a spectrogram, where the speech utterance is broken by pauses at fairly regular intervals.)

The length of pauses may be linguistically controlled, viz. to reflect the nature of semantic juncture. Major pauses reflect major semantic junctures, minor pauses occur at phrase boundaries, syllable-internal pauses occur at 'chunk' boundaries.

The location of major and minor pauses appears to be under linguistic control to the extent that the grammar is able to control how much of an abstract string enters a given STM 'chunk'. The linguistic control of pause location 'breaks down' in accelerative timing, when the grammar is generating strings faster than Short Term Memory is able to temporally structure them. The location of (syllable-internal) pauses in long semantic topics suggests that the grammar 'sacrifices' some control of pause location in the overload situation.

II. The phonetic changes in the abstract string entered into an STM 'chunk' suggest that the grammar has little control over the temporal structuring of an utterance. The syllabification created during the formation of articulatory programs may ignore word boundaries. Co-articulation phenomena may delete morphological, syntactic and semantic information. These findings suggest that speech rhythm, beyond the specification of segmental durations as long or short (relative to one another), is determined outside the grammar.
Appendix

The following two tracings are included in order to provide the reader with some sense of the physical data. Three signals occur in each tracing: the top line is an amplitude contour, showing changes in loudness. The second line is a fundamental frequency contour, 'Fo', which registers changes in pitch. The bottom line is the speech wave, a rapidly changing sine wave. The changes in the sine wave are enclosed in an envelope.

The physical recording was derived from the tape by sending the output of the tape to three separate 'signal analyzers'. The pitch 'signal analyzer' consists of a Transpitch Meter which extracts the fundamental frequency from the speech wave. The output of the Transpitch Meter was sent into a pitch extractor which converts the Fo into a continuous waveform. (The pitch extractor was developed by Jeff Hardy and Bob Barker of the UCSD Phonetics Laboratory.) The amplitude 'signal analyzer' extracts the amplitude of the speech waveform and converts it into a continuous waveform. This device was developed by Bob Barker and Professor Timothy Smith.) The speech waveform, in conjunction with the fundamental frequency and amplitude waveforms, is sent into an oscilloscope which produces a physical copy of the changing values of each of these signals across time. (The scale is 50mm/s.) The amplitude contour is a good indicator of the location of syllable boundaries. The waveform usually drops at these boundaries. In slow speech, the fundamental frequency curve shows word boundaries by a contour drop. During accelerative timing only pre-pausal phrase boundaries are shown.

A short semantic topic and a long semantic topic are presented. The former shows fairly regular stress timing. The latter indicates accelerative, with less prominent amplitude, i.e., stress, contours.
Figure 1. A Short Semantic Topic

\[ dB \]
\[ 0 \]
\[ -2 \]
\[ -6 \]
\[ -10 \]

\[ Hz \]
\[ 160 \]
\[ 120 \]
\[ 90 \]
\[ 60 \]

.102s
.106s

// mo nyi xo:i /ma ka: ma: x nyu: / c //
"mu: nyu:i, makam ma:x nyu" ta
"Well, younger brother, where are you going," he says

Figure 2. A Long Semantic Topic with Accelerative Timing

\[ dB \]
\[ 0 \]
\[ -2 \]
\[ -6 \]
\[ -10 \]

\[ Hz \]
\[ 160 \]
\[ 120 \]
\[ 90 \]
\[ 60 \]

.08s
.020s

ny:li: de:z \( \text{mam} \) m\( \text{mam} \) p\text{a} \( \text{ma} \) ny\( \text{vi} \) \( \text{ve} \) r\( \text{ar} \) ny:li: p\text{a} \( \text{ma} \) \( \text{mam} \) mak
"/ ny:li: de:z \( \text{mam} \) m\( \text{mam} \) p\text{a} \( \text{ma} \) m\( \text{pam} \) \( \text{pin} \) ny\( \text{vi} \) ar\( \text{ar} \) ny:li: \( \text{pa} \) \( \text{ma} \) \( \text{mam} \) \( \text{mam} \),"
"As for my going along here now, I am on my way to look for a job,"

Scale: 50 mm/s
Footnotes

1. I wish to thank the Cocopas who shared their language with me, especially Hope Miller, Lillian Hayes, and Victor Hayes. I would also like to thank Professor Margaret Langdon, Professor James Crawford and Carol Slater who gave willingly of their time to discuss earlier versions of this paper. Professor Crawford taught me much of what I understand linguistically of the Cocopa language. Professor Langdon taught me most of what I understand about American Indian linguistics and the Yuman family of languages. Needless to say, the errors of this work are my own.

2. Other languages in the Yuman language family have also been described as being 'stress timed': Walapai (Redden, 1966) and Yavapai (Sheterian, nd).

3. The format in which the data is presented is as follows: the first line contains a phonetic transcription, enclosed in square brackets, '[ ]'. Hyphens in the phonetic transcription mark syllable boundaries. The second line is a phonemic transcription drawn from Crawford's published version of this narrative (1975). The third line indicates morphological structure, hyphens separate individual morphemes. The fourth line glosses each morpheme isolated in the third line. Again, hyphens separate morphemes. An equal sign, '=' , separates meaning subparts of a single morpheme. For example, 'i', 'I say' is glossed 1=say. The suppletive third person form, 'a', is glossed 3=say; pa- is the subject-object pronounal prefix for transitive verbs with third person subject and third person object, it is glossed 3=3o (3o is an abbreviation for third person object). In the line of morpheme glosses, an asterisk, '*', marks a discontinuous stem, e.g., p-kat, '1=meet=it', p-u-kat, '*-3=meet=it', p-p-u-kat, 3o-*=3-meet. Finally, the fifth line in the data provides a loose English translation (from Crawford (1976)).

The following abbreviatory conventions are used in the morpheme glosses: adv, 'adversative, but'; dem, 'demonstrative'. (The following affixes are glossed as den: pa- 'here, now, in this manner', pu- 'nearby, recent past or future, in that manner', sa- 'overthere, distant past or future, in that strange manner'-pic 'demonstrative subject case marker', -piny 'demonstrative object case marker', evid, 'evidential, this is true'; irr, 'intention irrealis', o, 'object (direct or indirect); pl, 'plural'; prf, 'perfective'; s, 'subject'; sr 'switch reference, indicating that the following verb has a different subject from the current verb'; ss, 'same subject, indicating that the following verb has the same subject as the current verb'; ':' , 'length (marked on vowels and sonorants); 1, 'first person pronominal prefix'; 2, 'second person pronominal prefix'; 3, 'third person pronominal prefix'.

4. The asterisk on this form, and its glosses on succeeding
lines, indicates that this was a speech error. My consultant suspected that the speaker intended to say *nakay*, 'where', but changed his mind.
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