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Palauan Noun Paradigms

1. Introduction

This paper deals with phonological alternations in noun paradigms in Palauan, a Mayalo-Polynesian language utilized by approximately 17,000 speakers in the Palauan archipelago, Guam, and the Mariana Islands (Lewis, 2009). The data set utilized in this analysis originated from the *New Palauan-English dictionary* (Josephs, 1990) and each Palauan noun in the data set appears in its respective non-possessive form and possessive form. In these data, we observe that the underlying representation of Palauan nouns are largely the result of abstract analysis meaning that our underlying forms are derived utilizing parts of the non-possessive form and possessive form of each noun. Furthermore, we observe that the underlying form of a noun is largely constructed from the entire non-possessive form of the noun with a word-final vowel. Because of phonological processes and the suffixation of a possessive affix, this word-final vowel only surfaces in the possessive form of a noun. In short, underlying forms for Palauan nouns are derived by combining parts of the two observed surface allomorphs of that noun through abstraction which is a beneficial and problematic approach to our data according to our theory.

In this paper, we propose that phonological alternations are largely influenced by the syllable structure of Palauan and stress alternations. In our data set, we observe various alternations between the two observable surface allomorphs of a noun. The surface allomorphs alternate between [i]~[Ø] and/or [u]~[Ø] which is sensitive to stress; [a]~[Ø], [ɛ]~[Ø], and/or [u]~[Ø] which is sensitive to word boundary; [-high]~[ə] which is sensitive to stress; [ŋ]~[Ø] which is sensitive to the syllable structure in Palauan; and [l] ~ [l] which is sensitive to syllable structure of Palauan. The alternations observed in these data are not idiosyncratic but rather systematic and rule-governed, providing evidence for the theorization of phonological rules. As a result, we observe that the syllabification of /l/ and the deletion of /ŋ/ in specific phonological environments is due to restriction of what phones are permitted in the onset and coda of a syllable in Palauan. Since a formal stress rule to represent stress alternations is not formulated in this paper, we can infer that stress is predictable and it applies after the syllabification of a word. In addition, stress alternations generate the environment for [+syllabic] unstressed phones to reduce to a schwa [ə] and high vowels [i] and [u] to be deleted. Most importantly, our analysis reveals several ordering relationships between the theorized phonological rules. We observe that Word Final Vowel Deletion feeds [ŋ] Deletion, High Vowel Deletion feeds /l/ Syllabification, the Stress Rule (not formulated) feeds High Vowel Deletion, and the Stress Rule feeds Vowel Reduction. Furthermore, Vowel Reduction counterbleeds High Vowel Deletion, and /l/ Syllabification counterfeeds Word Final Vowel Deletion. However, they are some abstract alternations that can't be captured by these phonological rules.

This paper is organized as follows. First, §2 expounds the syllable structure in Palauan nouns while discussing our theoretical framework which generates the 3-part Syllabification for our derivations and phonological rules. Next, §3 posits morphological rules for the possessive form by looking at the suffix /-l/. Subsequently, §4 interprets the empirical alternations between the non-possessive forms and possessive forms of nouns and postulates the underlying forms of nouns utilizing abstractness. In addition, an abstract vowel (V) is proposed to account for the ambiguous vowels in the underlying forms of some nouns since schwa is not a Palauan phoneme and an abstract vowel (H) for the ambiguous high vowels being deleted in the underlying representation. §5 proposes the phonological rules that are dependent on the syllabification explained in §2 and explain the allomorphy in §4. In addition, this section also includes the phonemicization diagrams based on the proposed phonological rules to distinguish phonemic and allophonic sounds, and a Hasse diagram to explain the potential rule orderings of our theorized rules. Lastly, §6 illustrates and discusses our complete analysis via a series of derivations representative of all possible underlying forms and validate our rule ordering in §5.

2. Palauan Syllable Structure (3-Part Syllabification)

2.1 Violation of SSP

In the Palauan data set, we observed that Palauan syllables do not systematical follow or adhere to the Sonority Sequencing Principle (SSP). This observation is illustrated in diagram (1):

(1) Nouns that violate of SSP:

#	Non-Possessive	Possessive	gloss
20	'ðik	'ðkəl	'wedge'
10	ʔəl'sɛkl	ʔəlsə'kləl	'roasted tapioca fish'

In diagram (1), for noun (20) we see that a fricative [ð] is followed by a plosive [k] which precedes the vowel nucleus, a language systematically following SSP would want the more sonorous fricative closest to the syllable nucleus (vowel) —refer to the possessive form. This is a clear violation of SSP and a similar phenomenon occurs in noun (10) where the less sonorous plosive [k] is closest to the syllable nucleus while the more sonorous fricative [l] is not—refer to the non-possessive form.

Although violating the SSP does not have any repercussions on the alternations in our data, it is crucial for understand and modeling our 3-part Syllabification for Palauan. This SSP violation also aligns with our theory in that not all languages strictly follow the SSP they're can be a partial regard or a full disregard of SSP depending on the language (Hayes, 2009).

2.2 Allowable Onsets of Palauan

In the Palauan data set, we observed that Palauan allows complex onsets. More specifically, it allows up to 2 consonants and these [-syllabic] phones do not have to adhere to the SSP as mentioned in §2.1. This pattern is illustrated in diagram (2). The following diagram (3) will demonstrate a common pattern in our data that is utilized to avoid consonants in the onset being greater than 2.

(2) Allowable Onsets:

#	Non-Possessive	Possessive	gloss
17	'skors	skər'səl	'cane'
46	'ŋul	'ŋlil	'asthma'
24	'ŋibəs	ŋbə'səl	'drool'

In diagram (2), we can observe complex onsets with up to two consonants which do not strictly adhere to SSP in the possessive form of noun (24) where [ŋ], a nasal, a more sonorous consonant precedes [b], a plosive, a less sonorant consonant which is closest to the syllable nucleus. In the possessive form of noun (46), SSP is actually followed, supporting our previously made statement in §2.1 that a language can have a degree to which SSP is followed.

(3) Syllabification of /l/ and Syllable Structure:

#	Non-Possessive	Possessive	gloss
21	'kliðm	kl ð'məl	'head'
58	'kluk	kl 'kul	<i>Type of Palauan money</i>

In this spread, specifically the possessive form of noun (58), /l/ could have served as one of the consonants in the complex onsets of the deleted high vowel [i]. But, once [i] is deleted, it created a consonant cluster comprised of [kl] which is not allowed in Palauan because complex onsets must have only 2 consonants. The nucleus [u] was not able to syllabify a consonant in the cluster because it would leave a stray, thus leaving the consonant cluster unchanged. However, to resolve the issue /l/ surfaces as [l̥] (syllabic [l̥]), in that the stray consonant /l'— which is the result of applying the syllable structure of Palauan— is syllabified to create a new vowel nucleus. Subsequently, [l̥] takes [k] as it's onset to make a syllable in noun (58). Phonetically, liquids and glides are the most similar acoustically to vowels, and so it is an efficient choice to syllabify a liquid such as [l̥] to serve as the [+syllabic] syllable nucleus since it will be easier to produce in speech (Johnson, 2012). The syllabification of \l̥ allows speakers to avoid a sequence of three consonants in the onset when vowels are deleted.

2.3 Allowable Codas of Palauan

In the Palauan data set, we observe that Palauan allows complex onsets. More specifically, it allows up to 2 consonants and these [-syllabic] phones do not have to follow the SSP as mentioned in §2.1. On the same note, Palauan does not prioritize codas in that they are syllables with no codas this is because of the onset maximization principle which states that cross-linguistically languages tend to prefer richer onsets or more complex onsets than codas (Hayes, 2009). This pattern is illustrated in diagram (4).

(4) Coda /ŋ/ Alternation and Coda Formation:

#	Non-Possessive Form	Possessive Form	gloss
6	'btɔŋt	btəŋ'tɛl	'sander'
27	'klubəð	kl bə'ðɛl	'boat landing'
67	'ðɛr	ðər'ŋɛl	'remainder'

First, in the possessive form of noun (27), we observe that there is no coda because as stated in earlier codas are not prioritized in Palauan. Second, we also observe that the consonant [ŋ] is omitted when it is the last consonant in a complex coda. In other words [ŋ] must be the first consonant in the coda in order to surface in the surface form. Here in the non-possessive form of noun (67), [ŋ] was omitted from the surface form because it was the final consonant in the complex coda because it is preceded by the consonant [r]. But, in the non-possessive form of noun (6), [ŋ] surfaces in the surface form because it is the first consonant of the complex coda [ŋt]. In addition, in the possessive form of noun (6), [ŋ] surfaces in the surface form because it is the only consonant of a coda. In other words, this is not a complex coda, so the environment for [ŋ] to be omitted is present here. Right way, this theory has theoretical advantages: a majority of languages have a greater preference for complex onsets because of the onset maximization than complex codas and so this proposed theory adheres to this cross-linguistic phenomenon (Hayes, 2002). A formal phonological rule for [ŋ] deletion is given in §5 .

2.4 Syllable Nucleus

Some additional generalizations about the appearance of the [+syllabic] syllable nuclei can be made based on the data in the previous diagrams (1-4). We observe that in this sample data set only consonants appear in word final position. In addition, we can also assume there are no vowel clusters in that there's no more than one vowel in a row.

3. Morphological Rule

In the data set of Palauan nouns there's only one observed morphological rule and it applies to possessive nouns; it is formalized here in (5):

(5) Singular Possessive Noun Formation

$$X \rightarrow Xl \text{ if } \begin{bmatrix} \text{Noun} \\ +\text{possessive} \end{bmatrix}$$

Append the suffix [-l] to the underlying form if the root of the noun is possessive.

The possessive suffix /-l/ is supported by the various data utilized earlier in diagrams (1)-(4). But diagram (6) illustrates a fundamental problem that reinforces our morphological rule.

(6) Complications for Suffixes:

#	Non-possessive	Possessive	gloss
8	'tɲakl	tɲə'klɛl	'peace offering'
46	'ɲul	'ɲlil	'asthma'

While it is the case that every possessive form of a noun appears to end with both the /-l/ and a vowel, we actually strongly assume that the vowel is a part of the root morpheme and /-l/ is suffixed unto the underlying form of the root morpheme for possession. This is due to the fact that there's a significant amount of variance in the vowels that precede the /-l/ suffix which creates inconsistencies such as the one presented in diagram (6). Because [i] and [ɛ] occupy the same phonological environment, there's no explain why [i] surfaces in some contexts and [ɛ] surfaces in other contexts. Ultimately, there would be no reasonable, simple way to explain why the possessive forms of nouns (8) and (46) receive different suffixes, it's just not predictable.

4. Allomorphy and Underlying Forms

So far, in §2, we've have expounded on the syllable structure in Palauan nouns while discussing our theoretical framework which generates the 3-part Syllabification rule, and in §3 interpreted the data set to garner a morphological rule. Now, we can analyze each of the alternations observed in the data between the non-possessive and possessive forms of a noun to derive its underlying form.

4.1 [a]~[∅], [ɛ]~[∅], and/or [u]~[∅] Alternations

We observed in the data that the non-possessive and possessive surface forms alternate between an [l] in the non-possessive form and a syllabified [l] in the possessive form. We can posit the underlying forms for nouns with this alternation in diagram (7).

(7) Alternations between final vowels and ∅ and underlying forms:

#	Non-possessive	Possessive	gloss	Proposed underlying form
58	'kluk	kl̩ 'kul	Type of Palauan money	/kluku/
21	'kliðm	kl̩ ð 'mɛl	'head'	/kliðmɛ/
35	'buŋ	'bŋal	'flower'	/buŋa/

In each of our proposed underlying forms, there's a large amount similarity to the non-possessive form, but the vowel that appears before the [l] in the possessive form is included in the word final position of the underlying form. As expounded upon in §3, we posited that the vowel that appears in the possessive form and not the non-possessive form belongs to the root morpheme because the vowel alternations are unpredictable. Additionally, we discussed in §2 that vowels do not naturally occur in word-final position only consonants occupy that environment. As a result, we can propose that the suffixation of /-l/ in the possessive form inhibited a vowel deletion that occurred in the non-possessive form that targeted word-final vowels.

4.2 [ŋ]~[∅] Alternations

We observed in the data that the non-possessive and possessive surface forms alternate between an [∅] in the non-possessive form and a syllabified [ŋ] in the possessive form. We can posit the underlying forms for nouns with this alternation in diagram (8).

(8) [ŋ]~[∅] Alternations and underlying forms:

#	Non-possessive	Possessive	Gloss	Proposed Underlying Form
61	'btar	btər'ŋɛl	'swing'	/btar'ŋɛ/
62	'klab	kləb'ŋɛl	'harvested tuber'	/klabŋɛ/

As mentioned in §4.1, the proposed underlying forms include the word final vowel. For this alternation, we should present two options to validate the presence of [ŋ] in the proposed underlying form. The options for represent the alternation [ŋ]~[∅] are [ŋ] Deletion and [ŋ] Insertion. Since we included [ŋ] in the proposed underlying form, we suggest that there's a phonological rule that deletes [ŋ] when it occurs in a specific

phonological environment, and this proposition is strongly supported by what was expounded upon in §2.3. In 2.3, we observed that in complex codas [ŋ] could only appear if it is the first consonant in coda. In nouns (61) and (62), [ŋ] is preceded by a consonant and followed by a vowel. As explained earlier, a vowel deletion rule would apply here deleting the final vowel which makes [ŋ] final consonant in the complex coda which is illegal based on our 3-Part Syllabification rules. As result, to make a legal coda, a phonological rule deleting [ŋ] would need to apply leading to the non-possessive surface form.

However, if [ŋ] were to be inserted in into underlying form to yield possessive forms, then the phonological environments [ŋ] would occur in would be unpredictable refer to diagram (9) for an illustration of this concept.

(9) Evidence for the inconsistency of [ŋ] insertion:

#	Non-possessive	Possessive	gloss	Proposed Underlying forms
62	'klab	kləb'ŋəl	'harvested tuber'	/klabŋɛ/
16	'kbokb	kbə'kbəl	'wall'	/kbokbɛ/

There's an inconsistency present in this diagram. Although [ŋ] was inserted in the possessive form of noun (62) in the environment where it is preceded by [b] and proceeded by [ɛ], in noun (16) the same environment occurs but [ŋ] is not inserted.

4.3 [i]~[Ø] and/or [u]~[Ø] Alternations and [-high]~[ə] Alternations

We observed in the data that the non-possessive and possessive surface forms alternate between an [i]~[Ø] and/or [u]~[Ø]. In other words, the two observable surface forces alternate between the high vowels of the phonemic inventory and [Ø]. In addition, we observe that the two observable surface forms alternate between the [-high] vowels of the phonemic inventory of Palauan and schwa [ə]. We can posit the underlying forms for nouns with this alternation in diagram (10).

(10) [i]~[Ø] and/or [u]~[Ø] Alternation and [-high]~[ə] Alternations and underlying forms:

#	Non-possessive	Possessive	gloss	Proposed Underlying Forms
54	'siŋ	'sŋul	'unclean smell'	/siŋu/
37	'tub	'tbal	'spittle'	/tuba/
14	'ŋor	ŋə'rəl	'mouth'	/ŋorɛ/
7	'tkakl	tkə'kləl	'prop'	/tkaklɛ/

In nouns (54) and (37) we observe that only the high vowels of Palauan [i] and [u] surface in the non-possessive form, but not in the possessive form. In addition, this pattern is not observed with the mid and low vowels (or [-high] vowels) of Palauan in nouns (14) and (7). Based on observation, we could propose that high vowel [i] and [u] are being inserted into the non-possessive form by a phonological rule, but such a proposal would not hold since the vowels appear in a multiple of unpredictable environments. This is a similar phenomenon present with [ŋ] in §4.2. As a result, we can conclude that high vowels are, mostly likely being deleted from our proposed underlying form. Now, in nouns (14) and (7) it appears that the alternation is stress sensitive, in that [-high] vowels become schwa [ə] unstressed. In short, we propose that there's a phonological rule that deletes high vowels when they are unstressed, and another phonological rule cause unstressed [-high] vowels to surface as [ə].

4.5 Abstract Vowel (V) and Ambiguity of [ə]

While the [-high]~[ə] alternation is able to describe most forms in the Palauan data set, there still some circumstances where the underlying form is impossible to efficiently discern. Diagram (11) presents evidence to demonstrates these circumstances.

(11) Evidence for Underminable underlying forms:

#	Non-possessive	Possessive	gloss	Proposed Underlying Form
1	kləŋəltə'ŋat	kləŋəltəŋə'təl	'good fortune'	/kləŋəltəŋatə/**
15	kə'rrokɾ	kərrək'ɾəl	'thickness'	/kə'rrokɾə/**

(12) Usage of Abstract Vowel (V) in underlying forms:

#	Non-possessive	Possessive	gloss	Proposed Underlying Form
1	kləŋəltə'ŋat	kləŋəltəŋə'təl	'good fortune'	/klVŋVltVŋVtə/
15	kə'rrokɾ	kərrək'ɾəl	'thickness'	/kV'rrokɾə/

Given the Palauan phonemic inventory, we can conclude that [ə] is not a natural occurring vowel in Palauan. As a result, in diagram (12) we can assume underlying vowels surface as a [ə] in both the non-possessive and underlying form and are displaying an alternation with [ə], we are just unable to observe whether that underlying vowel is [a], [o], or [ɛ]. As a result, we propose the abstract vowel (V) to stand in place of the underlying vowel in the underlying representation of the Palauan noun as shown in (12).

4.6 Abstract Vowel (H) and [ɪ] ~ [i] Alternations

The final alternation we observe in Palauan is the alternation between [ɪ] ~ [i] in the non-possessive and possessive forms. However, they are cases in which the underlying form of words that include the syllabic [ɪ] cannot be derived because of a similar phenomenon that occurred in §4.5.

(13) [ɪ] ~ [i] Alternations and underlying forms:

#	Non-Possessive	Possessive	gloss	Proposed Underlying Form
21	'kliðm	kl̩ ð 'mɛl	'head'	/kliðmɛ/
58	'kluk	kl̩ 'kul	<i>Type of Palauan money</i>	/kluku/

As discussed, and observed in §2.2, complex onsets in Palauan are not able to be syllabified when made up of three or more consonants. In diagram (13), we simply observe a phonological rule which will be presented in section §5 that is syllabifying /l/ when it appears in a complex onset that violates this restriction.

However, there are some circumstances similar to those in §4.5, where the underlying form of words that include a syllabified /l/ cannot be derived. Diagram (14) displays this circumstance.

(14) Evidence for Underminable Underlying forms:

#	Non-possessive	Possessive	gloss	Proposed Underlying Form
43	kl̩ 'ðuŋ	kl̩ ð 'ŋil	'good behavior'	/ kl̩[i or u]ðuŋi/***

In table (14), we posit that the underlying form of noun (43) includes a high vowel between [l̩] and [ð], based on what we already know about the alternation of high vowels in §4.3. As a result, either [i] or [u] was deleted from the underlying form, and we propose the abstract vowel H to stand in place of the underlying high vowel in the underlying representation as shown in (15).

(15) Usage of Abstract Vowel (H) in underlying forms:

#	Non-possessive	Possessive	gloss	Proposed Underlying Form
43	kl̩ 'ðuŋ	kl̩ ð 'ŋil	'good behavior'	/ kl̩Hðuŋi/

4.7 Abstractness and SPE theory

The ambiguities present in §4.6 and §4.5 display abstract underlying forms, which comes in conflict with child acquisition of Palauan. As Hayes elaborated, there's a finite window of opportunity during which language acquisition takes place, and the proposal of "abstract vowels" could be problematic because we are asking the language acquirer to entertain "radical hypotheses" about the underlying forms in their language (Hayes, 2002). Hayes continues to expound that these "radical hypothesis" could possibly make it more difficult for the language acquirer to deal with underlying forms in their native language by generating more ambiguities in underlying forms that the learner has to account for (Hayes, 2002). In other words, abstract underlying forms create more ambiguities for the learner of a language to take into account during that small window of opportunity for language acquisition which could be problematic. Note that Hayes also mentions that necessity of psycholinguistic research in order to validate abstract analysis and its possible consequences. Furthermore, our phonological theory demands that our rules be as simple as possible that is using the smallest amount symbols possible in order to be easily acquired by the learner so that they may form their simplest thoughts. As a result, utilizing abstract analysis to understand ambiguous sets of data such as those in §4.6 and §4.5, would mean that there would more ambiguities that are not included in this data set that a language acquire would have to consider. This assumption allows us to posit that there's probably a greater, simple phonological rule that is in agreeance with our theory and accounts for those ambiguities. The abstractness observed in non-ambiguous data can be explained by phonological rules that our theory agrees with.

5. Phonological Rules

5.1 High Vowel Deletion

As the reader will recall in §4.3, there exists a phonological rule that deletes high vowels [i] and [u] in unstressed environments. The following phonological rule formulated in (16) accounts for this alternation.

(16) High Vowel Deletion

$$\left[\begin{array}{l} +\text{syllabic} \\ -\text{stress} \\ +\text{high} \end{array} \right] \rightarrow \emptyset$$

Delete an unstressed high vowel in all contexts.

This rule proposal has theoretical advantages: cross-linguistically it is a common process to delete certain sounds in order to make words easier to pronounce as one-syllable structures (Hayes, 2002). Our theory reminds us that phonologies should be as simple as possible so the learn can acquire language and efficient phonological process that reduces the energy required for speech production is in agreement with our theory.

5.2 /l/ Syllabification

As previously discussed in §2.2 and § 4.6, there exists a phonological rule syllabifies /l/. As the reader will recall, this allows of the consonant to serve as the nucleus of a syllable, when it appears in a complex onset that violates the syllable structure of Palauan as discussed in §2.2. The following phonological rule formulated in (17) accounts for this alternation.

(17) /l/ - Syllabification:

$l' \rightarrow [+syllabic]$

Syllabify /l/ when it's a stray consonant in a word.

Here, High Vowel Deletion and 3-Part Syllabification create an illegal consonant cluster in the onset constituted of stray consonants. The stray [l'] in that consonant cluster is targeted by this rule and surfaces as a syllabic [l] that is now a syllable nucleus that is able to syllabify the other stray consonants in the cluster creating a new syllable. This was generalized with no environment because the rule ordering of the phonological rules creates the environment for this rule to apply.

Phonetically, liquids and glides are relatively the most sonorous [-syllabic] phones, have vowel like properties as a result, and are relatively easier to vocalize into [+syllabic] phones (Johnson, 2012). In the Palauan phonemic inventory, the most sonorous vowel and the only liquid is /l/. Syllables require the nucleus of a syllable to be [+syllabic] (Hayes, 2009), and so /l/ surfacing a syllabified [l] is a natural phonological process due to its phonetic properties. Our theory reminds us that phonological rules must be as simple as possible so the learner can acquire the language, and the syllabification of /l/ into a [+syllabic] phone for efficient and relatively less effortful speech production is in agreement with our theory.

5.3 Word Final Vowel Deletion

As previously discussed in §4.1, there exists a phonological rule that deletes a vowel in word-final position. The following phonological rule formulated in (18) accounts for this alternation.

(18) Word Final Vowel Deletion:

$[+syllabic] \rightarrow \emptyset / \text{ ______ }]_{\text{word}}$

Delete vowel when it occurs in word-final position.

This proposal has theoretical advantages: cross-linguistically languages perform interesting phonological processes at the end of words to reduce the articulatory work

needed to produce a word final speech sound; for instance, final consonant devoicing is when a voiced consonant surfaces as a voiceless consonant at the end of a word (Hayes, 2009). Phonetically, vowels are some of the most effortful sounds to produce in language (Johnson, 1996). As a result, a phonological rule that deletes a vowel at the end of a word to reduce the energy that would be expended if that vowel was produced word finally is a beneficial rule and it agrees with our theory that phonologies should be as simple as possible so the learner can easily acquire the language.

5.3 [ŋ] Deletion

As the reader will recall in §4.2 and §2.3, there exists a phonological rule that deletes [ŋ] in word final position because it must be the first consonant in the complex coda to surface. If it is not, then it is deleted because it cannot be syllabified as the second consonant in the complex coda. The following phonological rule formulated in (19) accounts for this alternation.

(19) [ŋ] Deletion

$$/ŋ/ \rightarrow \emptyset / C ______]_\sigma$$

Delete /ŋ/ when in word-final coda position and preceded by a consonant.

5.3 Vowel Reduction

Finally, as previously discussed in §4.3, there exists a phonological rule that reduces unstressed vowels to [ə]. The following phonological rule formulated in (20) accounts for this alternation.

(20) Vowel Reduction

$$\left[\begin{array}{l} +\text{syllabic} \\ -\text{stress} \end{array} \right] \rightarrow [ə]$$

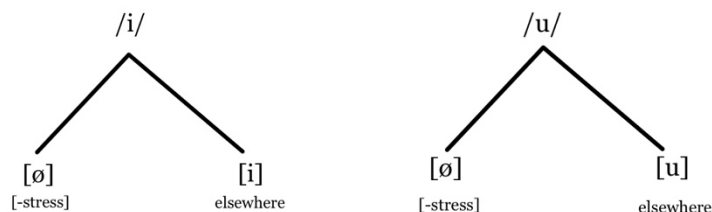
Reduce all unstressed vowels to schwa [ə] in all contexts.

This proposed rule does not specify an environment because the rule ordering of these phonological rules allows it to apply in the correct environment which is after High Vowel Deletion. Articulatory, the schwa [ə] is relatively the easiest vowel to produce because there's little to no constriction in the oral cavity (lips and tongue) giving schwa the status of a neutral vowel in some languages (Johnson, 2012). Throughout the data, we observed that unstressed vowels surface as schwa which is phonetically natural because the Palauan want to reduce the energy needed for speech production in an unstressed syllable by reducing all vowels which require considerably more energy to produce to a schwa. Our theory reminds us that phonologies should be easy for the

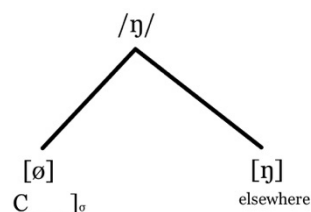
learner to acquire the language and a vowel reduction rule to that makes all vowels surface as a schwa in unstressed syllables is a beneficial and simple process.

5.6 Phonemicization Diagram

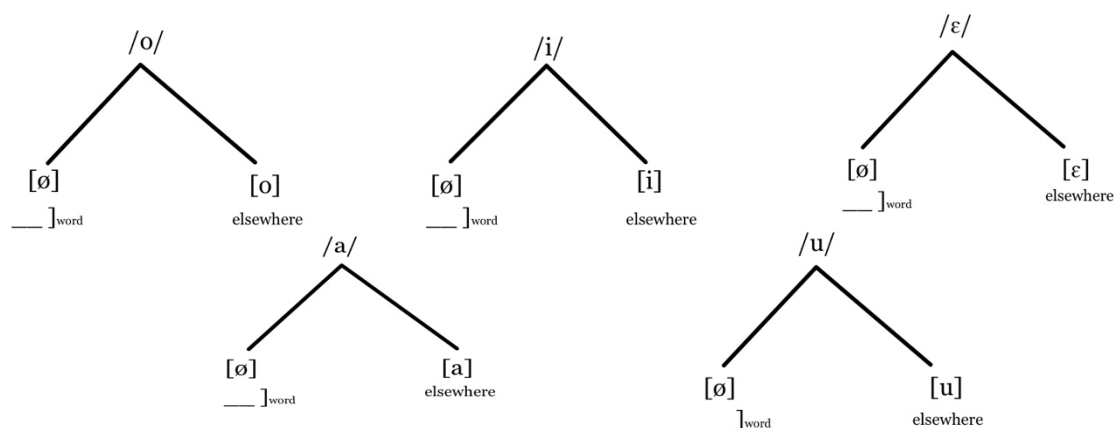
Based on the rules described in this section, we propose phonemicizations for the phonemes and allophones relevant to Palauan noun alternations, which are visualized in (21):



/i/ and /u/ surface as [ø] (is deleted) in unstressed environments; otherwise /i/ surfaces as [i] and /u/ surfaces as [u] elsewhere. We also observe a case of neutralization in which both high vowels surface as [ø] in unstressed environments.

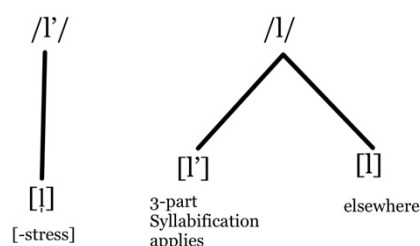


/ŋ/ surfaces as [ø] (is deleted) in environment where it is the last consonant in a complex coda; otherwise, it surfaces as [ŋ] elsewhere.

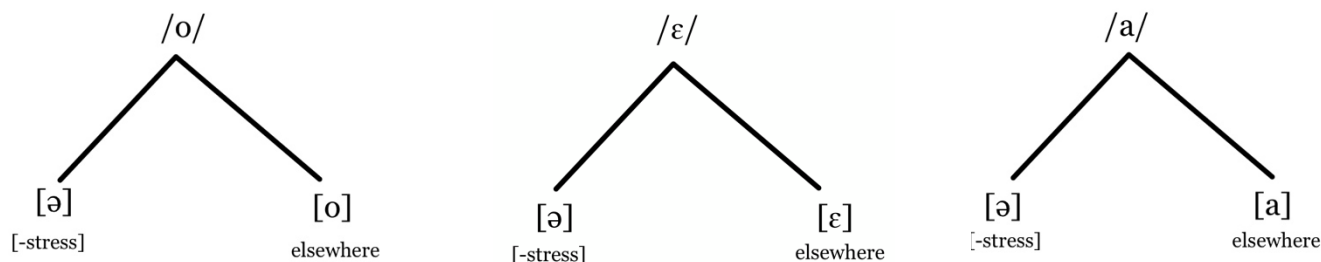


[+syllabic] phones—which are all the vowels in the Palauan phonemic inventory—surface as [ø] in the environment where they occur in word final position; otherwise, they surface as their respective allophones elsewhere. We also observe cases of neutralization. We also observe a case neutralization in which all vowels surface as

[∅] in word-final position.



/l/ surfaces as [l'] a which stray consonant part of consonant cluster which is generated by applying the 3-Part Syllabification rule; otherwise, it surfaces as [l] elsewhere. We also see that /l'/ the stray [l] consonant surfaces as a syllabified consonant [l].



[-high] phones—which are all the vowels in the Palauan phonemic inventory that are not high vowels—surface as [ə] schwa when they occur in unstressed environments; otherwise, they surface as their respective allophones. We also observe a case of neutralization in that all [-high] phonemes surface as schwa [ə] when they surface in unstressed environments.

5.6 Rule Ordering

In the data set, we observe a number of phonological interactions and relationships occur between the proposed phonological rules, the stress rule, and 3-part Syllabification. Word-Final Vowel Deletion appears to feed [ŋ], always in the context where the nasal is followed by a vowel.

High Vowel Deletion appears to feed /l/ Syllabification because an [l] can only be syllabified if a vowel is deleted. As the reader will recall from §2.2, when a high vowel is deleted a consonant cluster that violates the onset requirements in Palauan is generated and that violation needs to be resolved by syllabifying /l/ so it can become a syllable nucleus.

High Vowel Deletion is being feed by the Palauan Stress Rule which is feed by the 3-Part Syllabification rule. This is due to the fact that the deletion of a high vowel is triggered

by the change in stress which happens once a noun is syllabified with the 3-part Syllabification rule.

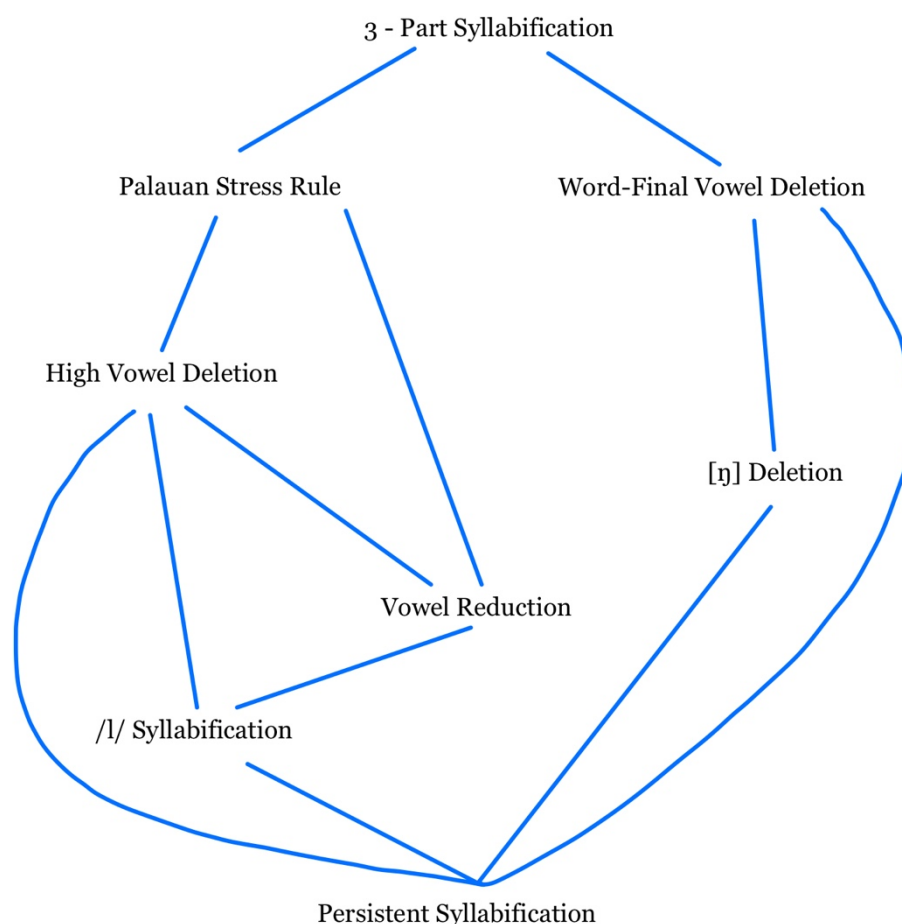
The Palauan stress rule feeds Vowel Reduction by creating the unstressed environments where vowels reduce to schwa. Vowel Reduction counterbleeds High Vowel Deletion because if vowel reduction came first it would have reduced all unstressed vowels to schwa which would have got rid of the target high vowels the rule deletes. In other words, Vowel Reduction could have created an environment where Vowel Deletion couldn't apply but Vowel Reduction came too late.

High Vowel Deletion bleeds Vowel Reduction, in the cases where words only contain high vowels, High Vowel Deletion which is an earlier rule deletes those unstressed high vowels once stress is applied which destroys the environment (unstressed vowels) Vowel Reduction needs to apply.

/l/ Syllabification feeds counterfeeds Vowel Reduction, /l/ Syllabification would syllabify an [l] making it [+syllabic] Vowel Reduction could have reduced that syllabified [l] to schwa [ə] demonstrating that /l/ Syllabification had the potential to feed Vowel Reduction but it came too late.

Finally, all of the observed rules feed Persistent Syllabification because whenever a phonological rule applies, the 3-part Syllabification rule reapplies if necessary, to maintain the onset and coda requirements of Palauan on intermediate forms.

(22) Hasse Diagram



6. Derivations

(21) Derivation with Correct Rule Ordering

Non-Possessive	Possessive	Non-Possessive	Possessive	Non-Possessive	Possessive	Form
/kliðmɛ/ 'head'	/kliðmɛ/ 'head'	/ðikɛ/ 'wedge'	/ðikɛ/ 'wedge'	/ðɛrɲɛ/ 'remainder'	/ðɛrɲɛ/ 'remainder'	Underlying form of root morpheme
						Morphology
-----	kliðmɛl	-----	ðikɛl	-----	ðɛrɲɛl	$X \rightarrow Xl$ if $\left[\begin{array}{c} \text{Noun} \\ +\text{possessive} \end{array} \right]$
						Phonology
klið.mɛ	klið.mɛl	ði.kɛ	ði.kɛl	ðɛr.ɲɛ	ðɛr.ɲɛl	3-Part Syllabification
'klið.mɛ	klið.'mɛl	ði.'kɛ	ði.'kɛl	'ðɛr.ɲɛ	ðɛr.'ɲɛl	Stress Rule (not formulated)
'klið.m	-----	ði.'k	-----	'ðɛr.ɲ	-----	Word-Final Vowel Deletion [+syllabic] $\rightarrow \emptyset$ / $\underline{\quad}$] _{word}
kliðm	klið.mɛl	ðik	ði.kɛl	ðɛr.ɲ	ðɛr.ɲɛl	Syllabification (persistent)
'kliðm	klið.'mɛl	'ðik	ði.'kɛl	'ðɛr.ɲ	ðɛr.'ɲɛl	Stress Rule (not formulated)
-----	k l ð.'mɛl	-----	ð.'kɛl	-----	-----	High Vowel Deletion $\left[\begin{array}{c} +\text{syllabic} \\ -\text{stress} \\ +\text{high} \end{array} \right] \rightarrow \emptyset$
kliðm	k l ð.mɛl	ðik	ðkɛl	ðɛr.ɲ	ðɛr.ɲɛl	Syllabification (persistent)
'kliðm	k l ð.'mɛl	'ðik	'ðkɛl	'ðɛr.ɲ	ðɛr.'ɲɛl	Stress Rule (not formulated)
-----	-----	-----	-----	-----	ðɛr.'ɲɛl	Vowel Reduction $\left[\begin{array}{c} +\text{syllabic} \\ -\text{stress} \end{array} \right] \rightarrow [\text{ə}]$
kliðm	k l ð.mɛl	ðik	-----	ðɛr.ɲ	ðɛr.ɲɛl	Syllabification (persistent)
'kliðm	k l ð.'mɛl	'ðik	-----	'ðɛr.ɲ	ðɛr.'ɲɛl	Stress Rule (not formulated)
-----	-----	-----	-----	'ðɛr	-----	[ɲ] Deletion /ɲ/ $\rightarrow \emptyset$ / C $\underline{\quad}$] σ
kliðm	k l ð.mɛl	ðik	ðkɛl	ðɛr	ðɛr.ɲɛl	Syllabification (persistent)
'kliðm	k l ð.'mɛl	'ðik	'ðkɛl	'ðɛr	ðɛr.ɲɛl	Stress Rule (not formulated)
-----	k l ð.'mɛl	-----	-----	-----	-----	/l/ Syllabification l' \rightarrow [+syllabic]
kliðm	k l ð.mɛl	ðik	ðkɛl	ðɛr	ðɛr.ɲɛl	Syllabification (persistent)
'kliðm	k l ð.'mɛl	'ðik	'ðkɛl	'ðɛr	ðɛr.'ɲɛl	Stress Rule (not formulated)
['kliðm]	[k l ð' mɛl]	['ðik]	['ðkɛl]	['ðɛr]	[ðɛr.'ɲɛl]	Surface Form

In the derivation table provided in (21), we observe that the six rules proposed in the present analysis— one of which is the morphological rule for possession and the other five are the proposed phonological rules based on alternations in the two surface forms of Palauan nouns— work in tandem to derive the correct non-possessive and possessive forms for the proposed underlying forms of the nouns. The derivations of examples [kl̥ð'mɛl] 'head (poss.)' and ['ðɛr] 'remainder' offered a helpful illustration to visualize what was discussed in §2 and §4. More specifically, we see that their syllabification after High Vowel Deletion or Word-Final Vowel Deletion introduces stray consonants since the Paulan onset and coda requirements were violated. We are also able to see how /l/ syllabification resolves the onset violation by syllabifying /l/ to create syllable nucleus to syllabify the stray consonants, and how [ŋ] Deletion resolves the coda violation by omitting the stray consonant [ŋ]. Note that this is simply a sample derivation. Our Hasse Diagram in (20) which represents all the observed relationships between the proposed rules, 3-part syllabification, stress and persistent syllabification, offers a number of permutations for how rules can be ordered to derive these surface forms.

7. Conclusion

In this paper, we observed several cases of abstractness in regard to how ambiguous Palauan nouns surface in both the non-possessive and possessive form. In summary, the underlying form of each Palauan noun is comprised of largely its non-possessive form and a specific vowel in word final position found in the possessive form. In addition, we have demonstrated that the various phonological alternations between the possessive and non-possessive surface forms were driven by the syllable structure of Palauan and are derived from abstract underlying forms representations. While a stress rule to account for stress alternations was not formulated, it is evident that stress is predictable, influenced by the syllable structure of Palauan, and affects our proposed phonological rules to generalize observed alternations. We mainly observed alternations involving Palauan vowels and the two consonants [l] and [ŋ]. For the vowels in unstressed environments, we observed that the high vowels [i] and [u] are deleted because insertion would yield unpredictable environments that we cannot generalize into a rule. In addition, we also observed that unstressed [-high] vowels reduced to schwa [ə]. As for vowels in stressed environments, they only surface as allomorphs of themselves. In regard to the consonants, we observed that [ŋ] was deleted from complex codas when it's the final consonant of the complex coda while syllabic /l/ which is derived from the stray consonant [l'] being syllabified is utilized as syllable nuclei to resolve onset violations. Lastly, the possessive morpheme /-l/ had an influence on the surface forms presented in the data set because it protected the last vowel in each word from deletion.

While our current analysis is able to account for most the alternations in Palauan nouns, there were some specific words in the data set whose underlying forms were not able to be determined because of ambiguities with the vowel that is present in the underlying form to derive the vowel(s) in the surface forms. As a result, to resolve the ambiguity in the vowels of the underlying forms of these specific data, a larger data set of words heavily comprised with schwa [ə] and [i]/[u] vowels in their surface forms are needed to further investigate and resolve this ambiguity. Furthermore, with this additional data we

would be to probe at the idea that these ambiguities can be represented by a more general or simple rule that adheres to our SPE theory.

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