A comparison of Parallel Optimality Theory, Lexical Phonology and Stratal Optimality Theory using evidence from affixation processes in Korean

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Abstract: Korean is written using "syllable blocks" – blocks of characters grouped roughly according to their syllabification. In most cases, intervocalic consonants are placed in onset position of the second syllable, in accordance with what would be predicted by the Maximal Onset Principle. However, in some words, particularly words formed by affixation processes, the written form of each morpheme is preserved, placing morpheme-final consonants in a coda despite them being intervocalic. Derwing *et al.* (1990) found that many Korean speakers' judgements of syllabification correlate to the predictions made by these syllable blocks, but that this is found to be the case more frequently with some affixes than with others. A model of phonology must therefore be able to account for this variation within a language. By using pause-break tests to collect syllabification judgements on a wider range of suffixes, this study shows that Lexical Phonology and Stratal Optimality Theory are more effective than Parallel Optimality Theory and determines at which level each of the 30 suffixes analysed are applied.

Keywords: phonology, Optimality Theory, Lexical Phonology, Stratal Optimality Theory, affixation, Korean, syllabification

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1. Introduction

This dissertation will compare three theories of phonology: Parallel OT, Lexical Phonology, and Stratal OT. By analysing evidence from Korean affixation using all three proposed methods, I aim to determine which has the most explanatory power in the context of syllabification. This will be done in 7 main parts: first, in Section 2, I will introduce concepts relevant to both the phonological theory and to Korean phonology and affixation more specifically. In Section 3, the many suffixes found in Korean will be categorised and a small range selected for inclusion in this study, before the details of the method are outlined in Section 4. Section 5 presents the results, as well as some statistical analysis, while Section 6 discusses the value of the data collected. Finally, after applying the 3 models of phonology to these findings in Section 7, I conclude that both Lexical Phonology and Stratal OT are better suited to explaining Korean affixation processes than Parallel OT and suggest further application of this method could be used to distinguish between the two.

2. Literature review

2.1. Parallel Optimality Theory

Optimality Theory (OT), first outlined by Prince and Smolensky (1993), is a proposed mental representation of phonology which uses a ranked series of universal constraints to determine the most optimal candidate for the surface form of a given word. These constraints each describe a condition which is not permissible, and assign violation marks to any candidate which breaches it. OT assumes that dialectal differences can be explained by variation in the rankings of the constraints, but not by any language or dialect having any constraint which is not present in another. However, Parallel OT, which only accounts for underlying forms (input) and surface forms (output), has faced criticism for being unable to explain certain variation found within a single language or dialect (e.g. Davis 2000, Collie 2007: 3-4).

2.2. Lexical Phonology

The main benefit of rule-based phonology over OT is the possibility for rule ordering. Surface forms which are opaque under Parallel OT can be explained by looking at the intermediate forms.

Lexical Phonology, or LP, (Kiparsky 1982: 3-92) uses these principles to work with affixation processes. It accounts for variation in the behaviour of different affixes by assuming that they differ only in the stage at which they are applied. Level 1 affixes are applied to the stem at the first stage, which allows all following rules to apply as they would to a single morpheme. Level 2 affixes undergo affixation after some of these rules have been applied, resulting in those rules having different effects. However, while Lexical Phonology is more useful than Parallel OT due to its increased explanatory power, a degree of universality is lost in the return to language-specific rules.

2.3. Stratal Optimality Theory

Stratal OT (e.g. Kiparsky 2000, Bermúdez-Otero 2010) combines characteristics from both OT and LP. Like LP, it assumes that phonological processes are applied in stages, or cycles, transforming the underlying form into the surface form through intermediate steps. In different cycles, the order of constraints is able to change, allowing different winning candidates depending on which cycles take place before and after affixation. This makes it possible to explain surface forms of words which, under Parallel OT, would be opaque, while still making use of the proposed universal tendencies which make the theory more desirable than LP.

We can apply all of these theories to this study by focusing exclusively on syllabification cycles in Korean. I hypothesise that all affixes in Korean can be categorised as either Level 1 or Level 2 affixes, and that these categories can be determined by studying their behaviour with regard to syllable boundaries. Assuming this is the case, Level 1 suffixes will be the ones which appear to be applied before a syllabification cycle, while suffixes applied at Level 2 will have been applied after that same cycle. Of course, many languages have word- and even phrase-level syllabification steps (Cardinaletti and Repetti 2009), which would make it impossible

to determine the levels of different affixes by this method alone. This has been reported in Korean (Cardinaletti and Repetti 2009: 78), but, as will be seen in the following sections, this does not seem to universally be the case.

2.4. Korean Phonology

Kabak and Idsardi (2007: 30) shows the full phonemic inventory of Korean, which will be referred to throughout this essay. Both IPA transcriptions and simple romanisations will be used here, so Tables 1 and 2 show the phonemes themselves, written in the International Phonetic Alphabet, and a table found in the Appendix shows how they will be written using the conventions of the Revised Romanization of Korean.

		Labial	Alveolar	Alveo-palatal	Velar	Glottal
Plosives	Plain	p	t	c	k	
	Tense	p'	t'	c'	k'	
	Aspirated	p^h	t^h	c^h	k^h	
Fricative	Plain		s			h
	Tense		s'			
Nasal		m	n		ŋ	
Liquid			l			

Table 1: (Kabak and Idsardi 2007: 30)

	-Back		+Back	
	-Round	+Round	-Round	+Round
High	i	ü	ɯ	u
Mid	e	ø	ə	o
Low	ɛ		a	

Table 2: (Kabak and Idsardi 2007: 30)

Lee (1999: 121) provides an alternative vowel inventory (Figure 1), which includes the /ʌ/ vowel, but does not show any instances of /ə/. By listening to spontaneous Korean speech, it seems that both vowels can be found, so both will be considered part of the relevant phonemic inventory for the rest of this essay.

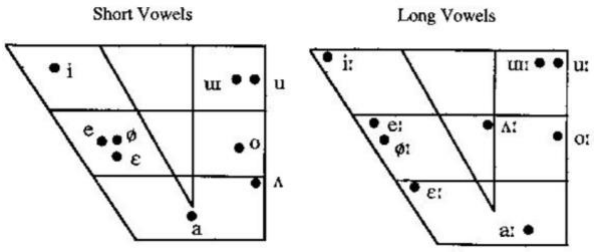

Figure 1: (Lee 1999: 121)

Korean plosives fall into one of three categories: tense, lax (also referred to as plain) and aspirated (Kim and Duanmu 2004: 59) and their production varies depending on syllable position. Lax plosives may be either voiced or unvoiced, with the unvoiced forms found in phrase- or word-initial and syllable-final positions, and the voiced forms in syllable-initial, word- or phrase-medial positions (Kim and Duanmu 2004: 65). Tense and aspirated consonants are always unvoiced, but all 3 plosive types are produced as neutral and unreleased when found in coda position (Kim and Duanmu 2004: 65). Because this study focuses on the production of words in isolation, rather than connected speech, the phrase-initial/phrase-medial distinction will not be addressed in the presentation of the results.

Korean lax consonants appear to be underlyingly voiceless, and will be treated as such for this study. This is because, though they tend to be voiced as word-medial onsets, they may behave differently depending on the adjacent sounds (Kim-Renaud 1974: 8). If syllable position is less relevant to their voicing than features of adjacent segments, processes such as final devoicing are less likely to be taking place than the spreading of the feature {+voice}. This will be explored more in Section 5.3.

Some analyses of Korean (e.g. Ahn and Iverson 2004) have suggested that tense consonants are not ejective but geminate. This evaluation of tense consonants is somewhat contentious and, as Kim and Duanmu (2004: 84-85) show, comes with negative implications for what we already know about syllable structure in Korean. The existence of this uncertainty in linguistic study points to a potential variation within the Korean speaking population, both in perception and production of tense consonants, so to avoid results being affected by which perception a participant has, tense consonants will not be used in the environment being tested here.

The ㅇ character in Korean can be found in both onsets and codas, but is pronounced vastly differently – in coda position, it is realised as a velar nasal, while when written at the beginning of a syllable block, it indicates that the syllable has a null onset and begins with a vowel sound (Kim and Duanmu 2004: 94). Although there is some debate as to whether onset ㅇ is associated with some articulation, this study will not look at how suffixes behave when added to morphemes which end with the velar nasal, since the analysis of both forms as allophones of one phoneme is not universally accepted (Kim and Duanmu 2004: 94).

Derwing *et al.* (1990: 236) shows how Korean syllable boundaries are generally placed before a consonant, regardless of the spelling breaks. Since spelling breaks tend to reflect this except in the case of compounds and complex words, it is reasonable to interpret any cases of this trend not being followed as indicators of the affixation processes involved.

2.5. Korean Affixes

Korean is a highly agglutinative language (e.g. Matteson *et al.* 2018: 2482), which is a class of language in which each morpheme supplies a new piece of either grammatical or semantic information, and combining a greater number of morphemes results in a more specific utterance. Since many of these morphemes are bound, this means that a single Korean word may contain information that, in English, could only be communicated in a short phrase or even a full sentence.

Derwing *et al.* (1990) performed pause-break tests to find whether native speakers show a preference for onsets as we might expect. The pause-break method is explained in greater detail in Section 4. The results (Derwing *et al.* 1990: 233-236) show significant variation between individual words. In all cases with the "spelling break" (the syllable boundary indicated by the written form) coming before the consonant, participants showed a clear preference for placing the consonant in onset position, whereas when the break is after the consonant in question the number of participants who preferred the onset option was generally closer to half, and in some cases most chose the coda. It is worth noting that, while the proportion of speakers favouring the coda position in certain words may be quite high, the position of

consonants which tend to syllabify as onsets show significantly higher levels of agreement among participants. This indicates that the Maximal Onset Principle is present and relevant in Korean, and that a word-level syllabification step may be present in some groups within the Korean speaking population. The study also had a "meaning" group of participants who were allowed to read the words being tested, and this group was shown to follow the breaks indicated in the orthography far more than the other group. Since this study will not use the written form of any of the tested words, it is reasonable to expect a less significant preference for placing the consonant in coda position than was found by Derwing *et al.*.

This data (Derwing *et al.* 1990: 233-236) also provides supporting evidence that different affixes behave differently with regard to how they affect syllable boundaries and tells us about the effect of a few specific affixes (see Table 3). For example "-i" (a nominative particle) behaves in line with what we would expect from a Level 2 affix in that it does not syllabify with the preceding consonant (according to over half of the responses), while the status of "-eo" is less widely agreed on but does seem to be treated more like a Level 1 affix. Note that Table 3 uses Yale Romanization, and here the *-eo* suffix is represented by "/E".

B. Real Unambiguous Words	**S1/Co**	**S2/On**
1. Single Segments Average Single Segments	**.32**	**.68**
a. Spelling Break before C Average Preconsonant	**.13**	**.87**
1) PHI/LI 'flute'	.24	.76
(2) SO/LA 'shell'	.34	.66
(3) SO/MO 'consumption'	.05	.95
(4) SA/CHANG 'boss'	.02	.98
(5) A/PPA 'daddy'	.02	.98
(6) KA/CCA 'fake'	.12	.88
b. Spelling Break after C Average Postconsonant	**.59**	**.41**
(1) SEYM/I 'counting (nom.)'	.61	.39
(2) PANG/I 'bread'	.87	.13
(3) KASS/E 'went' '	.42	.58
(4) MWUKK/E 'bundling'	.48	.52
2. Clusters Average Clusters	**.19**	**.81**
a. Spelling Break between CC Average Intercluster	**.03**	**.97**
(1) KWUK/SWU 'noodle'	.02	.98
(2) CHENG/SO 'cleaning'	.04	.96
(3) NAM/CA 'man'	.04	.96
(4) SIM/CI 'wick'	.02	.98
b. Spelling Break after CC Average Postcluster	**.35**	**.65**
(1) SALM/I 'living (nom.)'	.35	.65
(2) PWULK/E 'red (ind.)'	.42	.58
(3) KAPS/I 'price (nom.)'	.36	.64
(4) SAKS/I 'wage (nom.)'	.30	.70

Table 3: (Derwing et al. 1990: 235)

3. Suffixes Tested

Korean speakers use far too many suffixes in speech to be comprehensively judged and analysed in a study of this scale. For this reason, a shortlist of 30 was created, using a small number of relevant suffixes representing a range of categories. These categories were designed to ensure that the survey accounted for both phonological and morphological variables. Some categories were not represented in the survey, either because no corresponding suffix exists or because they were omitted to keep the survey a reasonable length. Collecting data in this way is likely to show a difference in how inflectional affixes behave when compared to derivational ones, but my hope is that by including more specific categories, we might see some other relationship, such as whether suffixes associated with verbs are more likely to undergo affixation at an earlier stage than, for example, noun inflections.

3.1. Phonological Categories

The 30 suffixes used in the survey all start with one of 5 vowel sounds: /a/, /e/, /i/, /ʌ/, and /ə/. Some of these categories are more represented than others – for example, there are 9 suffixes beginning with /ə/ used here, while suffixes which begin with /e/ are generally less common in Korean, and fall into a much smaller range of the morphological categories. Despite this, collecting data on the behaviour of the 2 *-e* suffixes will tell us more about any trends and provide more evidence for which features are likely to have an effect on affix levels.

This vowel set is not exhaustive – Korean speech also uses /o/ and /u/ sounds, but they are found very rarely in the relevant environment, so have been omitted in favour of presenting participants with a list of more commonly used and recognisable suffixes. The glides /w/ and /j/ also exist in Korean, and are considered “components of diphthongs” (Lee 1999: 121), but due to dialect variation some speakers may think of them as onsets. Most consonants are permitted in onsets preceding /w/ and /j/, but this study is focused on suffixes with unambiguously empty onsets.

3.2. Morphological Categories

The suffixes being tested have also been divided based on both the word class that they can be affixed to, and the class that a word becomes once the affix has been added. For example, *-eum* is added to verb stems, but the resulting word is a noun. *-ing*, as in "smoking is prohibited", is a rough English equivalent. Suffixes which do not change the word class, such as *-eoss.eo*, which is a past tense marker and thus can only be used alongside verbs, have also been included.

Because I have used up to 2 suffixes from each of the morphological categories, derivational suffixes are more represented than inflectional suffixes. Their behaviour will be compared based on whether they are inflectional or derivational, but since the study aims to look in more detail at several other variables, ensuring an equal number of each suffix type is not necessary or practical.

3.3. Definitions

The stimuli used in the survey are shown in Table 29 in the Appendix, with the stems and suffixes separated and rough translations provided. Each stem was selected with consideration of its frequency and ease of recognition. Over the remainder of this section, I will give more detail about the suffixes and their meanings in Korean.

3.3.1. -eo and -a suffixes

Suffixes beginning with either /ʌ/ or /a/ are often added to verb stems to add grammatical meaning such as tense or mood. The meanings of suffix pairs of this kind (e.g. past tense conditional suffixes *-eoss.eu.myeon* and *-ass.eu.myeon*) are identical, with the distinction being purely phonological. This implies that they share one underlying form which changes slightly for ease of pronunciation depending on the stem. Although we would not expect any significant difference, I have chosen to study the behaviour of the corresponding suffixes in the cases of verb inflections, since controlling for meaning will provide more evidence of how, if at all, the phonological features of a suffix may impact the syllabification of the word.

There are some suffixes beginning with these vowels which are not verb inflections, and 2 have been selected for this study (though this does not mean that there are no more examples). *-eobs.neun* is a derivational suffix which changes noun stems to adjectives. In the word used here, this suffix is equivalent to English "-less" and *mas.eobs.neun* roughly translates to "tasteless". *-a* is added to names as a diminutive to make them more affectionate or familiar; the name *Seojun* becomes *Seojun-a*, which can be used both to call the attention of somebody with the name, or to refer to them.

3.3.2. -i suffixes

Suffixes with the initial vowel /i/ are most often found with noun stems – in fact, in this study, all of the *-i* suffixes are modifiers of nouns. Many of these suffixes are used to form verbs which refer to the state of being the stem noun. For example, the affixes *-i.e.yo* and *-ib.ni.da* both roughly translate to "is" (or "am" or "are"), with *-ib.ni.da* differing only in its higher formality, and *-i.eoss.eu.myeon* is the combination of a number of suffixes equivalent to the English phrase "if it (or I/you) were". Complex suffixes have been included here for the purpose of showing the interactions between multiple suffixes when they are applied to a stem, and whether they are applied at different stages or together as a new individual suffix.

The suffix *-i.ra.go* is used in reported speech, and can be added to a stem of any class. The meaning of the resulting word or phrase has many of the same properties as an English Complementizer Phrase (CP), which would be reason to categorise the suffix as derivational. However, since the only information added is grammatical, particularly in cases like the one used here, it is more appropriate to consider *-i.ra.go* an inflectional suffix.

3.3.3. -eu suffixes

This group of suffixes varies in function. The most frequently used *-eu* suffixes are noun inflections: *-eun* denotes that the stem is the subject of a clause, and *-eur* is affixed to the direct object. *-eur* can also be affixed to verb stems (as a derivational suffix) to enable them to function as nouns, as can *-eum*.

Suffixes beginning with this vowel may also be affixed to verbs, such as *-eu.se.yo*, which is an imperative mood marker.

3.3.4. -e suffixes

The final group included here is suffixes beginning with the vowel /e/. This study includes only 2 suffixes of this kind, because /e/ is a relatively uncommon suffix-initial vowel in Korean. These suffixes refer either to a location (*-e*) or a recipient (*-e.ge*).

4. Methodology

4.1. Participants

For this study, native speakers of Korean were required because non-native speakers may have non-nativelike judgements of syllable boundaries. All participants must be over the age of 18 and developmentally typical since I do not have permission to work with vulnerable groups. This is not expected to affect the results greatly, but further research looking at groups not represented here would be valuable.

Because the phenomenon being studied here is not likely to be affected greatly by social factors, the survey did not ask for any data about the participants. I have made efforts to make sure all demographics are represented, but at this stage I have chosen not to analyse within those groups. This decision will be discussed further in Section 6.

4.2. Method

The data was collected using an online survey. Each question gave the participants a set of pause-break style recordings of a Korean word and asked them to rank the options in order of how natural they sounded. All of the words included a stem ending with a consonant and at least one suffix with an empty onset.

Pause-break tests use recordings of words with pauses in various positions to collect information on speakers' judgements of where syllable boundaries lie (e.g. Derwing *et al.* 1990). In the most simplified form, the pauses are placed before and

after intervocalic consonants, but there can be variations when working with consonant clusters. For example, in an English version of the pause-break method, participants may hear the word “melon” with pauses in the following positions indicated by dashes: “me-lon”, “mel-on” and “mel-lon”. The option preferred by the greatest proportion of participants would indicate whether the /l/ is syllabified as an onset, a coda, or ambisyllabic.

The order of questions was randomised using a random number generator, to minimise the risk of participant judgements being influenced by similarities between consecutive stimuli. Given that the survey was kept as short as possible and therefore did not include any questions regarding stimuli not directly relevant to the study, there is still an underlying possibility that a participant’s responses may have been affected by their perception of the purpose of the survey.

To create the survey, recordings of two native Korean speakers were used. This was to reduce the effect of non-nativelike pronunciation on what participants considered more natural. In Section 5.3, I will also use evidence from the production of these two speakers as further indication of how stem-final consonants are syllabified and produced when followed by each of the suffixes.

4.3. Pilot Study and Adjustments

The first survey to be sent out used only the pause-break audio, in an effort to eliminate all possible interference from either seeing or hearing the word before making a judgement. Within the first few days of collecting responses using this survey, the overwhelming feedback was that the participants needed to know which word was being said in order to properly decide which option sounded the most natural. I believed that reading the words would make the written syllable breaks too prominent in the mind of the listener, and significantly affect their answers. For this reason, I made the decision to play an unaltered recording of a native Korean speaker reading out the word before the syllabification options are heard. Data collected in the pilot study is not included in the results shown in Section 5.

5. Results

This section will look at the judgements made by the participants in the study. The results have been split into three parts – in the first, I show the results of all questions with a binary response, and use logistic regression to determine which, if any, factors can be used as predictors of affixation levels. In the second, I compare the responses to the ranked questions of the survey to the findings of 5.1. Finally, in Section 5.3, I look at the production of the words in isolation by two native Korean speakers.

5.1. Forced Choice Questions

The responses to the questions which asked the participants to choose the more natural of two options are shown in Table 4. As in Table 3, S1/Co indicates the number of participants who preferred the option that placed the consonant in the coda of the preceding syllable, and S2/On the number who chose the option which placed it in the onset of the following syllable. Proportions are shown as decimals in brackets. The words have been separated visually into "STEM/SUFFIX", following the spelling breaks found in Korean, for ease of interpretation.

Word	**S1/Co**	**S2/On**
SEOJUN/AH	38 (.585)	27 (.415)
PEN/IRANG	22 (.338)	43 (.662)
NOR/EUM	6 (.092)	59 (.908)
CHAJ/EUMYEON	8 (.123)	57 (.877)
JAG/AJIDA	13 (.2)	52 (.8)
AR/ASEO	20 (.308)	45 (.692)
CHAEK/IBNIDA	25 (.385)	40 (.615)
GIR/EOJIDA	21 (.323)	44 (.677)
SAR/ADO	17 (.262)	48 (.738)
MEOG/EUL	8 (.123)	57 (.877)
HANGUG/IN	16 (.246)	49 (.754)
DONGMUR/IEYO	19 (.292)	46 (.708)
SON/EURO	29 (.446)	36 (.554)
MANDEUR/EOSSEUMYEON	24 (.369)	41 (.631)
MUR/IEOSSEUMYEON	24 (.369)	41 (.631)
SARAM/IRAGO	31 (.477)	34 (.523)
DAD/ASSEUMYEON	8 (.123)	57 (.877)
GEOD/EOSSEO	9 (.138)	56 (.862)
IREUM/EUN	24 (.369)	41 (.631)
SEONSAENGNIM/EGE	23 (.354)	42 (.646)
DDEUD/EOSEO	7 (.108)	58 (.892)
MEOG/EODO	8 (.123)	57 (.877)

Table 4: Responses to forced choice questions

In almost all cases, at least 50% of participants chose to place the consonant in the onset of the following syllable, but with values spread throughout a range of .415 to .908, it is clear that the variation is significant. The overwhelming preference for syllabifying consonants as onsets is not surprising either – as seen in the results from Derwing *et al.* (1990: 230-231), when participants did not read the word being tested, they did show a similar preference for "open syllables". For these reasons, categorising these affixes will not be possible simply by looking at which option is favoured by more than 50% of the judgements. Instead, at this stage, I will not attempt to categorise any individual suffixes at all, but will focus on how different features correspond to the frequency of judgements which favour the coda consonant.

Using logistic regression, with the binary dependent variable "coda consonant", we can test any number of potential predictor variables. Here I will test a combination of features from both the suffixes themselves and from the stems they have been affixed to. Identifying the suffix levels is the ultimate goal, so it is not necessary to analyse variables related directly to the stem, such as final consonant, as they are

extremely unlikely to have any effect at all. The 5 potential predictors I chose to analyse within this data are outlined below.

First, I categorised suffixes based on their initial vowel. This may have some effect on the preceding consonant, since the speaker would only need to use information about an adjacent segment to determine its behaviour.

Next, stimuli were categorised by the class of the stem before any affixes are added. The stems found in this study fall into only 3 classes: noun, verb, and adjective. The classes of words formed by adding the suffixes in question were also analysed, the possible categories being noun, verb, and what would, in English, be a prepositional phrase, such as "in the middle" (*mit-e*).

Finally, the suffixes have been categorised by whether they are inflectional or derivational. In LP, derivational affixes are usually applied at Level 1, and inflections at Level 2. All of the suffixes tested can be added to any Korean word, so we would expect inflections to be significantly less likely to affect the stem than derivations.

The results of this analysis are shown in their entirety in Table 5. This study will focus only on the Estimate (the magnitude of the effect of a predictor variable on the response variable) and p-values (the probability of the effect being found in the case that the null hypothesis is true). In this case, the null hypothesis is that there is no direct causal link between the predictor variables and the response variable.

	Estimate	Standard Error	z	p
(Intercept)	-0.87226	0.6723	-1.297	0.194489
Vowel: e	-1.26322	0.50888	-2.482	0.013052
Vowel: eo	0.0518	0.20898	0.248	0.804226
Vowel: eu	-0.87727	0.35974	-2.439	0.014742
Vowel: i	-1.3312	0.51028	-2.609	0.009086
Stem class: noun	1.74563	0.58479	2.985	0.002835
Stem class: verb	-0.35596	0.45821	-0.777	0.437254
Formed class: preposition	0.69813	0.35444	1.97	0.048876
Formed class: verb	-1.16655	0.48575	-2.402	0.016326
Inf/Der: inflectional	0.83391	0.61183	1.363	0.172887

Table 5: Logistic regression results

Some values are missing from these results – because logistic regression uses comparison, the categories not included in the table are considered to have Estimate values of 0, with all other values showing the effect of a predictor relative to this. For example, the Estimate value of -1.26322 for Vowel: e tells us that a word with a suffix beginning with this vowel is 1.26322 times less likely to syllabify the stem-final consonant as a coda than a word with a suffix beginning with /a/.

Looking at the Estimate values for the suffix-initial vowels, we can see that /ʌ/ is the most likely to cause the preceding consonant to be syllabified as a coda, closely followed by /a/, with /ə/, /e/ and finally /i/ the least likely. Of these, most have a p value <0.05, which is the standard marker of statistical significance. However, the p value for /ʌ/ is much greater than 0.05, meaning the difference found between suffixes beginning with /ʌ/ and /a/ is not significant enough to rule out the effect of chance. Given that the "-*eo*" and "-*a*" suffixes differed only in their initial vowel, this strongly suggests that phonology alone is not a useful predictor of affix behaviour, and it is likely that the more significant differences found in suffixes with other initial vowels are related to the effects of some other variable.

The behaviour of words formed from noun and verb stems is compared to that of words with adjective stems. Words with noun stems were found to be the most likely to be syllabified with the stem-final consonant as a coda, which we can see from the positive Estimate value. This value is also relatively large, meaning words with noun stems are highly likely to behave in this way compared to words with non-noun stems, and the p value is very small, showing high significance. Conversely, words with verb stems showed a slightly greater tendency to be syllabified according to the Maximal Onset Principle than words with adjective stems, but the p value is large enough that the trend found in this data could be consistent with random chance.

With regard to the different word classes formed by affixation, significant differences were found between all three categories, with prepositions the most likely to be syllabified with the stem-final consonant as a coda, and verbs the least likely.

There was not a significant difference found in this data between inflectional and derivational suffixes. This is somewhat surprising, because inflectional affixes are thought to generally be added to words at a later stage than derivational affixes. Because there does not appear to be a significant correlation between this feature of a

suffix and its behaviour in this study, it is possible that Korean affixes are treated as individuals and categorised by a more specific property than we might usually expect.

5.2. Ranked Questions

The results from the questions which let participants rank more than 2 options are presented in clustered column graphs. Using what we know about Korean phonology, it seems reasonable to expect speakers to almost universally agree that options with sounds found only in onset position syllabified as codas are less permissible than all alternatives. This holds up in many of the cases in this study, as Figures 2-7 show. The words which show this tendency can be readily explained using a model which looks only at input and output forms such as Parallel OT, as I will show in Section 7.1.

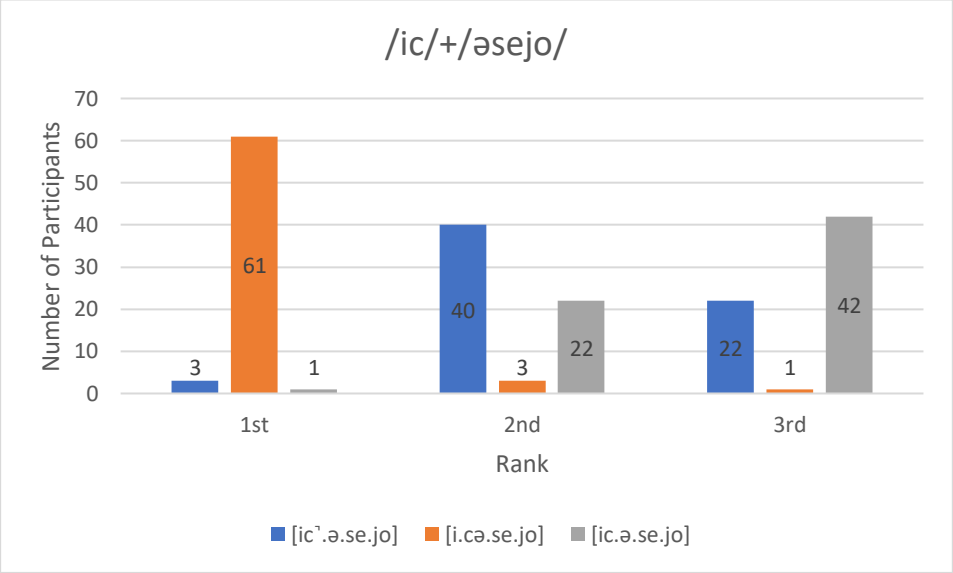

Figure 2: Responses: /ic/+/əsejo/

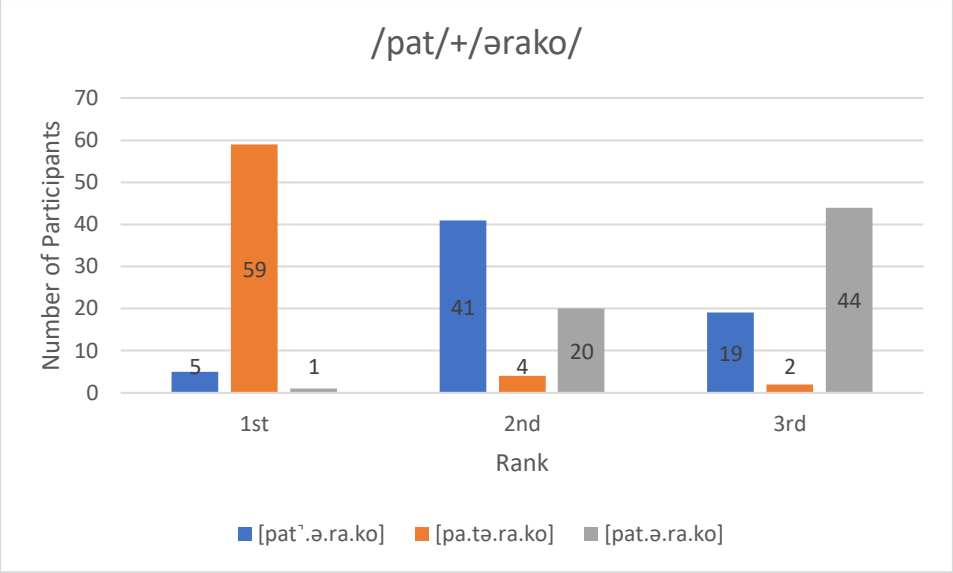

Figure 3: Responses: /pat/+/ərako/

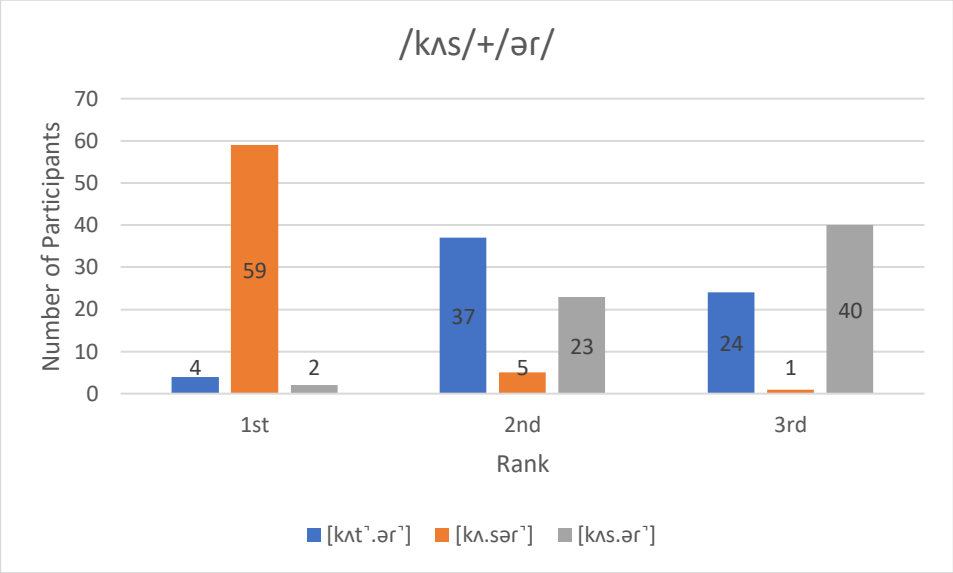

Figure 4: Responses: /kʌs/+/ər/

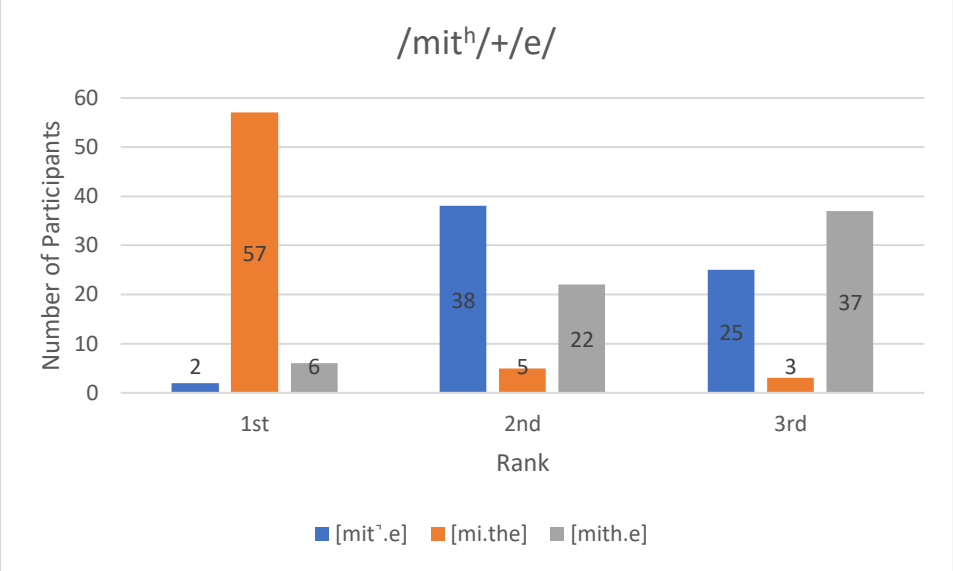

Figure 5: Responses: /mitʰ/+/e/

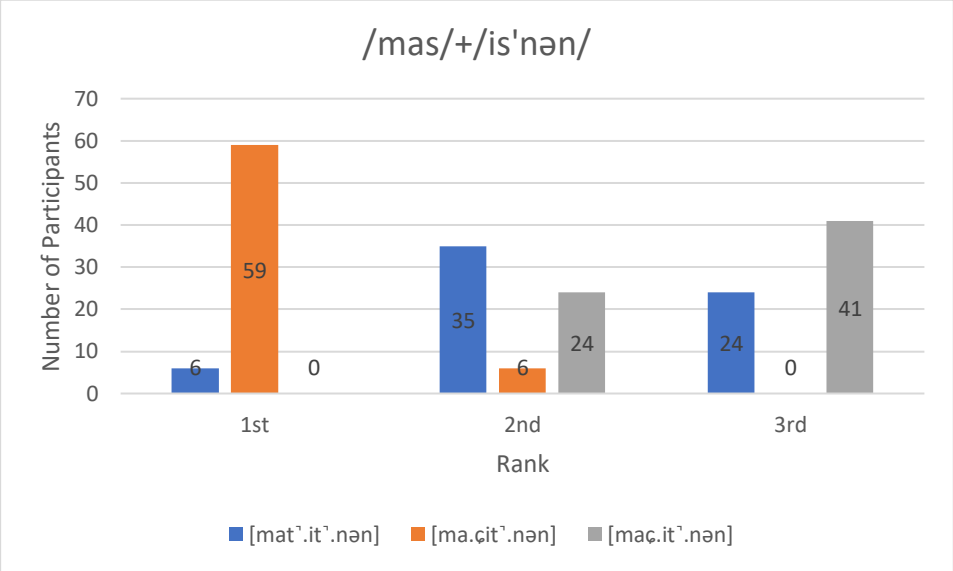

Figure 6: Responses: /mas/+/is'nən/

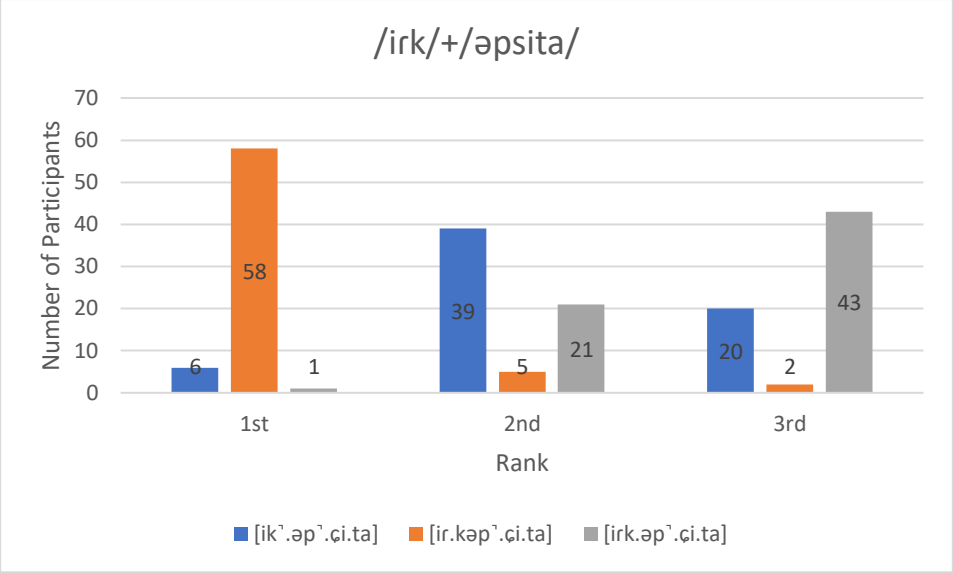

Figure 7: Responses: /ɪrk/+/əpsita/

The stem /ɪrk/ contains a coda cluster, which is not permissible in Korean. In this question, participants were presented with one option which reduced the cluster from /ɾk/ to [kˀ], one which placed the syllable boundary between the two consonants, and one which preserved the coda entirely. As in questions such as the one on /mit^{h}/+/e/, participants overwhelmingly ranked the option with a consonant in the onset as most natural and the prohibited form as the least natural.

However, the responses to the questions concerning /mas/+/ʌpnən/ and /anc/+/as'ʌ/ do not show this trend. In the case of /mas/+/ʌpnən/, the options with a plosive found in place of the underlying /s/ were both generally ranked higher than those with the stem-final fricative preserved, which is not surprising since most native Korean speakers do produce the consonant as a plosive in this word, as will be evidenced in Section 5.3. Because Korean does not allow fricatives syllable-finally, we might expect [ma.sʌpˀ.nən] to be more preferred than [mas.ʌpˀ.nən] if we were to assume that these judgements are based solely on the surface forms. Similarly, the option [anc.a.s'ʌ] should be ranked lower than [ancˀ.a.s'ʌ] because of the released coda segment. The fact that these predictions are not what was found by the survey suggests that a generative approach should be used.

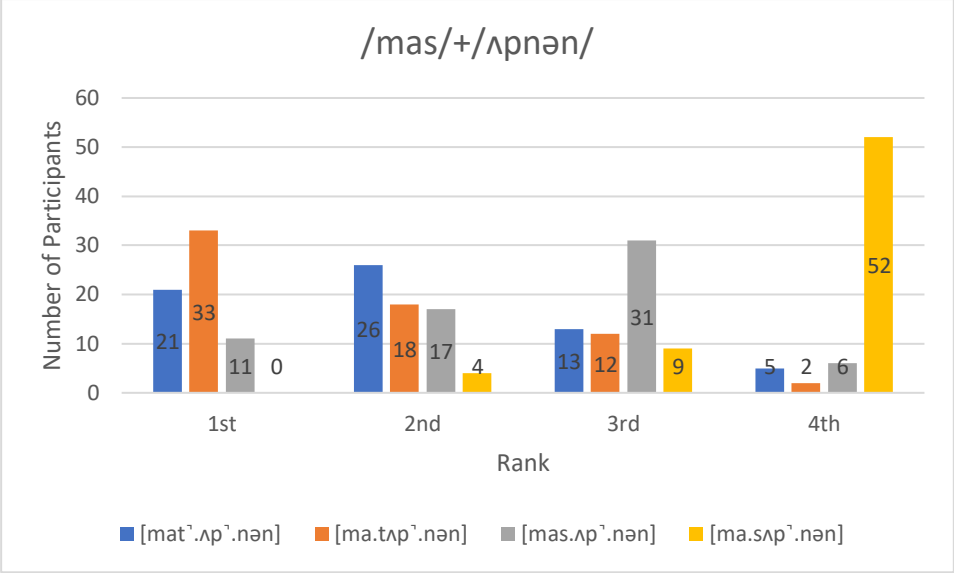

Figure 8: Responses: /mas/+/ʌpnən/

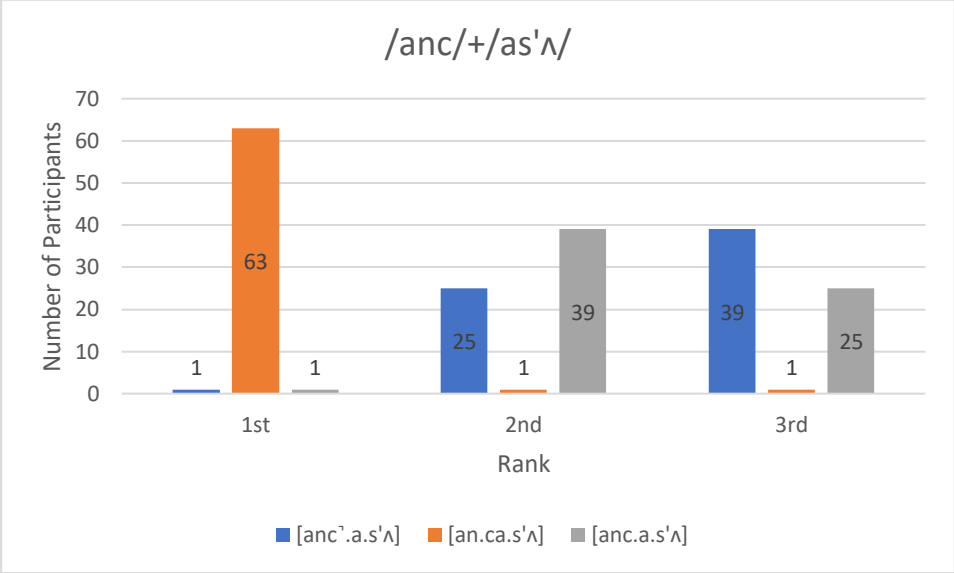

Figure 9:Responses: /anc/+/as'ʌ/

5.3. Native Pronunciation

The survey used audio from two native Korean speakers, who each recorded themselves producing the stimulus words in full. The words were produced in isolation, and read from a list, which could reduce how natural their pronunciation is, but this is not likely to cause significant changes here since I will only use evidence from their production of a single word-internal segment. Kim and Duanmu (2004: 65) suggest that lax stops are voiced when syllable-initial and voiceless in coda position, so the voicing of

these consonants may be used as an indication of how they are syllabified. Equally, all oral consonants are said to be produced as unreleased stops when found in codas (Kim and Duanmu 2004: 65), so we can use the presence of a release burst, aspiration or frication to show a consonant's position in the syllable where there is no voicing contrast.

Speaker 1 is a young adult male native speaker of Korean. He has lived in England for several years, including some of his childhood, and in feedback given on the survey one participant commented that his accent sounded like the accent of a Korean-American. His pronunciation gives us an insight into how some speakers syllabify and produce stem-final consonants, but may be less native-like than the pronunciation of a Korean speaker who has never lived in any other country.

Speaker 2 is a middle-aged, female speaker who has also lived in England, but since she moved away from Korea well into her adult life, her native accent is likely to have been preserved to a greater extent than Speaker 1's. Feedback from other native speakers did not include any mention of her pronunciation sounding strange or non-native-like, which means we can assume that her production of some sounds is more representative of native Korean speech. The production of these segments by both speakers was alike, which indicates that these pronunciations are consistent in the wider Korean speaking population.

The speakers produced nearly all stem-final consonants in a way we would expect them to be produced as onsets. Plain stops were voiced, and consonants were generally released or fricated according to their underlying form. While this does not help us categorise any suffixes as Level 1 or Level 2, it does provide supporting evidence that syllable position may not be the main factor in how consonants are produced in Korean speech.

There was only one exception to this tendency to produce consonants in a manner associated with onsets. As the results from the survey indicate, the underlying /s/ phoneme found in *mas.eobs.neun* is overwhelmingly realised as a surface [t], and the speakers both produced it as a plosive, rather than a fricative, as we would expect a coda /s/ to be produced. However, strangely, they did not produce a [t] sound, but instead a voiced [d]. Assuming that voicing is linked to syllable position, this suggests that the consonant has been syllabified as an onset. This, though, does not explain why the

underlying /s/ is not produced as a fricative. I will show how this finding can be accounted for in Section 7.

6. Discussion

In this section, I evaluate the reliability of the method used above. In 6.1 I will look at the survey itself and how the questions were designed. In 6.2, I consider the effect of fatigue or misunderstanding on participants' responses, and finally in 6.3 I discuss social factors and points for further study.

6.1. Survey Structure

Given the aims of the study, as well as the constraints on time and resources, it was most effective in this case to use a simple survey to collect data, rather than analyse large amounts of natural speech. By also collecting recordings of key words from two speakers, I aimed to incorporate the useful elements of both styles of data collection. However, data from only two speakers is not enough to generalise from, so this data should be treated as supplementary to the responses to the survey and only used to compare findings.

The most useful questions in the survey were those which had the participants rank several options from "best" to "worst". There were only 8 of this type, with the remaining 22 being forced choice questions with only 2 options. The reason for this was that the Korean speaker I approached to provide the recordings had difficulty producing onset consonants in coda positions. She was able to record the variations with coda consonants in Syllable 1 and with onset consonants in Syllable 2, but for the ranked questions I used editing software to create additional options by moving onset consonants from immediately after the pause to immediately before. This process was used on all of the words provided, but in many cases the result was either too similar to another option to easily distinguish or audibly edited; either of these factors would have affected participants' judgements, so for the affected questions only the original 2 recordings were used. In a reproduction of this study it may be beneficial to use recordings from a native speaker of Korean who is also trained in

phonetics and able to produce the relevant consonant sounds in either onset or coda position.

The ranked questions were initially intended to give participants 4 choices, asking them to compare onset vs coda syllabification for both the sound permitted in onsets and the respective sound found in codas. This was achieved successfully with only one of the questions, because it was not possible in most cases to place the unreleased consonants in onset position without the stimuli sounding unnatural. This could also be improved by having a trained phonetician produce the stimulus recordings, as it could eliminate the need for editing entirely.

6.2. Fatigue and Confusion

The survey used to collect this data consisted of 30 questions, all of which were roughly the same. It is reasonable to assume that participants experienced a degree of fatigue, or boredom, towards the end, which may have caused them to rush. They may have begun to overgeneralise or pay less attention to the stimuli before selecting an option. In a test with a more controlled environment, it may be possible to minimise fatigue by giving participants breaks or spreading the survey across multiple sessions. Since this was not something that could be reliably done with an online survey, I aimed to achieve similar results by overestimating the duration of the survey – the information on the first page of the survey warned that it could take up to 30 minutes, while most participants took only around 15 – and encouraging participants to come back to it later if they felt they needed to for any reason. One way to determine whether a participant's responses were affected by fatigue is to look for a higher frequency of one type of response in later questions, and more variation in earlier questions. They may also begin to choose randomly; then we might expect their responses to be split more evenly between the different options. However, since these possible indicators are so distinct, and both trends could be found in the responses from a participant who did not experience fatigue and gave their genuine judgements throughout, it would not be possible to tell from the responses alone whether they were affected by this.

On the other hand, it is also possible that participants became more reliable as the survey progressed. In order to not influence judgements, participants were not told

exactly what was being studied until after they completed the survey. This may have caused some to be confused by the first few questions, which could have led to more random selections early on in the survey. Though it is present, this possibility is rather small, especially since participants were only asked to make judgements on which options sounded the most natural, which can be done fairly intuitively and without the need for a high level of metalinguistic awareness.

Although the factors discussed here are not cause to consider the results from any participant unreliable, they may affect some responses. Given the limited scale of this study, I assume a potential margin of error of 20%. This represents 13 participants who may have selected an answer which does not correspond to their actual perception of the most optimal candidate. In Section 7, this will lead me to group the behaviour of the suffixes by which questions elicited a S1/Co judgement from more than 20% of participants. Though 20% is a large proportion, it is impossible to reduce the number of outliers to 0 in any study, and due to the nature of the survey, it is not excessive to consider a possible 13 outlying responses here. Had there been enough time to collect data from more speakers, a similar number of outliers would become less significant and the point at which a distinction can be made would hopefully become clear.

6.3. Other Factors

Because the survey used did not collect social data on the participants, it is unclear how these factors may have affected judgements. This was done to maintain as much confidentiality as possible and to avoid alienating any participants who might have felt uncomfortable giving potentially identifying information. Since the survey only received 65 responses, I prioritised participant retention over social data. However, collecting additional information such as age, dialect region, and any other languages spoken by the participants would likely yield interesting results. For example, of the 27 participants who chose the option which placed the consonant in the onset in question 1 of the survey, 12 chose the same option for every question of this kind. This points to a possible word- or phrase-level syllabification step used by some, but not all, speakers, but does not tell us why this is the case. This may be a feature of some dialects of Korean, but could also be a wider trend of this step either emerging

in younger speakers or becoming less widely used and more associated with older speakers. To understand this finding in more depth, further study would need to be conducted with a greater focus on social factors.

It would also be beneficial to study the differences in judgements caused by speaking another language; some languages prohibit codas entirely, while others allow more complex syllable structures than Korean. Contact between Korean and a language which has different rules on syllabification would likely have an impact on a speaker and their perception of how consonants are syllabified. This survey did not ask participants to disclose any other languages spoken, so these effects are not shown in the data. However, syllabification is a feature acquired very early, meaning a speaker's judgement is likely to be most reliant on their native language. Since all participants were native speakers of Korean, and the structure of the survey did not require them to use any knowledge of other languages, this factor would not affect the results in a meaningful way.

Additionally, Korean is fairly unique in its writing system, which makes commitments with regard to which syllable a consonant is more associated with. By using recordings of the words and not presenting participants with the written form, the survey reduced the probability of judgements being affected by the writing break as much as was possible, but did not eliminate it entirely. The survey relied on questions using written Korean for clarity, meaning all participants were necessarily literate, and therefore influenced somewhat by the known written syllable breaks. Conducting a similar study with illiterate Korean speakers could reveal more accurately how syllabification is used in Korean.

7. Analysis

This section will analyse these results using all three of the methods described in Section 2. In 7.1, I introduce the relevant constraints and demonstrate how Parallel OT cannot account for all of the output forms. Sections 7.2 and 7.3 use LP and Stratal OT respectively to determine which more readily explains the affixation processes found in Korean.

7.1. Parallel OT

To explain these findings using OT, we must first find the relevant constraints. Given that Korean speakers do, overall, have a tendency to syllabify consonants as onsets where possible, the constraint *CODA (Mester and Padgett 1994) must be part of the analysis. *CODA assigns 1 violation mark for every segment in a coda position, which causes candidates which adhere to the Maximal Onset Principle to be more optimal than those which do not, unless they violate a more highly ranked constraint. In a more comprehensive OT analysis of Korean, we would expect to also find a constraint disallowing complex onsets, but this study deals only with intervocalic consonants, so it will not be necessary or possible to determine how such a constraint would be ranked using only the data shown above. Some additional constraints will be introduced in Section 7.3 for a more comprehensive analysis, but do not need to be included here because they do not affect the outcome under Parallel OT.

However, since candidates which seem to violate *CODA seemed to be preferred in some cases, the ranking must involve another constraint. A similar phenomenon is found in German, which prohibits resyllabification across a morpheme boundary (Mikuteit 2003: 3005). This suggests a need for the use of a morphology-sensitive alignment constraint, in this case ALIGN(STEM, R, SYLLABLE, R), which assigns a violation mark for every segment found on the rightmost edge of a stem which is not also at the rightmost edge of a syllable – that is, this constraint states that stem-final consonants must be syllabified as codas. Because it is the only alignment constraint used in this analysis, it will appear as ALIGN in tables.

The sound changes observed here must also be accounted for by constraints. As we have seen, Korean only allows a few consonant sounds in coda positions, and the common features of those sounds allows us to explain all of them using only the constraints outlined below.

Looking first at the plosives, coda sounds must be voiceless and unreleased. As seen in Section 2.4, all Korean plosives are underlyingly voiceless, with the exception of the alveolar flap. As such, the only constraint needed to eliminate candidates with voiced coda consonants is a faithfulness constraint – either IDENT-IO or IDENT(VOICE) could work here. A related constraint, IDENT(MANNER) will also be used in 7.3. Faithfulness constraints which require a given feature be preserved were proposed by

McCarthy (2007), with IDENT-IO an extension of these which assigns a violation mark for every segment with any feature changed between the input and the output.

I also propose a constraint *RELEASEDCODA. This is less widely used in OT, but can be justified by showing that unreleased codas are a universal tendency. Unreleased coda consonants can be found in several diverse languages; as well as Korean, speakers of many dialects of English do not audibly release word-final consonants (Bermúdez-Otero 2007) or the first of two adjacent plosives (e.g. Henderson and Repp 1982: 71-72). Word-final stops are also unreleased in Karitiana, a language spoken by some Brazilians (Storto, Demolin 2002). Given that none of these languages are closely related, it is reasonable to assume that coda consonants have a tendency to not be audibly released, and consequently that *RELEASEDCODA is a valid universal constraint.

Using these constraints, the reductions of all Korean stops to their coda forms are explained. They predict that, although coda /c/ is usually transcribed as [t], it is in fact realised as an unreleased palatal stop, which is very difficult to distinguish from its alveolar counterpart. This could be confirmed using, for example, a comparative palatographic analysis of native Korean production of the /t/ and /c/ phonemes in coda environments. It was not possible to conduct such an analysis for this study, given the budgetary constraints, but in the absence of any contradictory data there is no reason to believe that the constraints outlined above do not comprehensively explain the behaviour of all plosives used in Korean.

I also argue that it is possible to account for the change of /ɾ/ to [l] in codas using *RELEASEDCODA. This is because the alveolar tap sound is produced by articulatory movements very similar to those used to produce the lateral approximant, with the tongue tip making contact with the alveolar ridge. Despite being a central, rather than lateral, consonant, the sound produced at the moment of closure is perceptually similar enough to [l] that using the two interchangeably could reasonably go unnoticed in connected speech. This assertion is supported by the findings of Iverson and Sohn (1994: 90-92), who point out that it is the approximant quality of the phoneme which spreads to adjacent nasals, rather than the the {+lateral} feature. For this reason, the phoneme /ɾ/ will be written as [ɾˇ] when it is found in a coda.

To explain the neutralisation of /s/ and /s'/ to unreleased [t'] in coda position, we can introduce a further constraint *CODAFRICATIVE. This assigns 1 violation mark for every fricative found in a coda, and an equivalent ALIGN-L (FRIC,σ) has been proposed in a previous OT analysis of Caribbean Spanish (Piñeros ND: 9-30), which gives us evidence that this tendency may be universal. However, by considering fricatives as "necessarily released" (Iverson and Sohn 1994:91), it is possible to account for the neutralisation of /s/ and /s'/ using *RELEASEDCODA. While either of these constraints is valid, it is wise to avoid using more constraints than necessary in OT, so this analysis will consider the behaviour of Korean fricatives a consequence of the *RELEASEDCODA constraint.

Finally, since plain stops are voiced when found word-medially, a constraint is needed to allow for this. Word-initial plosives are voiceless in Korean, so a constraint which requires onsets to be voiced is not appropriate in this case. Since plain consonants were produced as voiced by both speakers regardless of how participants syllabified them, the qualities of adjacent segments are more likely to cause a consonant to be voiced than their position in a syllable; Korean plain stops are realised as voiced when found between any two voiced sounds, including other consonants (Kim and Duanmu 2004: 65). This can be considered a product of the constraint CONSERVEARTICULATORYEFFORT (CAE), previously used by Jun (1995: 121) because of the inherent effort associated with opening and closing the vocal folds in a short time – it is easier for a speaker to maintain voicing than to change it. Candidates with voiceless nasals will not be included in the tables in this section or in Section 6.3, because they violate both CAE and IDENT(VOICE). CAE can also be used to explain the palatalisation of /s/ in words such as *mas.iss.neun*. Palatalisation of consonants before [i] or [j] is found in many languages, as it reduces the distance between the sounds in the mouth. This causes production of the string to be more efficient with respect to articulatory effort. Shariatmadari (2006), among others, acknowledges the importance of "Ease of Articulation".

To prevent this constraint from causing intervocalic aspirated and ejective plosives to be voiced, further constraints *D^h and *D' must be introduced, which assign violations marks for each voiced aspirated segment and each voiced ejective segment respectively. Since aspiration directly correlates with Voice Onset Time (e.g. Cho and Ladefoged 1999), and ejectives are characterised by a complete glottal

closure (e.g. Lindau 1984), producing consonants of these types without voicing should be a universal tendency. Some constraint which prohibits voiced fricatives should also be considered, since they are not found in Korean, even intervocalically (Chang 2008: 2). Although voiced fricatives are found in language, there is a "widespread occurrence of devoicing in fricatives that are phonemically voiced" (Haggard 1978: 95), which could be caused by a constraint such as *VOICEDFRICATIVE. These constraints must be more highly ranked than CAE, or they would have no effect on the winning candidate. In the interest of conserving space in the tables, these candidates and the associated constraints will not be shown.

Using these constraints, many of the results shown in Section 5 are readily explained under Parallel OT. For example, 61 of the 65 participants preferred the syllabification [i.cə.se.jo] compared to [ic.ə.se.jo] and [icˀ.ə.se.jo], and both speakers in Section 5.3 produced the stem-final consonant as [ɟ], which indicates that the winning candidate should be [i.ɟə.se.jo]. In this case, the winning candidate is [i.ɟə.se.jo] as long as ALIGN(STEM, R, SYLLABLE, R) and both IDENT constraints are ranked below CAE and *CODA. We do not know, from his example alone, the exact ranking beyond this, but we can assume that *RELEASEDCODA outranks *CODA, since any candidate which violates *RELEASEDCODA would automatically violate *CODA. Thus, for it to be relevant to a language, *RELEASEDCODA should be ranked more highly. Table 6 shows this ranking, with dotted lines between constraints which cannot be compared at this stage. *RELEASEDCODA is shown separately, because its ranking is not relevant here.

/ic/+/əsejo/	CAE	*CODA	ALIGN	IDENT-IO
[iɟ.ə.se.jo]		*!		*
☞[i.ɟə.se.jo]			*	*
[iɟˀ.ə.se.jo]		*!		*
[ic.ə.se.jo]	*!	*		
[i.cə.se.jo]	*!		*	
[icˀ.ə.se.jo]	*!	*		*

*RELEASEDCODA
*
*

Table 6: Parallel OT: /ic/+/əsejo/

As is shown in Tables 30-39 in the appendix, this constraint ranking can be preserved while still producing the desired winning candidate for around half of the

words tested in this study. OT assumes a single ranking of constraints which applies to every word in a given language, so we would hope to see this consistency in an analysis. *RELEASEDCODA will be removed from the tables for these examples, because its inclusion in the ranking does not affect the winning candidate.

However, this ranking does not as easily produce the desired winner in cases such as the one shown below; most participants judged the option [sʌ.ɟun.a] as more optimal than [sʌ.ɟu.na], despite the latter being the clear winner when using what seems in the previous examples to be the correct constraint ranking. This example, along with all of those not easily explained under Parallel OT, will be considered more in the following sections.

/sʌcun/+/a/	CAE	*CODA	ALIGN	IDENT -IO
☞[sʌ.ɟun.a]		*!		
[sʌ.ɟu.na]			*	
[sʌ.ɟunˀ.a]		*!		*
[sʌ.ɟun̥.a]	*!	*		*
[sʌ.ɟu.n̥a]	*!		*	*
[sʌ.ɟun̥ˀ.a]	*!	*		*

Table 7: Parallel OT: /sʌcun/+/a/ (ranking shown above)

Table 8 shows a new ranking under which [sʌ.ɟun.a] is the winning candidate:

/sʌcun/+/a/	CAE	ALIGN	IDENT -IO	*CODA	*RELEASED CODA
☞[sʌ.ɟun.a]			*	*	*
[sʌ.ɟu.na]		*!	*		
[sʌ.ɟunˀ.a]			**!	*	
[sʌ.cun.a]	*!			*	*
[sʌ.cu.na]	*!	*			
[sʌ.cunˀ.a]	*!		*	*	

Table 8: Parallel OT: /sʌcun/+/a/ (correct ranking)

For [sʌ.ɟun.a] to win, ALIGN(STEM, R, SYLLABLE, R) AND IDENT-IO must outrank *CODA. CAE must also be ranked more highly than IDENT-IO to prevent [sʌ.cun.a]

from winning. The ranking of *RELEASEDCODA still cannot be determined, because the difference between [sʌ.ɟunˀ.a] and [sʌ.ɟun.a] is not significant, but it may be possible to find by looking at further examples. By assuming this to be the correct constraint ranking, we can explain the behaviour of /sʌ.ɟun/+/a/ and other words which seem to behave similarly. However, this would mean that the tables presented above are inaccurate and changing the ranking in this way would cause a non-optimal candidate to win in those cases. This tells us that Parallel OT cannot be the appropriate model to apply to this data, because it does not allow for a change in ranking within a single dialect.

7.2. Lexical Phonology

LP is able to show the processes which could lead to the variation found relatively simply, by assuming that transparent surface forms are caused by early affixation processes, while opaque forms undergo some changes before affixation. To account for the specific findings of this study, the key difference is whether affixation occurs before or after a syllabification step. Affixes applied at Level 1 are applied before syllabification, allowing the stem-final consonant to be syllabified as an onset; Level 2 begins after this syllabification, meaning the stem-final consonant has been syllabified as a coda, and as a consequence the sound may change to fit the conditions of coda consonants. A word-level syllabification may occur for some speakers, but the variation remains and cannot be explained without looking at the intermediate stages between underlying and surface forms.

	/mas/+/is’nən/	/mas/+/ʌpnən/
Level 1		
Apply irregular and non-neutral affixes	[masis’nən]	-
Syllabify	[ma.sis’.nən]	[mas]+[ʌp.nən]
C→Cˀ/ _$	[ma.sitˀ.nənˀ]	[matˀ]+[ʌpˀ.nənˀ]
Level 2		
Apply remaining affixes	-	[matˀ.ʌpˀ.nənˀ]
Post-Lexical		
s→ɕ/ _i	[ma.ɕitˀ.nənˀ]	-
Cˀ→C/ _V	-	[mat.ʌpˀ.nənˀ]
T→D/ {+voi}_{+voi}	[ma.ɕidˀ.nənˀ]	[mad.ʌbˀ.nənˀ]
Syllabify	[ma.ɕidˀ.nənˀ]	[ma.dʌbˀ.nənˀ]

Table 9: LP: /mas/+/is’nən/, /mas/+/ʌpnən/

In this analysis, some stages are written as rules; I define coda reduction, for example, as C→Cˀ/ _$, where C represents an underspecified consonant, Cˀ the unreleased equivalent, and $ marks a syllable boundary. s→ɕ/ _i allows for the palatalisation of /s/ when it appears before [i]. Cˀ→C/ _V causes unreleased consonants to become released when they precede a vowel – as discussed in Section 7.1, this is a necessary process in languages with unreleased consonants. Finally, T→D/ {+voi}_{+voi} causes plain plosives to be realised as voiced when they appear between two voiced segments, regardless of their position in the syllable. Where sounds are unspecified for a given feature in a rule, that feature should not be affected by the rule.

The preference for [mas.ʌpˀ.nən] over [ma.sʌpˀ.nən], while unexpected given that [s] is not permitted syllable-finally, is also made more clear by applying LP. Although [mas.ʌp.nən] is not a permissible form, it is found in the intermediate stages before [ma.dʌbˀ.nən], while [ma.sʌp.nən] is not. There were also many participants who did judge [matˀ.ʌpˀ.nən] as most optimal, lending credibility to the idea that the post-lexical syllabification is not universal. This is strong supporting evidence for an

analysis of this kind, as a Parallel OT analysis assumes that one candidate is optimal and that there is no “better” non-optimal form.

Participants’ ranking of the four options also correlates to the stage at which they are found in the table; the option with a syllable-initial released plosive was generally preferred, while [matˀ.ʌpˀ.nən], found at an earlier step, was judged second most optimal, and [mas.ʌpˀ.nən], the first intermediate form, was third most optimal according to the native speakers. It is possible that when a form which is not permissible has been ranked more highly than a form which is, this is due to which of them occurs as an intermediate form. Conversely, when the ranking favours permissible forms above prohibited forms, this is likely a consequence of participants judging the options solely on how permissible they are, which may tell us that none of the options are found as intermediate forms.

As seen when analysing the behaviour of stem-final /s/ in /mas/+/eobsneun/, the Cˀ→C/ _V step causes [tˀ] to become [t], even in cases of the underlying form containing a /s/. This tells us that for an underlying /s/ to be produced as [s], it must avoid being reduced to [tˀ]. Thus, any suffix which preserves the /s/ sound must be applied at Level 1.

Table 10 uses the same framework to compare /ic/+/əsejo/ and /sʌcun/+/a/. By applying one affix at an earlier level, we can see the cause of the variation in syllabification shown. The post-lexical syllabification step is shown, as in the previous table, but is only used by around 50% of speakers. The other half of the population does not apply this final step, which is what gives the surface form of [sʌ.ɟun.a] that was found to be preferred by many participants. I show how this process applies to the other words tested in the study in Tables 40-42 found in the appendix.

	/ic/+/əsejo/	/sʌcun/+/a/
Level 1		
Apply irregular and non-neutral affixes	[icəsejo]	-
Syllabify	[i.cə.se.jo]	[sʌ.cun]+[a]
C→Cˀ/ _$	-	[sʌ.cunˀ]+[a]
Level 2		
Apply remaining affixes	-	[sʌ.cunˀ.a]
Post-Lexical		
s→ɕ/ _i	-	-
Cˀ→C/ _V	-	[sʌ.cun.a]
T→D/ {+voi}_{+voi}	[i.ɟə.se.jo]	[sʌ.ɟun.a]
Syllabify	[i.ɟə.se.jo]	[sʌ.ɟu.na]

Table 10: LP: /ic/+/əsejo/, /sʌcun/+/a/

This method of analysis clearly shows how variation between words, as well as variation between speakers, is possible. The post-lexical steps also account for the finding in Section 5.3 that speakers produce all intervocalic consonants the same way, despite variation in the syllabification. This rule order, excluding the post-lexical syllabification, seems to be universal in Korean speakers, and can be applied to any word, but the return to rule-based phonology leads to a loss of some of the universality. While rules such as T→D/ {+voi}_{+voi} neatly explain the behaviour of certain sounds in Korean, they come with a necessary assumption that all speakers must learn language-specific rules and that the role of innate linguistic knowledge is reduced.

The LP analysis shown here also makes predictions regarding which intermediate forms we would expect to find. Although some of these predictions could be changed slightly by altering the rule order, some, such as the intermediate forms of /mas/+/ʌbnən/, must be present in this model for the output to be the same as the surface form we have found.

7.3. Stratal OT

It is also possible to account for all of the results of this survey by implementing a Stratal OT model. Those words whose syllabification can be readily explained under Parallel OT would behave in the same way in Stratal OT, with the suffixes applied at an early stage. Another constraint must be introduced here which assigns a violation mark for every unreleased segment which directly precedes a vowel. Producing a CV string without releasing the initial consonant is inherently suboptimal, because the nature of the sounds requires the tongue to obstruct the airflow before allowing it to pass through; the movement of the tongue between these states is what we consider a release, and it necessarily produces the associated burst of air. I will call this constraint *C˺V. As in the LP analysis, those with apparently non-optimal surface forms must undergo affixation at a later level. I will demonstrate this first using /mas/+/ʌbnən/ as an example.

At the first stage, the stem /mas/ is considered alone, and constraints are applied with the ranking shown. Although many constraints cannot be comprehensively ranked, the necessary rankings are shown below. CAE is not shown in the tables showing the ranking at the first stage, because it cannot be compared to any of the other constraints; its high ranking at the second stage means that its ranking at earlier stages does not tell us anything about the surface form of any word. It is clear from the data that MAX-IO (McCarthy 2007), DEP-IO (McCarthy 2007) and *C$^{\text{UNSYLL}}$ (found as PARSE-C in Kenstowicz (1996)) must all be present and ranked highly at every stage in Korean, because forms such as [ma.sa], [ma], and [ma.s] are never found. However, they will not be shown on the remaining tables in this section, because they are not violated by any of the candidates considered in the survey.

/mas/	*RELEASED CODA	MAX -IO	DEP-IO	*C$^{UN}_{SYLL}$	IDENT(VOICE)	IDENT(MANNER)	IDENT-IO	*CODA	ALIGN
[mas]	*!							*	
[maz]	*!				*		*	*	
[mat]	*!					*	*	*	
☞[matˀ]						*	*	*	
[madˀ]					*!	*	*	*	
[ma]		*!							
[ma.sa]			*!						*
[ma.s]				*!					*

Table 11: Stratal OT: /mas/+/ʌpnən/ (1st cycle)

/matˀ/+/ʌpnən/	CAE	*CˀV	IDENT(MANNER)	ALIGN	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[matˀ.ʌp.nən]	**!	*				*		
[ma.tˀʌp.nən]	**!	*		*				
[matˀ.ʌbˀ.nən]	*!	*				*		*
[ma.tʌbˀ.nən]	*!			*				*
[mat.ʌbˀ.nən]	*!				*	*		*
[madˀ.ʌbˀ.nən]		*!				*	*	**
☞[mad.ʌbˀ.nən]					*	*	*	**
[ma.dʌbˀ.nən]				*!			*	**
[ma.sʌbˀ.nən]			*!	*				**
[mas.ʌbˀ.nən]			*!		*	*		**
[ma.zʌbˀ.nən]			*!	*			*	**

Table 12: Stratal OT: /mas/+/ʌpnən/ (2nd cycle)

The constraint ranking at the second stage clearly shows some change from the first stage. Specifically, the ranking of IDENT(MANNER) and IDENT(VOICE) has swapped, as has the ranking of ALIGN and *CODA. Stratal OT permits a change in the ranking of this type when it occurs between cycles.

For those speakers who syllabify post-lexically, another stage would be used to allow *CODA to cause all surface forms to be syllabified according to the MOP. It is impossible to determine how ALIGN(STEM, R, SYLLABLE, R) would be ranked compared to *CODA at this stage, because morphological boundaries would not apply in any case.

I will show in the rest of this section that these rankings can be used to produce the desired surface forms in all cases in this study. Tables 11 and 12 should be considered the full ranking, and some constraints will be omitted from later examples where they apply the same number of violation marks to every candidate.

/sʌcun/	*RELEASED CODA	IDENT(VOICE)	IDENT(MANNER)	IDENT-IO	*CODA	ALIGN
[sʌ.cun]	*!				*	
☞[sʌ.cunˀ]				*	*	
[sʌ.ɟun]	*!			*	*	
[sʌ.ɟunˀ]		*!		**	*	

Table 13: Stratal OT: /sʌcun/+/a/ (1st cycle)

/sʌ.cunˀ/+/a/	CAE	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[sʌ.cun.a]	*!			*	*		*
☞[sʌ.ɟun.a]				*	*	*	**
[sʌ.ɟunˀ.a]		*!			*	*	*
[sʌ.cunˀ.a]	*!	*			*		
[sʌ.cu.na]	*!		*				*
[sʌ.ɟu.na]			*!			*	**
[sʌ.ɟu.nˀa]		*!	*			*	*
[sʌ.cu.nˀa]	*!	*	*				

Table 14: Stratal OT: /sʌcun/+/a/ (2nd cycle)

/noɾ/+/əm/	*RELEASED CODA	IDENT(VOICE)	IDENT(MANNER)	IDENT-IO	*CODA	ALIGN
[no.ɾəm]	*!				*	
[noɾ.əm]	*!*				**	
☞[no.ɾəmˀ]				*	*	
[noɾ.əmˀ]	*!			*	**	
[no.ɾˀəmˀ]				**!	*	
[noɾˀ.əmˀ]				**!	**	

Table 15: Stratal OT: /noɾ/+/əm/ (1st cycle)

/no.ɾəmˀ/	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[no.ɾəm]		*!	*		*
[noɾ.əm]		**!	**		*
☞[no.ɾəmˀ]			*		
[noɾ.əmˀ]		*!	**		
[no.ɾˀəmˀ]	*!		*		*
[noɾˀ.əmˀ]	*!		**		*

Table 16: Stratal OT: /noɾ/+/əm/ (2nd cycle)

/mas/+/is'nən/	*RELEASEDCODA	IDENT(MANNER)	IDENT-IO	*CODA
☞[ma.sitˀ.nənˀ]			**	**
[mas.itˀ.nənˀ]	*!		**	***
[matˀ.itˀ.nənˀ]		*!	***	***
[ma.titˀ.nənˀ]		*!	***	**
[ma.ɕitˀ.nənˀ]			***!	**
[maɕ.itˀ.nənˀ]	*!		***	***

Table 17: Stratal OT: /mas/+/is'nən/ (1st cycle)

/ma.sitˀ.nənˀ/	CAE	*CˀV	IDENT(MANNER)	*RELEASEDCODA	*CODA	IDENT-IO
[ma.sitˀ.nənˀ]	*!					
[mas.itˀ.nənˀ]	*!			*	*	
[matˀ.itˀ.nənˀ]		*!	*			*
[ma.titˀ.nənˀ]			*!		*	*
☞[ma.ɕitˀ.nənˀ]						*
[maɕ.itˀ.nənˀ]				*!	*	*

Table 18: Stratal OT: /mas/+/is'nən/ (2nd cycle)

Using only the data from my survey, it is not possible to determine the ranking of CAE at the first stage. If CAE outranks IDENT-IO, the intermediate form and the surface form would be identical; if this ranking is reversed the intermediate form would instead be [ma.sitˀ.nənˀ] as shown by the tables above. Since neither of these would affect the surface form of [ma.ɕitˀ.nənˀ], either could be used to account for the data we have.

The remaining tables showing that this process can be applied to all of the words from this study can be found in the appendix.

7.4. Compound Suffixes

Three compound suffixes were considered here, as were their constituent suffixes, but were not shown in earlier sections due to their unusual behaviour. *-eoss.eu.myeon* and *-ass.eu.myeon* are the combinations of *-eu.myeon* with *-eoss.eo* and *-ass.eo* respectively, with the /i/ from *-i.e.yo* added to form *-i.eoss.eu.myeon.* Because in LP and Stratal OT affixes applied at earlier levels are found closer to the stem, we expect the behaviour of these suffixes to reflect this. However, in observing only the syllabification of the stem-final consonant, this does not appear to be the case.

The judgements of the participants indicate that *-eoss.eo* and *-ass.eo* are applied at Level 1, causing the stem-final consonant to be syllabified as an onset; since they are found closer to the stem than *-eu.myeon*, this is in line with expectations. The compound suffix *-ass.eu.myeon* was judged as behaving in this same way, with the stem-final consonant syllabified as an onset by many participants, which tells us that at least the first of the suffixes must apply at Level 1. Interestingly, the syllable-final /s'/ is not reduced to an unreleased plosive. There are 2 possible explanations for this: either *-eu.myeon* is also added at Level 1, before the first syllabification, or the constraint which requires stem-final consonants be placed in a coda is used, and does not affect morpheme-final sounds which do not belong to the stem. The latter is only possible under an OT analysis, while the former may be true regardless of which model is used.

The judgements given of the compound suffix *-eoss.eu.myeon* are somewhat contradictory to the above assumptions. Both *-eoss.eo* and *-eu.myeon* seem to behave as Level 1 affixes, as does *-ass.eo*, which we would expect would cause *-eoss.eu.myeon* to be judged in the same, or a very similar, way as *-ass.eu.myeon*. However, 24 of the 65 participants (36.9%) said the stem-final consonant should be syllabified as a coda in this case, as we would see with Level 2 suffixes. Additionally, *-i.e.yo* and *-ib.ni.da* both behave as Level 2 affixes, but this morpheme is placed directly adjacent to the stem in the compound *-i.eoss.eu.myeon*, despite being applied at the latest stage of all 3 constituent suffixes. The stem-final consonant found before *-i.eoss.eu.myeon* also behaves in a manner associated with Level 2 affixation, which suggests that *-eoss.eo* and *-eu.myeon* are not applied independently.

It seems from this evidence that the affixes in question are not simply sums of their constituent parts – if they were, *-eoss.eu.myeon* should behave in the same way as *-ass.eu.myeon* in every context, and the morphemes used in *-i.eoss.eu.myeon* would not be found in this order. It is possible that some compound affixes have been lexicalised and now behave as individual suffixes in their own right, not as a series of pre-existing suffixes. I suggested in Section 5.1 that all suffixes in Korean are treated in this way, which supports the possibility of this also being true in the case of compounds. *-eur* has also been shown to behave as a Level 1 affix when applied to both verb and noun stems, which may be further evidence that suffixes can be lexicalised in Korean.

Tables 19-26 show the processes that these suffixes would undergo assuming that they are treated in this way.

	/tat/+/as'əmjʌn/	/mantəɾ/+/ʌs'əmjʌn/
Level 1		
Apply irregular and non-neutral affixes	[tatas'əmjʌn]	-
Syllabify	[ta.ta.s'ə.mjʌn]	[man.təɾ]+[ʌ.s'ə.mjʌn]
C→Cˀ/ _$	[ta.ta.s'ə.mjʌnˀ]	[manˀ.təɾˀ]+[ʌ.s'ə.mjʌnˀ]
Level 2		
Apply remaining affixes	-	[manˀ.təɾˀ.ʌ.s'ə.mjʌnˀ]
Post-Lexical		
s→ɕ/ _i	-	-
Cˀ→C/ _V	-	[manˀ.təɾ.ʌ.s'ə.mjʌnˀ]
T→D/ {+voi}_{+voi}	[ta.da.s'ə.mjʌnˀ]	-
Syllabify	[ta.da.s'ə.mjʌnˀ]	[manˀ.tə.ɾʌ.sə.mjʌnˀ]

Table 19: LP: /tat/+/as'əmjʌn/, /mantəɾ/+/ʌs'əmjʌn/

	/muɾ/+/iʌsʾəmjʌn/
Level 1	
Apply irregular and non-neutral affixes	-
Syllabify	[muɾ]+[i.ʌ.sʾə.mjʌn]
C→Cˀ/ _$	[muɾˀ]+[i.ʌ.sʾə.mjʌnˀ]
Level 2	
Apply remaining affixes	[muɾˀ.i.ʌ.sʾə.mjʌnˀ]
Post-Lexical	
s→ɕ/ _i	-
Cˀ→C/ _V	[muɾ.i.ʌ.sʾə.mjʌnˀ]
T→D/ {+voi}_{+voi}	-
Syllabify	[mu.ɾi.ʌ.sə.mjʌnˀ]

Table 20: LP: /muɾ/+/iʌsʾəmjʌn/

/tat/+/as'əmjʌn/	*RELEASED CODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
[tat.a.s'ə.mjʌn]	*!			*	
[tatˀ.a.s'ə.mjʌn]			*!	*	
☞[ta.ta.s'ə.mjʌn]					*
[tad.a.s'ə.mjʌn]	*!	*	*	*	
[tadˀ.a.s'ə.mjʌn]		*!	*	*	
[ta.da.s'ə.mjʌn]		*!	*		*

Table 21: Stratal OT: /tat/+/as'əmjʌn/ (1st cycle)

/ta.ta.s'ə.mjʌn/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[tat.a.s'ə.mjʌn]	*!		*	*		
[tatˀ.a.s'ə.mjʌn]	*!	*		*		*
[ta.ta.s'ə.mjʌn]	*!					
[tad.a.s'ə.mjʌn]			*!	*	*	*
[tadˀ.a.s'ə.mjʌn]		*!		*	*	*
☞[ta.da.s'ə.mjʌn]					*	*

Table 22: Stratal OT: /tat/+/as'əmjʌn/ (2nd cycle)

/mantəɾ/	*RELEASEDCODA	IDENT(VOICE)	IDENT-IO	*CODA
[man.təɾ]	**!			**
[man.təɾˀ]	*!		*	**
☞[manˀ.təɾˀ]			**	**
[man.dəɾ]	**!	*	*	**
[man.dəɾˀ]	*!	*	**	**
[manˀ.dəɾˀ]		*!	***	**

Table 23: Stratal OT: /mantəɾ/+/ʌsˈəmjʌn/ (1st cycle)

/manˀ.təɾˀ/+/ʌsˈəmjʌn/	CAE	*CˀV	ALIGN	*RELEASED CODA	*CODA	IDENT(VOICE)	IDENT-IO
[manˀ.təɾˀ.ʌ.sˈə.mjʌn]	*!	*			*		
[manˀ.təɾ.ʌ.sˈə.mjʌn]	*!			*	*		*
[manˀ.dəɾˀ.ʌ.sˈə.mjʌn]		*!			*	*	*
☞[manˀ.dəɾ.ʌ.sˈə.mjʌn]				*	*	*	**
[manˀ.də.ɾʌ.sˈə.mjʌn]			*!			*	**
[manˀ.tə.ɾʌ.sˈə.mjʌn]	*!		*				*

Table 24: Stratal OT: /mantəɾ/+/ʌsˈəmjʌn/ (2nd cycle)

/muɾ/	*RELEASEDCODA	IDENT-IO	*CODA
[muɾ]	*!		*
☞[muɾˀ]		*	*

Table 25: Stratal OT: /muɾ/+/iʌsˀəmjʌn/ (1st cycle)

/muɾˀ/+/iʌsˀəmjʌn/	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT-IO
[muɾˀ.i.ʌ.sˀə.mjʌn]	*!			*	
☞[muɾ.i.ʌ.sˀə.mjʌn]			*	*	*
[mu.ɾˀi.ʌ.sˀə.mjʌn]	*!	*			
[mu.ɾi.ʌ.sˀə.mjʌn]		*!			*

Table 26: Stratal OT: /muɾ/+/iʌsˀəmjʌn/ (2nd cycle)

8. Conclusion

The findings of this study clearly demonstrate a variation in the behaviour of different suffixes which cannot be explained by Parallel OT. LP and Stratal OT are both able to produce the desired output form in all cases, but predict different intermediate forms. For example, there is no constraint ranking under which a candidate with the stem-final consonant syllabified as a coda can win after the affixation stage, since morpheme boundaries are not considered by OT once a single word has been formed, meaning no candidate violates the relevant alignment constraint. This means that for [mad.ʌb.nən] to win using Stratal OT, [matˀ.ʌb.nən] and [mat.ʌb.nən] cannot be intermediate forms. Conversely, for an output of [mad.ʌb.nən] in the LP model, [matˀ.ʌb.nən] and [mat.ʌb.nən] are highly likely to be intermediate forms.

The data collected in this study does not tell us definitively which intermediate forms are used, but patterns such as the significant tendency of participants to favour [mas.ʌpˀ.nənˀ], among others, over [ma.sʌpˀ.nənˀ] suggest that asking participants to rank several options is an effective method of eliciting judgements on both surface and intermediate forms. Overall, these findings do not allow us to make a judgement

on which model is more appropriate, but it is my view that a similar study which gives participants more options to rank would provide strong evidence.

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10. Appendix

10.1. Korean Phonemes

The following tables show the Korean characters, their romanisations using conventions of the Revised Romanization of Korean, and IPA transcriptions of their production. ’ represents tense or ejective consonants. The consonants have been transcribed for both onset and coda environments.

Other vowels are found in Korean, but are not universally treated as individual phonemes and so have been omitted from the table. Where romanised Korean is used, “.” represents the syllable breaks indicated by the written form. In IPA transcriptions, “.” refers to the syllable boundary in speech.

The survey used to collect data can be found here: https:[[forms.gle[eh7fTZQYkvrv1PrN9

Hangeul Character	Romanised Form	Onset	Coda
ㅂ	b	b	p̚
ㅍ	p	p^h	p̚
ㅃ	pp/bb	p’	p̚
ㄷ	d	d	t̚
ㅌ	t	t^h	t̚
ㄸ	tt/dd	t’	t̚
ㄱ	g	g	k̚
ㅋ	k	k^h	k̚
ㄲ	kk/gg	k’	k̚
ㅈ	j	ʄ	c̚
ㅊ	ch	c^h	c̚
ㅉ	jj	c’	c̚
ㅅ	s	s	t̚
ㅆ	ss	s’	t̚
ㅁ	m	m	m
ㄴ	n	n	n
ㅇ	ng	No sound	ŋ
ㄹ	r	ɾ	ɾ̚

Table 27: Korean consonants, their romanisations, and pronunciations in both onset and coda position

Hangeul Character	Romanised Form	Pronunciation
ㅏ	a	a
ㅓ	eo	ʌ
ㅣ	i	i
ㅔ	e	e
ㅐ	ae	ɛ
ㅡ	eu	ə
ㅗ	o	o
ㅜ	u	u

Table 28: Korean vowels, their romanisations and pronunciations

10.2. Suffixes

Stem	Stem Meaning	Suffix	Translation
Seojun	Korean name	-a	Seojun (affectionate)
Pen	Pen	-i.rang	A pen and…
Nor	Play	-eum	Playing (noun)
Chaj	Find	-eu.myeon	If one finds
Jag	Small	-a.ji.da	Becomes small
Ij	Forget	-eu.se.yo	Please forget
Anj	Sit	-ass.eo	Sat
Ar	Know	-a.seo	Because one knows
Chaeg	Book	-ib.ni.da	It is a book
Gir	Long	-eo.ji.da	Becomes long
Bad	Receive	-eu.ra.go	I was told to receive
Sar	Live	-a.do	Despite living
Meog	Eat	-eul	Eating (noun)
Hangug	Korea	-in	Korean (person)
Dongmul	Animal	-i.e.yo	It is an animal
Son	Hand	-eu.ro	With one's hand
Geos	Thing	-eul	Thing (direct object)
Mas	Taste	-eobs.neun	Tasteless
Mit	Middle	-e	In the middle
Mandeur	Make	-eoss.eu.myeon	If one made
Mur	Water	-i.eoss.eu.myeon	If it were water
Ilk	Read	-eub.si.da	Let's read
Saram	Person	-i.ra.go	Person (reported speech)
Dad	Close	-ass.eu.myeon	If it closed
Geod	Walk	-eoss.eo	Walked
Mas	Taste	-iss.neun	Tasty
Ireum	Name	-eun	Name (subject)
Seonsaengnim	Teacher	-e.ge	To the teacher
Ddeud	Open	-eo.seo	Because one opens
Meog	Eat	-eo.do	Despite eating

Table 29: Stimuli used in the survey, separated into stem and suffix and defined

10.3. Parallel OT Tables

/anc/+/as'ʌ/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[anɟ.a.s'ʌ]		*!		*
☞[an.ɟa.s'ʌ]			*	*
[anɟˀ.a.s'ʌ]		*!		*
[anc.a.s'ʌ]	*!	*		
[an.ca.s'ʌ]	*!		*	
[ancˀ.a.s'ʌ]	*!	*		*

Table 30: Parallel OT: /anc/+/as'ʌ/

/pat/+/ɘrako/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[pad.ɘ.ɾa.go]		*!		*
☞[pa.dɘ.ɾa.go]			*	*
[padˀ.ɘ.ɾa.go]		*!		*
[pat.ɘ.ɾa.ko]	**!	*		
[pa.tɘ.ɾa.ko]	**!		*	
[patˀ.ɘ.ɾa.go]	*!	*		*

Table 31: Parallel OT: /pat/+/ɘrako/

/noɾ/+/əm/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[noɾ.əm]		*!		*
☞[no.ɾəm]			*	*
[noɾˀ.əm]		*!		*
[noɾ̥.əm]	*!	*		
[no.ɾ̥əm]	*!		*	
[noɾ̥ˀ.əm]	*!	*		*

Table 32: Parallel OT: /noɾ/+/əm/

/cʰac/+/əmjʌn/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[cʰaɟ.ə.mjʌn]		*!		*
☞[cʰa.ɟə.mjʌn]			*	*
[cʰaɟˀ.ə.mjʌn]		*!		*
[cʰac.ə.mjʌn]	*!	*		
[cʰac.ə.mjʌn]	*!		*	
[cʰacˀ.ə.mjʌn]	*!	*		*

Table 33: Parallel OT: /cʰac/+/əmjʌn/

/mʌk/+/ər/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[mʌg.əɾˀ]		*!		*
☞[mʌ.gəɾˀ]			*	*
[mʌgˀ.əɾˀ]		*!		*
[mʌk.əɾˀ]	*!	*		
[mʌ.kəɾˀ]	*!		*	
[mʌkˀ.əɾˀ]	*!	*		*

Table 34: Parallel OT: /mʌk/+/ər/

/kʌt/+/ʌs'ʌ/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[kʌd.ʌ.s'ʌ]		*!		*
☞[kʌ.dʌ.s'ʌ]			*	*
[kʌdˀ.ʌ.s'ʌ]		*!		*
[kʌt.ʌ.s'ʌ]	*!	*		
[kʌ.tʌ.s'ʌ]	*!		*	
[kʌtˀ.ʌ.s'ʌ]	*!	*		*

Table 35: Parallel OT: /kʌt/+/ʌs'ʌ/

/t'ət/+/ʌsʌ/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[t'əd.ʌ.sʌ]		*!		*
☞[t'ə.dʌ.sʌ]			*	*
[t'ədˀ.ʌ.sʌ]		*!		*
[t'ət.ʌ.sʌ]	*!	*		
[t'ə.tʌ.sʌ]	*!		*	
[t'ətˀ.ʌ.sʌ]	*!	*		*

Table 36: Parallel OT: /tət/+/ʌsʌ/

/mʌk/+/ʌto/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[mʌg.ʌ.do]		*!		*
☞[mʌ.gʌ.do]			*	*
[mʌgˀ.ʌ.do]		*!		*
[mʌk.ʌ.do]	*!	*		
[mʌ.kʌ.to]	**!		*	
[mʌkˀ.ʌ.do]	*!	*		*

Table 37: Parallel OT: /mʌk/+/ʌto/

/kʌs/+/əɾ/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[gʌs.əɾˀ]		*!		
☞[gʌ.səɾˀ]			*	
[gʌtˀ.əɾˀ]	*!	*		*
[gʌ.zəɾˀ]			*	*!
[gʌz.əɾˀ]		*!		*
[gʌdˀ.əɾˀ]		*!		*

Table 38: Parallel OT: /kʌs/+/əɾ/

/mit^{h}/+/e/	CAE	*CODA	ALIGN(STEM, R, SYLLABLE, R)	IDENT-IO
[mit^{h}.e]		*!		
☞[mi.t^{h}e]			*	
[mitˀ.e]	*!	*		*
[mi.de]			*	*
[mid.e]		*!		*
[midˀ.e]		*!		*
[mi.te]	*!		*	*
[mit.e]	*!			*

Table 39: Parallel OT: /mit^{h}/+/e/

10.4. Lexical Phonology Tables

	/anc/+/as’ʌ/	/pʰen/+/iɾaŋ/	/noɾ/+/əm/	/cʰac/+/əmjʌn/	/cak/+/acita/	/aɾ/+/asʌ/	/cʰɛk/+/ipnita/	/kiɾ/+/ʌcita/
Level 1								
Apply irregular and non-neutral affixes	[ancas’ʌ]	-	[noɾəm]	[cʰacəmjʌn]	[cakacita]	-	-	-
Syllabify	[an.ca.s’ʌ]	[pʰen]+[i.raŋ]	[no.ɾəm]	[cʰa.cə.mjʌn]	[ca.ka.ci.ta]	[aɾ]+[a.sʌ]	[cʰɛk]+[ip.ni.ta]	[kiɾ]+[ʌ.ci.ta]
C→Cˀ/ _$	-	[pʰenˀ]+[i.raŋˀ]	[no.ɾəmˀ]	[cʰa.cə.mjʌnˀ]	-	[aɾˀ]+[a.sʌ]	[cʰɛkˀ]+[ipˀ.ni.ta]	[kiɾˀ]+[ʌ.ci.ta]
Level 2								
Apply remaining affixes	-	[pʰenˀ.i.raŋˀ]	-	-	-	[aɾˀ.a.sʌ]	[cʰɛkˀ.ipˀ.ni.ta]	[kiɾˀ.ʌ.ci.ta]
Post-Lexical								
s→ɕ/ _i	-	-	-	-	-	-	-	-
Cˀ→C/ _V	-	[pʰen.i.raŋˀ]	-	-	-	[aɾ.a.sʌ]	[cʰɛk.ipˀ.ni.ta]	[kiɾ.ʌ.ci.ta]
T→D/ {+voi}_{+voi}	-	-	-	[cʰa.ɟə.mjʌnˀ]	[ca.ga.ɟi.da]	-	[cʰɛg.ibˀ.ni.da]	[kiɾ.ʌ.ɟi.da]
Syllabify	[an.ca.s’ʌ]	[pʰe.ni.raŋˀ]	[no.ɾəmˀ]	[cʰa.ɟə.mjʌnˀ]	[ca.ga.ɟi.da]	[a.ɾa.sʌ]	[cʰɛ.gibˀ.ni.da]	[ki.ɾʌ.ɟi.da]

Table 40: LP: /anc/+/as’ʌ/, /pʰen/+/iɾaŋ/, /noɾ/+/əm/, /cʰac/+/əmjʌn/, /cak/+/acita/, /aɾ/+/asʌ/, /cʰɛk/+/ipnita/, /kiɾ/+/ʌcita/

	/pat/+/ərako/	/saɾ/+/ato/	/mʌk/+/əɾ/	/hankuk/+/in/	/toŋmuɾ/+/iejo/	/son/+/əro/	/kʌs/+/əɾ/	/mit^{h}/+/e/
Level 1								
Apply irregular and non-neutral affixes	[patərako]	-	[mʌkəɾ]	-	-	-	[kʌsəɾ]	[mit^{h}e]
Syllabify	[pa.tə.ɾa.ko]	[saɾ]+[a.do]	[mʌ.kəɾ]	[han.kuk]+[in]	[toŋ.muɾ]+[i.e.jo]	[son]+[ə.ɾo]	[kʌ.səɾ]	[mi.t^{h}e]
C→Cˀ/ _$	-	[saɾˀ]+[a.do]	[mʌ.kəɾˀ]	[han.kukˀ]+[inˀ]	[toŋˀ.muɾˀ]+[i.e.jo]	[sonˀ]+[ə.ɾo]	[kʌ.səɾˀ]	-
Level 2								
Apply remaining affixes	-	[saɾˀ.a.do]	-	[han.kukˀ.inˀ]	[toŋˀ.muɾˀ.i.e.jo]	[sonˀ.ə.ɾo]	-	-
Post-Lexical								
s→ɕ/ _i	-	-	-	-	-	-	-	-
Cˀ→C/ _V	-	[saɾ.a.to]	-	[han.kuk.inˀ]	[toŋˀ.muɾ.i.e.jo]	[son.ə.ɾo]	-	-
T→D/ {+voi}_{+voi}	[pa.də.ɾa.go]	[sa.ɾa.do]	[mʌ.gəɾˀ]	[han.gug.inˀ]	-	-	-	-
Syllabify	[pa.də.ɾa.go]	[sa.ɾa.do]	[mʌ.gəɾˀ]	[hanˀ.gu.ginˀ]	[toŋ.mu.ɾi.e.jo]	[so.nə.ɾo]	[kʌ.səɾˀ]	[mi.t^{h}e]

Table 41: LP: /pat/+/ərako/, /saɾ/+/ato/, /mʌk/+/əɾ/, /hankuk/+/in/, /toŋmuɾ/+/iejo/, /son/+/əro/, /kʌs/+/əɾ/, /mit^{h}/+/e/

	/iɾk/+/əpsita/	/saɾam/+/iɾako/	/kʌt/+/ʌs'ʌ/	/iɾəm/+/ən/	/sʌnsɛŋnim/+/eke/	/t'ət/+/ʌsʌ/	/mʌk/+/ʌto/
Level 1							
Apply irregular and non-neutral affixes	[iɾkəpsita]	-	[kʌtʌs'ʌ]	-	-	[t'ətʌsʌ]	[mʌkʌto]
Syllabify	[iɾ.kəp.si.ta]	[sa.ɾam]+[i.ɾa.ko]	[kʌ.tʌ.s'ʌ]	[i.ɾəm]+[ən]	[sʌn.sɛŋ.nim]+[e.ke]	[t'ə.tʌ.sʌ]	[mʌ.kʌ.to]
C→C'/ _$	[iɾ'.kəp'.si.ta]	[sa.ɾam']+[i.ɾa.ko]	-	[i.ɾəm']+[ən']	[sʌn'.sɛŋ'.nim']+[e.ke]	-	-
Level 2							
Apply remaining affixes	-	[sa.ɾam'.i.ɾa.ko]	-	[i.ɾəm'.ən']	[sʌn'.sɛŋ'.nim'.e.ke]	-	-
Post-Lexical							
s→ɕ/ _i	[iɾ'.kəp'.ɕi.ta]	-	-	-	-	-	-
C'→C/ _V	-	[sa.ɾam.i.ɾa.ko]	-	[i.ɾəm.ən']	[sʌn'.sɛŋ'.nim.e.ke]	-	-
T→D/ {+voi}_{+voi}	[iɾ'.gəp'.ɕi.da]	[sa.ɾa.mi.ɾa.go]	[kʌ.dʌ.s'ʌ]	-	[sʌn'.sɛŋ'.nim.e.ge]	[t'ə.dʌ.sʌ]	[mʌ.gʌ.do]
Syllabify	[iɾ'.gəb'.ɕi.da]	[sa.ɾa.mi.ɾa.go]	[kʌ.dʌ.s'ʌ]	[i.ɾə.mən']	[sʌn'.sɛŋ'.ni.me.ge]	[t'ə.dʌ.sʌ]	[mʌ.gʌ.do]

Table 42: LP: /iɾk/+/əpsita/, /saɾam/+/iɾako/, /kʌt/+/ʌs'ʌ/, /iɾəm/+/ən/, /sʌnsɛŋnim/+/eke/, /t'ət/+ʌsʌ/, /mʌk/+/ʌto/

10.5. Stratal OT Tables

/pʰen/	*RELEASED CODA	IDENT(VOICE)	IDENT(MANNER)	IDENT-IO	*CODA
[pʰen]	*!				*
☞[pʰenˀ]				*	*
[pʰetˀ]		*!	*	*	*

Table 43: Stratal OT: /pʰen/+/ɪraŋ/ (1st cycle)

/pʰenˀ/+/ɪraŋ/	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT-IO
[pʰenˀ.i.ɾaŋ]	*!			*	
☞[pʰen.i.ɾaŋ]			*	*	*
[pʰe.nˀi.ɾaŋ]	*!	*			
[pʰe.ni.ɾaŋ]		*!			*

Table 44: Stratal OT: /pʰen/+/ɪraŋ/ (2nd cycle)

/cʰac/+/əmjʌn/	*RELEASED CODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
[cʰa.cə.mjʌn]	*!			*	*
[cʰac.ə.mjʌn]	**!			**	
[cʰacˀ.ə.mjʌn]	*!			**	
☞[cʰa.cə.mjʌnˀ]			*	*	*
[cʰac.ə.mjʌnˀ]	*!			**	
[cʰacˀ.ə.mjʌnˀ]			**!	**	
[cʰa.ɟə.mjʌnˀ]		*!	**	*	*
[cʰaɟ.ə.mjʌnˀ]	*!	*	**	**	
[cʰaɟˀ.ə.mjʌnˀ]		*!	**	**	

Table 45: Stratal OT: /cʰac/+/əmjʌn/ (1st cycle)

/cʰa.cə.mjʌnˀ/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[cʰa.cə.mjʌn]	*!					*
[cʰac.ə.mjʌn]	*!		*	*		*
[cʰacˀ.ə.mjʌn]	*!	*		*		**
[cʰa.cə.mjʌnˀ]	*!					
[cʰac.ə.mjʌnˀ]	*!		*	*		
[cʰacˀ.ə.mjʌnˀ]	*!	*		*		*
☞[cʰa.ɟə.mjʌnˀ]					*	*
[cʰaɟ.ə.mjʌnˀ]			*!	*	*	*
[cʰaɟˀ.ə.mjʌnˀ]		*!		*	*	*

Table 46: Stratal OT: /cʰac/+/əmjʌn/ (2nd cycle)

/cak/+/acita/	*RELEASED CODA	IDENT(VOICE)	IDENT -IO	*CODA	ALIGN
☞[ca.ka.ci.ta]					*
[cak.a.ci.ta]	*!			*	
[cakˀ.a.ci.ta]			*!	*	
[ca.kˀa.ci.ta]			*!		*
[ca.ga.ci.ta]		*!	*		*
[cag.a.ci.ta]	*!		*	*	
[cagˀ.a.ci.ta]		*!	*	*	
[ca.gˀa.ci.ta]		*!	*		*
[ca.ga.ɟi.da]		***!	***		*
[cag.a.ɟi.da]	*!	***	***	*	
[cagˀ.a.ɟi.da]		***!	***	*	
[ca.gˀa.ɟi.da]		***!	***		*

Table 47: Stratal OT: /cak/+/acita/ (1st cycle)

/ca.ka.ci.ta/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT -IO
[ca.ka.ci.ta]	***!					
[cak.a.ci.ta]	***!		*	*		
[cakˀ.a.ci.ta]	***!	*		*		*
[ca.kˀa.ci.ta]	***!	*				*
[ca.ga.ci.ta]	**!				*	*
[cag.a.ci.ta]	**!		*	*	*	*
[cagˀ.a.ci.ta]	**!	*		*	*	*
[ca.gˀa.ci.ta]	**!	*			*	*
☞[ca.ga.ɟi.da]					***	***
[cag.a.ɟi.da]			*!	*	***	***
[cagˀ.a.ɟi.da]		*!		*	***	***
[ca.gˀa.ɟi.da]		*!			***	***

Table 48: Stratal OT: /cak/+/acita/ (2nd cycle)

/ic/+/əsejo/	*RELEASED CODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
[ic.ə.se.jo]	*!			*	
☞[i.cə.se.jo]					*
[icˀ.ə.se.jo]			*!	*	
[iɟ.ə.se.jo]	*!	*	*	*	
[i.ɟə.se.jo]		*!	*		*
[iɟˀ.ə.se.jo]		*!	*	*	
[i.ɟˀə.se.jo]		*!	*		*
[i.cˀə.se.jo]			*!		*

Table 49: Stratal OT: /ic/+/əsejo/ (1st cycle)

/i.cə.se.jo/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[ic.ə.se.jo]	*!		*	*		
[i.cə.se.jo]	*!					
[icˀ.ə.se.jo]	*!	*		*		*
[iɟ.ə.se.jo]			*!	*	*	*
☞[i.ɟə.se.jo]					*	*
[iɟˀ.ə.se.jo]		*!		*	*	*
[i.ɟˀə.se.jo]		*!			*	*
[i.cˀə.se.jo]	*!	*				*

Table 50: Stratal OT: /ic/+/əsejo/ (2nd cycle)

/anc/+/as'ʌ/	MAX -IO	DEP-IO	*RELEASED CODA	IDENT(VOICE)	IDENT -IO	*CODA	ALIGN
[anc.a.s'ʌ]			*!			**	
[an.ca.s'ʌ]			*!			*	*
[anc˺.a.s'ʌ]					*	**!	
[an.a.s'ʌ]	*!		*			*	
[anɟ.a.s'ʌ]			*!	*	*	**	
[an.ɟa.s'ʌ]			*!	*	*	*	*
[anɟ˺.a.s'ʌ]				*!	*	**	
[a.na.ca.s'ʌ]		*!					*
[a.na.s'ʌ]	*!						
☞[an˺.ca.s'ʌ]					*	*	*
[an˺.ɟa.s'ʌ]				*!	**	*	*

Table 51: Stratal OT: /anc/+/as'ʌ/ (1st cycle)

/an˺.ca.s'ʌ/	CAE	*C˺V	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT -IO
[anc.a.s'ʌ]	*!		*	**		*
[an.ca.s'ʌ]	*!		*	*		*
[anc˺.a.s'ʌ]	*!	*		**		**
[anɟ.a.s'ʌ]			*!	**	*	**
[an.ɟa.s'ʌ]			*!	*	*	**
[anɟ˺.a.s'ʌ]		*!		**	*	**
[an˺.ca.s'ʌ]	*!			*		
☞[an˺.ɟa.s'ʌ]				*	*	*

Table 52: Stratal OT: /anc/+/as'ʌ/ (2nd cycle)

/aɾ/	*RELEASED CODA	IDENT(VOICE)	IDENT(MANNER)	IDENT-IO	*CODA
[aɾ]	*!				*
☞[aɾˀ]				*	*
[at]	*!	*	*	*	*
[ad]	*!		*	*	*
[adˀ]			*!	*	*
[atˀ]		*!	*	*	*

Table 53: Stratal OT: /ar/+/asʌ/ (1st cycle)

/aɾˀ/+/asʌ/	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT-IO
[aɾˀ.a.sʌ]	*!			*	
☞[aɾ.a.sʌ]			*	*	*
[a.ɾˀa.sʌ]	*!	*			
[a.ɾa.sʌ]		*!			*

Table 54: Stratal OT: /ar/+/asʌ/ (2nd cycle)

/cʰɛk/	*RELEASED CODA	IDENT(VOICE)	IDENT(MANNER)	IDENT-IO	*CODA
[cʰɛk]	*!				*
[cʰɛg]	*!	*		*	*
☞[cʰɛkˀ]				*	*
[cʰɛgˀ]		*!		*	*
[cʰɛŋˀ]		*!	*	*	*

Table 55: Stratal OT: /cʰɛk/+/ipnita/ (1st cycle)

/cʰɛkˀ/+/ipnita/	CAE	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[cʰɛk.ip.ni.ta]	**!			*	*		*
[cʰɛ.kip.ni.ta]	**!		*				*
[cʰɛgˀ.ip.ni.ta]	*!	*			*	*	*
[cʰɛ.gˀip.ni.ta]	*!	*	*			*	*
[cʰɛ.gip.ni.ta]	*!		*			*	*
[cʰɛgˀ.ipˀ.ni.ta]	*!	*			*	*	**
[cʰɛg.ipˀ.ni.ta]	*!			*	*	*	**
[cʰɛ.gˀipˀ.ni.ta]	*!	*	*			*	**
[cʰɛ.gipˀ.ni.ta]	*!		*			*	**
[cʰɛkˀ.ipˀ.ni.da]	*!	*			*	*	**
[cʰɛk.ipˀ.ni.da]	*!			*	*	*	***
[cʰɛ.kˀipˀ.ni.da]	*!	*	*			*	**
[cʰɛ.kipˀ.ni.da]	*!		*			*	***
[cʰɛgˀ.ipˀ.ni.da]		*!			*	**	***
☞[cʰɛg.ipˀ.ni.da]				*	*	**	***
[cʰɛ.gˀipˀ.ni.da]		*!	*			**	***
[cʰɛ.gipˀ.ni.da]			*!			**	***

Table 56: Stratal OT: /cʰɛk/+/ipnita/ (2nd cycle)

/kiɾ/	*RELEASED CODA	IDENT -IO	*CODA
[kiɾ]	*!		*
☞[kiɾˀ]		*	*

Table 57: Stratal OT: /kiɾ/+/ʌcita/ (1st cycle)

/kiɾˀ/+/ʌcita/	CAE	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT -IO
[kiɾˀ.ʌ.ci.ta]	**!	*			*		
[kiɾˀ.ʌ.ɟi.da]		*!			*	**	**
☞[kiɾ.ʌ.ɟi.da]				*	*	**	***
[ki.ɾˀʌ.ɟi.da]		*!	*			**	**
[ki.ɾʌ.ɟi.da]			*!			**	***

Table 58: Stratal OT: /kiɾ/+/ʌcita/ (2nd cycle)

/pat/+/ərako/	*RELEASED CODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
[pat.ə.ɾa.ko]	*!			*	
☞[pa.tə.ɾa.ko]					*
[patˀ.ə.ɾa.ko]			*!	*	
[pa.tˀə.ɾa.ko]			*!		*
[pad.ə.ɾa.ko]	*!	*	*	*	
[pa.də.ɾa.ko]		*!	*		*
[padˀ.ə.ɾa.ko]		*!	*	*	
[pa.dˀə.ɾa.ko]		*!	*		*
[pad.ə.ɾa.go]	*!	**	**	*	
[pa.də.ɾa.go]		**!	**		*
[padˀ.ə.ɾa.go]		**!	**	*	
[pa.dˀə.ɾa.go]		**!	**		*

Table 59: Stratal OT: /pat/+/ərako/ (1st cycle)

/pa.tə.ɾa.ko/	CAE	*C'V	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[pat.ə.ɾa.ko]	**!		*	*		
[pa.tə.ɾa.ko]	**!					
[patˀ.ə.ɾa.ko]	**!	*		*		*
[pa.tˀə.ɾa.ko]	**!	*				*
[pad.ə.ɾa.ko]	*!		*	*	*	*
[pa.də.ɾa.ko]	*!				*	*
[padˀ.ə.ɾa.ko]	*!	*		*	*	*
[pa.dˀə.ɾa.ko]	*!	*			*	*
[pad.ə.ɾa.go]			*!	*	**	**
☞[pa.də.ɾa.go]					**	**
[padˀ.ə.ɾa.go]		*!		*	**	**
[pa.dˀə.ɾa.go]		*!			**	**

Table 60: Stratal OT: /pat/+/ərako/ (2nd cycle)

/saɾ/	*RELEASEDCODA	IDENT(VOICE)	IDENT(MANNER)	IDENT-IO	*CODA
[saɾ]	*!				*
☞[saɾˀ]				*	*
[sadˀ]			*!	*	*
[satˀ]		*!	*	*	*

Table 61: Stratal OT: /saɾ/+/ato/ (1st cycle)

/saɾˀ/+/ato/	CAE	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[saɾˀ.a.to]	*!	*			*		
[sa.ɾˀa.to]	*!	*	*				
[sa.ɾa.to]	*!		*				*
[saɾ.a.to]	*!			*	*		*
[saɾˀ.a.do]		*!			*	*	*
[sa.ɾˀa.do]		*!	*			*	*
☞[saɾ.a.do]				*	*	*	**
[sa.ɾa.do]			*!			*	**

Table 62: Stratal OT: /saɾ/+/ato/ (2nd cycle)

/mʌk/+/əɾ/	*RELEASEDCODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
[mʌ.kəɾ]	*!			*	*
[mʌk.əɾ]	**!			**	
☞[mʌ.kəɾˀ]			*	*	*
[mʌk.əɾˀ]	*!		*	**	
[mʌ.gəɾ]	*!	*	*	*	*
[mʌg.əɾ]	**!	*	*	**	
[mʌ.gəɾˀ]		*!	**	*	*
[mʌg.əɾˀ]	*!	*	**	**	
[mʌ.kˀəɾ]	*!		*	*	*
[mʌkˀ.əɾ]	*!		*	**	
[mʌkˀ.əɾˀ]			**!	**	
[mʌgˀ.əɾˀ]		*!	**	**	

Table 63: Stratal OT: /mʌk/+/əɾ/ (1st cycle)

/mʌ.kəɾˀ/	CAE	*C'V	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[mʌ.kəɾ]	*!		*	*		*
[mʌk.əɾ]	*!		**	**		*
[mʌ.kəɾˀ]	*!			*		
[mʌk.əɾˀ]	*!		*	**		
[mʌ.gəɾ]			*!	*	*	**
[mʌg.əɾ]			**!	**	*	**
☞[mʌ.gəɾˀ]				*	*	*
[mʌg.əɾˀ]			*!	**	*	*
[mʌkˀ.əɾ]	*!	*	*	**		**
[mʌ.kˀəɾˀ]	*!	*		*		*
[mʌkˀ.əɾˀ]	*!	*		**		*
[mʌgˀ.əɾˀ]		*!		**	*	*

Table 64: Stratal OT: /mʌk/+/əɾ/ (2nd cycle)

/hankuk/	*RELEASEDCODA	IDENT-IO	*CODA
[han.kuk]	**!		**
[han.kuk˺]	*!	*	**
[han˺.kuk]	*!	*	**
☞[han˺.kuk˺]		**	**

Table 65: Stratal OT: /hankuk/+/in/ (1st cycle)

/han˺.kuk˺/+/in/	CAE	*C˺V	ALIGN	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[han˺.kuk˺.in]	**!	*			*		
[han˺.kuk.in]	**!			*	*		*
[han˺.gu.k˺in]	*!	*	*				
[han˺.gu.kin]	*!		*				*
[han˺.gug˺.in]		*!			*	*	*
☞[han˺.gug.in]				*	*	*	*
[han˺.gu.g˺in]		*!	*			*	*
[han˺.gu.gin]			*!			*	*

Table 66: Stratal OT: /hankuk/+/in/ (2nd cycle)

/toŋmuɾ/	*RELEASEDCODA	IDENT(VOICE)	IDENT-IO	*CODA
[toŋ.muɾ]	**!			**
[toŋˀ.muɾ]	*!		*	**
☞[toŋˀ.muɾˀ]			**	**
[doŋˀ.muɾˀ]		*!	***	**

Table 67: Stratal OT: /toŋmuɾ/+/iejo/ (1st cycle)

/toŋˀ.muɾˀ/+/iejo/	*CˀV	ALIGN	*RELEASED CODA	*CODA	IDENT-IO
[toŋˀ.muɾˀ.i.e.jo]	*!			*	
[toŋˀ.mu.ɾˀi.e.jo]	*!	*			
☞[toŋˀ.muɾ.i.e.jo]			*	*	*
[toŋˀ.mu.ɾi.e.jo]		*!			*

Table 68: Stratal OT: /toŋmuɾ/+/iejo/ (2nd cycle)

/son/	*RELEASEDCODA	IDENT(MANNER)	IDENT-IO	*CODA
[son]	*!			*
☞[sonˀ]			*	*
[sodˀ]		*!	*	*

Table 69: Stratal OT: /son/+/ɘɾo/ (1st cycle)

/sonˀ/+/ɘɾo/	*CˀV	ALIGN	*RELEASED CODA	*CODA	IDENT-IO
[sonˀ.ə.ɾo]	*!			*	
☞[son.ə.ɾo]			*	*	*
[so.nə.ɾo]		*!			*
[so.nˀə.ɾo]	*!	*			

Table 70: Stratal OT: /son/+/ɘɾo/ (2nd cycle)

/kʌs/+/ər/	*RELEASEDCODA	IDENT(MANNER)	IDENT-IO	*CODA	ALIGN
[kʌs.ər]	**!			**	
[kʌtˀ.ərˀ]		*!	**	**	
[kʌs.ərˀ]	*!		*	**	
[kʌ.tərˀ]		*!	**	*	*
☞[kʌ.sərˀ]			*	*	*

Table 71: Stratal OT: /kʌs/+/ər/ (1st cycle)

/kʌ.sərˀ/	*CˀV	IDENT(MANNER)	*RELEASED CODA	*CODA	IDENT-IO
[kʌs.ər]			**!	**	*
[kʌtˀ.ərˀ]	*!	*		**	*
[kʌs.ərˀ]			*!	**	
[kʌ.sər]			*!	*	*
☞[kʌ.sərˀ]				*	

Table 72: Stratal OT: /kʌs/+/ər/ (2nd cycle)

/mit^{h}/+/e/	*RELEASEDCODA	IDENT-IO	*CODA	ALIGN
[mit^{h}.e]	*!		*	
[mitˀ.e]		*!	*	
☞[mi.t^{h}e]				*
[mi.te]		*!		*

Table 73: Stratal OT: /mit^{h}/+/e/ (1st cycle)

/mi.t^{h}e/	*CˀV	*RELEASED CODA	*CODA	IDENT-IO
[mit^{h}.e]		*!	*	
[mitˀ.e]	*!		*	*
☞[mi.t^{h}e]				
[mi.te]				*!

Table 74: Stratal OT: /mit^{h}/+/e/ (2nd cycle)

/iɾk/+/əpsita/	*RELEASEDCODA	IDENT-IO	*CODA	ALIGN
[iɾ.kəp.si.ta]	**!		**	*
☞[iɾˀ.kəpˀ.si.ta]		**	**	*
[iɾkˀ.əpˀ.si.ta]		**	***!	
[iɾk.əpˀ.si.ta]	*!	*	***	

Table 75: Stratal OT: /iɾk/+/əpsita/ (1st cycle)

/iɾˀ.kəpˀ.si.ta/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[iɾ.kəp.si.ta]	*!		**	**		*
[iɾˀ.kəpˀ.si.ta]	*!			**		
[iɾkˀ.əpˀ.ɕi.ta]		*!		***		***
[iɾk.əpˀ.ɕi.ta]			*!	***		**
[iɾ.kəp.ɕi.da]			**!	**	*	***
☞[iɾˀ.gəpˀ.ɕi.da]				**	*	**
[iɾkˀ.əpˀ.ɕi.da]	*!			***	*	****
[iɾk.əpˀ.ɕi.da]			*!	***	*	***

Table 76: Stratal OT: /iɾk/+/əpsita/ (2nd cycle)

/saɾam/	*RELEASEDCODA	IDENT-IO	*CODA
[sa.ɾam]	*!		*
[saɾ.am]	**!		**
☞[sa.ɾamˀ]		*	*
[saɾˀ.amˀ]		**!	**
[saɾˀ.am]	*!	*	**

Table 77: Stratal OT: /saɾam/+/iɾako/ (1st cycle)

/sa.ɾamˀ/+/iɾako/	CAE	*CˀV	ALIGN	*RELEASED CODA	*CODA	IDENT(VOICE)	IDENT-IO
[sa.ɾa.mi.ɾa.ko]	*!		*				*
[sa.ɾam.i.ɾa.ko]	*!			*	*		*
[sa.ɾa.mi.ɾa.go]			*!			*	**
☞[sa.ɾam.i.ɾa.go]				*	*	*	**
[sa.ɾamˀ.i.ɾa.ko]	*!	*			*		
[sa.ɾamˀ.i.ɾa.go]		*!			*	*	*

Table 78: Stratal OT: /saɾam/+/iɾako/ (2nd cycle)

/kʌt/+/ʌs’ʌ/	*RELEASEDCODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
☞[kʌ.tʌ.s’ʌ]					*
[kʌt.ʌ.s’ʌ]	*!			*	
[kʌtˀ.ʌ.s’ʌ]			*!	*	
[kʌ.dʌ.s’ʌ]		*!	*	*	*
[kʌd.ʌ.s’ʌ]	*!	*	*	*	
[kʌdˀ.ʌ.s’ʌ]		*!	*	*	

Table 79: Stratal OT: /kʌt/+/ʌs’ʌ/ (1st cycle)

/kʌ.tʌ.s’ʌ/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[kʌ.tʌ.s’ʌ]	*!					
[kʌt.ʌ.s’ʌ]	*!		*	*		
[kʌtˀ.ʌ.s’ʌ]	*!	*		*		*
☞[kʌ.dʌ.s’ʌ]					*	*
[kʌd.ʌ.s’ʌ]			*!	*	*	*
[kʌdˀ.ʌ.s’ʌ]		*!		*	*	*

Table 80: Stratal OT: /kʌt/+/ʌs’ʌ/ (2nd cycle)

/iɾəm/	*RELEASEDCODA	IDENT-IO	*CODA
[iˌɾəm]	*!		*
☞[iˌɾəmˀ]		*	*
[iɾˌəmˀ]	*!	*	**
[iɾˀˌəmˀ]		**!	**

Table 81: Stratal OT: /iɾəm/+/ən/ (1st cycle)

/iˌɾəmˀ/+/ən/	*CˀV	ALIGN	*RELEASEDCODA	*CODA	IDENT-IO
[iˌɾəmˀˌən]	*!			*	
[iˌɾəmˀˌənˀ]	*!			*	*
☞[iˌɾəmˌənˀ]			*	*	**
[iˌɾəˌmˀənˀ]	*!	*			*
[iˌɾəˌmənˀ]		*!			**
[iˌɾəˌmən]		*!			*

Table 82: Stratal OT: /iɾəm/+/ən/ (2nd cycle)

/sʌnsɛŋnim/	*RELEASED CODA	IDENT-IO	*CODA
[sʌn.sɛŋ.nim]	***!		***
☞[sʌnˀ.sɛŋˀ.nimˀ]		***	***
[sʌn.sɛŋ.nimˀ]	**!	*	***

Table 83: Stratal OT: /sʌnsɛŋnim/+/eke/ (1st cycle)

/sʌnˀ.sɛŋˀ.nimˀ/+/eke/	CAE	*CˀV	ALIGN	*RELEASED CODA	*CODA	IDENT(VOICE)	IDENT-IO
[sʌnˀ.sɛŋˀ.nimˀ.e.ke]	*!	*			*		
[sʌnˀ.sɛŋˀ.nim.e.ke]	*!			*	*		*
[sʌnˀ.sɛŋˀ.ni.me.ke]	*!		*				*
[sʌnˀ.sɛŋˀ.nimˀ.e.ge]		*!			*	*	*
☞[sʌnˀ.sɛŋˀ.nim.e.ge]				*	*	*	**
[sʌnˀ.sɛŋˀ.ni.me.ge]			*!			*	**

Table 84: Stratal OT: /sʌnsɛŋnim/+/eke/ (2nd cycle)

/t’ət/+/ʌsʌ/	*RELEASEDCODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
[t’ət.ʌ.sʌ]	*!			*	
[t’ətˀ.ʌ.sʌ]			*!	*	
☞[t’ə.tʌ.sʌ]					*
[t’əd.ʌ.sʌ]	*!	*	*	*	
[t’ədˀ.ʌ.sʌ]		*!	*	*	
[t’ə.dʌ.sʌ]		*!	*		*

Table 85: Stratal OT: /t’ət/+/ʌsʌ/ (1st cycle)

/t’ə.tʌ.sʌ/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[t’ət.ʌ.sʌ]	*!		*	*		
[t’ətˀ.ʌ.sʌ]	*!	*		*		*
[t’ə.tʌ.sʌ]	*!					
[t’əd.ʌ.sʌ]			*!	*	*	*
[t’ədˀ.ʌ.sʌ]		*!		*	*	*
☞[t’ə.dʌ.sʌ]					*	*

Table 86: Stratal OT: /t’ət/+/ʌsʌ/ (2nd cycle)

/mʌk/+/ʌto/	*RELEASEDCODA	IDENT(VOICE)	IDENT-IO	*CODA	ALIGN
[mʌk.ʌ.to]	*!			*	
[mʌkˀ.ʌ.to]			*!	*	
☞[mʌ.kʌ.to]					*
[mʌg.ʌ.do]	*!	**	**	*	
[mʌgˀ.ʌ.do]		**!	**	*	
[mʌ.gʌ.do]		**!	**		*

Table 87: Stratal OT: /mʌk/+/ʌto/ (1st cycle)

/mʌ.kʌ.to/	CAE	*CˀV	*RELEASEDCODA	*CODA	IDENT(VOICE)	IDENT-IO
[mʌk.ʌ.to]	**!		*	*		
[mʌkˀ.ʌ.to]	**!	*		*		*
[mʌ.kʌ.to]	**!					
[mʌg.ʌ.do]			*!	*	**	**
[mʌgˀ.ʌ.do]		*!		*	**	**
☞[mʌ.gʌ.do]					**	**

Table 88: Stratal OT: /mʌk/+/ʌto/ (2nd cycle)