# ACQUISITION OF ENGLISH LARYNGEAL FEATURE DISTRIBUTION BY NORWEGIAN LEARNERS

by

**Ann Kristin Aslaksen**

Master's Thesis in English Linguistics

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Department of Language and Linguistics

Faculty of Humanities

University of Tromsø

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Supervised by: Dr. Martin Krämer

# TABLE OF CONTENTS

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# CHAPTER 1

# INTRODUCTION

Both Norwegian and English belong to the Germanic languages, and as thus they show many similar phonological patterns. For instance, Norwegian and English have past tense suffixes that are analogous in that they vary between the voiced stop [d] and the voiceless stop [t] depending on which segment the suffixes follow. The laryngeal feature distribution of these suffixes is, with one exception being after sonorants, distributed similarly in both languages. Both English and Norwegian also have *s*-endings in use that are quite similar, for instance the possessive ending. However, while the English *s*-endings have the same pattern of laryngeal feature distribution as the past tense, it is only the unvoiced fricative that surfaces in this context in Norwegian as Norwegian does not have any voiced fricatives in its segment inventory.

For this thesis I have conducted a study on second language acquisition. The study is a cross-sectional investigation over three age groups in Norwegian secondary school (ungdomsskole and videregående skole). The study looks into how Norwegian learners of English as a second language acquire the laryngeal feature distribution as described above. It is particularly interesting to look at this part of the phonology due to the similarities and differences in distribution of laryngeal feature between these languages. The learners have an advantage in that the past tense suffixes are very similar in both languages, while it is a disadvantage that Norwegian lacks the segment [z] and that the laryngeal feature is different after sonorants in the past tense.

From the study it has become clear that the learners to a large extent transfer the Norwegian laryngeal distribution to English. The study also shows that the learners learn the laryngeal feature distribution of the past tense much quicker than the *s*-endings, even though the pattern is the same. One of the surprises of the study is the relatively quick acquisition of the segment [z] after sonorants in English compared to the other contexts, as this is opposite to the Norwegian pattern seen for the past tense.

This seems to be caused by the emergence of a universal constraint for voiced obstruents after sonorants.

The learning curves of the two types of suffixes are different in that the laryngeal distribution for the *s*-endings is acquired evenly in an s-shape, while for the past tense suffix it seems to be more u-shaped as it undergoes regression between the two youngest age groups. However, as we will see in chapter 5 this may not be the case as there is evidence for regarding the past tense acquisition curve as s-shaped as well. The results from the study have been applied to two learning theories, from which I will argue that the gradual learning algorithm cannot account for our data, while the constraint demotion algorithm fares better due to it allowing for the emergence of the unmarked.

The thesis is organized as follows: Chapter 2 will give a brief introduction to the laryngeal patterns of Northern Norwegian and the suffixes relevant for the study. It will also show the laryngeal patterns of English and the relevant suffixes. For both languages there will be provided Optimality Theoretic (OT) analyses which will give us a comparison of the two languages. Further, the two learning algorithms that will be applied to the data later in the thesis are briefly introduced. I then predict what we may see the learners produce in the study based on the Optimality Theoretic-analyses and algorithms presented.

Chapter 3 gives a summary of the methodology used to perform the study, the informants used, the method used to collect the data and how it was analyzed. This leads us to the results of the study that are presented in chapter 4.

In chapter 5 the results shown in chapter 4 are applied to the two algorithms presented in chapter 2. First we see how the constraint demotion algorithm fares with the *s*-endings and past tense suffix respectively, before we see the same for the gradual learning algorithm. This chapter also looks in more detail at the two learning curves that appear and try to explain the patterns seen. The variation that occurs within the learners and across the groups is also commented on in a separate section in this chapter. Finally chapter 6 summarizes the findings of the study.

# CHAPTER 2

# BACKGROUND

When studying the theories of voicing for the background of the Norwegian and English voicing patterns, two opposing views regarding the underlying specification of laryngeal feature have become prominent. Firstly, there is the view taken by Lombardi (1995; 1999), who claims that [voice] is the laryngeal feature in English. Then there is the view taken by Iverson and Salmons (1995) and Honeybone (2005) who argue for [spread glottis] as the underlying specification for all Germanic languages, except Dutch which has [voice] as the underlying specification.

Honeybone (2005) divides languages into language types according to their different voicing patterns. Group A is characterized by that '(i) the 'voiceless' stops are aspirated, at least in most or many environments, (ii) the 'voiced' series show inconclusive evidence of spontaneous voicing, and (iii) it is typical to find assimilation to 'voicelessness' in clusters, and not to 'voicedness', thus sonorants are often seen to devoice when adjacent to underlyingly 'voiceless' obstruents' (Honeybone, 2005: p. 329). Type B languages, on the other hand, typically have unaspirated voiceless series, a fully voiced voiced series and assimilation to voicedness in clusters.

Assuming these two language types, and what follows from this, makes more sense than claiming that [voice] is the underlying feature for both, when looking at assimilation to voicelessness in obstruent clusters, as only marked features may spread. Segments with underlying [ ] (nothing) do not have anything to spread, and cannot, therefore, cause assimilation.

According to Iverson and Salmons (1995), the feature that defines the voicing contrasts in Germanic languages is [spread glottis]. They bring forth English as a typical Germanic language, and argue that we only need a privative [spread glottis] feature to account for the voicing patterns of English. They claim that voiceless obstruents are specified as [spread glottis] underlyingly, while voiced obstruents are unspecified, or [ ], underlyingly for the laryngeal feature. This means that voiceless is equivalent to marked, and voice is equivalent to unmarked in Germanic languages. Following Honeybone's language types, as already outlined, we must assume that Germanic languages fall into the type A languages, and that this group has [spread glottis] as the underlying specification for laryngeal feature. The type B languages may be Romance or Slavic languages, in addition to the Germanic Dutch, as these show assimilation to voicedness. They should be specified for [voice] underlyingly, in accordance with Iverson and Salmons.

In this chapter we will first have a look at the laryngeal patterns of Northern Norwegian in section 2.1. That section will include a brief introduction to the suffixes we will be focusing on in this thesis, and their laryngeal distributions. An OT-analysis of the given patterns will also be provided. In section 2.2 the relevant laryngeal phonology of English will be outlined, and I will introduce the suffixes that will be compared to the Norwegian endings. An OT-analysis will then be given to show the parallels between English and Norwegian. In section 2.3 the two main learning algorithms that will be discussed in this thesis is briefly introduced. Predictions of what patterns the Norwegian learners of English will produce are then given in section 2.4 based on the OT-analyses given previously and the algorithms introduced.

### 2.1 Laryngeal patterns of Northern Norwegian

This section is mainly based on the phonology of Norwegian as described in Kristoffersen (2000). His book describes the sound system found in Urban East Norwegian (UEN), which differs to a great degree from the Northern Norwegian dialect found in Hammerfest, which is the dialect covered in this thesis. When I refer to *Northern Norwegian* in this thesis, the Hammerfest dialect is used as the reference point. The two systems are, however, remarkably similar when it comes to voicing patterns, and the use of the UEN phonology is therefore defended. Where relevant differences occur, these are pointed out in the text and commented on. The final analysis is of course based on the phonology of Northern Norwegian as described below.

### 2.1.1 General voicing patterns in simplex words

Norwegian 'contrasts two series of stops, a voiceless, aspirated series [$p^h$, $t^h$, $k^h$] with a (partially) voiced, unaspirated series [b, d, g]' (Kristoffersen, 2000: p. 74). These two series contrast in most contexts, except '[w]hen a stop immediately follows /s/, the contrast is neutralized in a voiceless, unaspirated stop' (Kristoffersen, 2000: p. 74). Such consonant clusters must be tautosyllabic for the statement to be valid.

| | | |
|---|---|---|
| (1) | [$p^h$uːl] *pol* 'off-licence' | [buːl] *bol* 'beehive' |
| | [$k^h$luː] *klo* 'claw' | [gluː] *glo* 'ember' |
| | [$k^h$nɑ$k^h$] *knakk* 'broke' | [knɑg] *knagg* 'peg' |
| | [mɑr$k^h$] *mark* 'field/land' | [mɑrg] *marg* 'marrow' |
| | /s$t^h$emme/ ~ [stemme] 'voice' | |

Postvocalic obstruent clusters must also agree in voicing in Norwegian. The /v/-sound which is usually described as an approximant also follows this pattern, in that it may never combine with voiceless obstruents, indeed it can only co-occur with the voiced obstruent [d].

| | | |
|---|---|---|
| (2) | [$p^h$ost] *post* (id.) | *[posd] |
| | [loft] *loft* (id.) | *[loʋt]/*[lofd] |
| | [$k^h$u.lɑps] *kollaps* 'collapse' | *[ku.lɑbs] |

In one aspect that Kristoffersen describes in the UEN phonology, Northern Norwegian differs; this is when it comes to sonorants. In UEN, when a *non-nasal* sonorant follows a voiceless stop or /f/, the obstruent triggers progressive assimilation, and the sonorant is fully or partially devoiced, as seen below.

| | | |
|---|---|---|
| (3) | /plante/ [pl̥ɑn.tɛ] 'plant' | /bla/ [blɑː] 'leaf' |
| | /fransk/ [fr̥ɑnsk] 'French' | /vrimle/ [ʋrim.le] 'swarm' |
| | /knipe/ [kni.pɛ] 'pinch' | /gnike/ [gnik.kɛ] 'rub' |

In Northern Norwegian, however, no sonorants are devoiced when following voiceless stops or /f/, which gives a pattern for Northern Norwegian like the one seen below in (4).

| | | |
|---|---|---|
| (4) | /plante/ [plɑn.tɛ] ’plant’ | /bla/ [blɑː] ’leaf’ |
| | /fransk/ [frɑnsk] ’French’ | /vrimle/ [ʋrim.le] ’swarm’ |
| | /knipe/ [kni.pɛ] ’pinch’ | /gnike/ [gnik.kɛ] ’rub’ |

Norwegian does not have a voicing series which contrasts in voicing with the voiceless fricatives; that is, Norwegian has no voiced fricatives. The /v/ sound is, as already mentioned, usually accounted for as an approximant, although it sometimes behaves as a fricative.

### 2.1.2 Voicing patterns in relevant suffixes

For the purpose of this thesis we are looking at suffixes that trigger laryngeal assimilation. Norwegian has four such suffixes, the past participle marker, the adjectival agreement marker for neuter singular, the nominalizing suffix and the possessive marker. The past participle marker alternates between [d] and [t], and the past tense marker which alternates between [de] and [te] behaves exactly the same. For convenience I will only refer to the past participle marker in this thesis. The adjectival agreement marker for neuter singular is always realized as [t] and the nominalizing suffix is always [sel]. Finally, the possessive marker is [s]. In Northern Norwegian, however, the latter is rarely, if ever, used productively. The only pattern of this ending that appears is lexicalized. The ending will be described here due to its possible influence from southern dialects in which it is used frequently.

#### The past participle marker [d] or [t]

Weak verbs are in Norwegian divided into two main classes. According to Faarlund, Lie and Vannebo (1997) the largest class derives past tense by adding [et] or [a] to the stem, where the Hammerfest dialect would produce the [a] ending. The ending that we will look at in this thesis is the second and smaller class, which derives the past tense by adding [t] or [d] as explained above. This suffix triggers progressive laryngeal assimilation. After voiceless obstruents and sonorant consonants we get [t], and after voiced obstruents and vowels we get [d], examples given in (5) below.

| | | | | |
|---|---|---|---|---|
| (5) | bruk-t, | mas-t, | tvil-t, | tjen-t |
| | use-PAST, | nag-PAST, | doubt-PAST, | earn-PAST |
| | lag-d, | kle-dd, | krev-d, | |
| | make-PAST, | dress-PAST, | demand-PAST | |

**The agreement marker [t]**

This agreement marker [t] triggers regressive laryngeal assimilation. That is, where we have an adjectival stem ending in a voiced obstruent or the approximant [ʋ], it becomes voiceless before the agreement marker. In adjectival stems that end in sonorants, no assimilation takes place, and the sonorants maintain their spontaneous voicing.

| | | | |
|---|---|---|---|
| (6) | stiv~stif-t, | trygg~tryk-t, | groʋ ~ grof-t |
| | stiff ~ stiff-NEUTER, | safe ~ safe-NEUT, | coarse-NEUT |
| | pen-t, | gal-t | |
| | pretty-NEUTER, | wrong-NEUTER | |

**The nominalizing suffix [sel]**

This suffix triggers regressive laryngeal assimilation, meaning it behaves just like the agreement marker [t], as we can see from the following words

| | | |
|---|---|---|
| (7) | føde ~ føt-sel, | redd ~ ret-sel |
| | give birth-INF ~ birth-SING-INDEF, | afraid-INF ~ fear-SING-INDEF |

**The possessive marker [s]**

This suffix can be divided in two: 'the clitic /-s/, which denotes possession, and which attaches to the right edge of NPs […and] the old genitive case marker /-s/ in idiomatic prepositional phrases headed by *til*'(Kristoffersen, 2000: p. 77).

The previous is considered unnatural, and replaced by the word 'sin' in most cases in Northern Norwegian. This way, the eastern Norwegian '*et lags'* (a team's) would be '*et lag sitt*' in Northern Norwegian dialects. The /-s/ clitic may however be used in articulate speech by politicians, teachers in higher education etc. This clitic does not trigger any assimilation, and hence falls out of the patterns we have seen so far.

It is only the idiomatic use of this clitic that can be heard in the spoken language of Northern Norwegian. This case marker triggers ‘devoicing and vowel shortening in stems ending in a voiced obstruent preceded by a long vowel’(Kristoffersen, 2000: p. 77). This gives outputs such as the ones seen in (8):

(8) stem: [lɑːg] ’team’

idiom: gjøre til [lɑks] ’to satisfy somebody’

According to Kristoffersen (2000), the underlying laryngeal feature is [asp(irated)] in Norwegian. He argues against [voice] being the underlying feature for several reasons, first of all due to the fact that /s/ does not trigger devoicing in sonorant and approximant clusters. When assuming [asp] to be the laryngeal feature in Norwegian, one may say that this lack of devoicing is due to /s/ carrying an empty laryngeal node [ ], meaning there is nothing to spread on to the sonorant. If one, however, assumes [voice] to be the laryngeal feature, there is no such solution available, and Kristoffersen argues that ‘[s]ince /s/ clearly is voiceless in Norwegian, it would be completely ad hoc to specify it with [voice] in order to block devoicing of following sonorants’ (Kristoffersen, 2000: p. 81). This is a particularly strong argument for Northern Norwegian due to sonorants never devoicing, as we saw in section 2.1.1 above.

The final evidence that Kristoffersen provides for [asp] being the underlying feature in stead of [voice] is found in the preterite and past participle markers /–Te/ and /–T/. If we assume [voice] underlyingly, more complicated solutions are required to get the right result whether we assume [voice] to be present in the suffix or not. If it is present, the problem occurs after voiceless obstruents where one would need to delink to get a voiceless suffix. According to Kristoffersen, [voice] being unspecified in the suffix ‘is not viable on the assumption that sonorants are unspecified for [voice], since the fact that the suffix appears as voiced after vowels and cannot then be accounted for’ (Kristoffersen, 2000: p. 83). Also, if [voice] is underlying, [asp] is required in addition to account for progressive devoicing as seen in the agreement and possessive markers. If, however, we assume [asp] to be the underlying feature, we get the right distribution using only this feature. This is carried out most easily by assuming [asp] to be missing in the suffix. Although Kristoffersen argues for using [asp] instead of [spread glottis] as the underlying feature, I will continue using [spread glottis] for Norwegian as well, as the reasons given for differentiating between these two (Kristoffersen, 2000: p. 81) will not affect the analysis in any way relevant for the purpose of this thesis.

### 2.1.3 OT-analysis

Based on the information about the suffixal laryngeal assimilation and underlying laryngeal feature specified as [spread glottis] as argued by Iverson and Salmons (1995) and Honeybone (2005) and the details about Norwegian laryngeal distributions in the relevant suffixes, I will in this section present an OT analysis of these patterns below.

First of all, Norwegian has a voicing distinction that gives minimal pairs, as seen in (1) above. To keep this distinction there must be constraints that make sure an input /puːl/ remains [pʰuːl] in the output, instead of [buːl], and the other way around. Such constraints may be $*Obs_{[lar]}$ and $MAX_{[lar]}$ as seen in (9) and (10) below.

(9) $*Obs_{[lar]}$: Obstruents specified for [spread glottis] are disallowed

(10) $MAX_{[lar]}$: A segment with [spread glottis] that appears in the input form must also appear with [spread glottis] in the output form.

Introducing the markedness constraint $*Obs_{[lar]}$ makes sure we allow for output forms without the feature [spread glottis], as in [buːl]. $MAX_{[lar]}$ is a faithfulness constraint that does not allow for the laryngeal feature of consonants in words such as [pʰuːl] to be deleted. How this works exactly can be seen in (11) and (12) below.

(11)

| /B/ol | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|
| ☞b | | |
| p | | *! |

In this tableau we see that the candidate with no laryngeal feature wins because the loser candidate violates the constraint $*Obs_{[lar]}$ as it has an output obstruent with a laryngeal feature. $MAX_{[lar]}$ does not make a difference at this point.

(12)

| /p/ol | MAX$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|
| ☞p | | * |
| b | *! | |

From this tableau we again see that the faithful candidate wins because the loser candidate has deleted the laryngeal feature from the input and therefore violates MAX$_{[lar]}$. The winner candidate violates the constraint *Obs$_{[lar]}$, as the loser candidate did in (11), and we can therefore conclude that the ranking of these two constraints must be MAX$_{[lar]}$ >>*Obs$_{[lar]}$.

I will now turn to look at how the constraints have to be ranked considering the different Norwegian suffixes we regard as relevant for this purpose.

**Past participle marker [t] or [d]**

As mentioned above, the past participle marker in Norwegian can be realized as either the voiceless [t] or the voiced [d] in Norwegian, depending on what type of segment it follows. The underlying representation for this suffix is presented as /T/ below, which in this case signifies that the underlying representation is unspecified for laryngeal feature.

Which participle marker is used to indicate past tense is dependent on the preceding segment, as seen in (5) above. We see that when the past tense marker is part of an obstruent cluster, the segments in the cluster agree in voicing specification. This means that we need an Agree constraint in the grammar, as seen in (13) below.

(13) Agree: Obstruent clusters agree in their laryngeal specification.

In (14) below we see that the Agree constraint needs to be ranked above *Obs$_{[lar]}$ to give the right result.

(14)

| bru/k+T/ | Agree | MAX$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|---|
| ☞a) kt | | | ** |
| b) kd | *! | | * |
| c) gt | *(!) | *(!) | * |
| d) gd | | *! | |

In the tableau in (14) we see that after voiceless obstruents we get a voiceless past tense suffix. This is because candidate b) violates Agree as the consonant cluster does not agree in laryngeal specification. It is, however, fully faithful otherwise, as the /k/ in the input remains [k] in the output. Candidate c) also violates Agree, but in addition it also violates $\text{MAX}_{[\text{lar}]}$, because the /k/ in the input has lost its laryngeal node in the output. Candidate d) is finally eliminated due to its violation of $\text{MAX}_{[\text{lar}]}$, on the same grounds as candidate c). This leaves us with candidate a) as the optimal candidate because the cluster agrees in voicing, and the /k/ has kept its laryngeal feature. Here we see that $^*\text{Obs}_{[\text{lar}]}$ has to be ranked below Agree in addition to $\text{MAX}_{[\text{lar}]}$, otherwise the optimal candidate would lose to the suboptimal candidate in b), as a) gets two violation marks for $^*\text{Obs}_{[\text{lar}]}$, while b) only gets one.

After sonorants the past tense suffix is produced as the voiceless obstruent [t]. This is the reverse of the universal pattern and constraint *NC̥ as described by Pater (1999). The constraint that will be used to account for this pattern is $\text{SO}_{[\text{lar}]}$ which is outlined below in (15).

(15) Sonorant-Obstruent$_{[\text{lar}]}$ ($\text{SO}_{[\text{lar}]}$): Sonorant consonants must be followed by obstruents that are specified for laryngeal feature.

In (16) below we see how this constraint has to be ranked relative to the $^*\text{Obs}_{[\text{lar}]}$ constraint to yield the right output form after sonorants in Norwegian.

(16)

| tvi/l+T/ | $\text{SO}_{[\text{lar}]}$ | $^*\text{Obs}_{[\text{lar}]}$ |
|---|---|---|
| ☞a) lt | | * |
| b) ld | *! | |

Candidate b) is here eliminated by violating the constraint $\text{SO}_{[\text{lar}]}$. Because our optimal output candidate in a) violates the constraint $^*\text{Obs}_{[\text{lar}]}$, the ranking of these two constraints must be $\text{SO}_{[\text{lar}]} >> {}^*\text{Obs}_{[\text{lar}]}$.

After voiced obstruents we get the voiced past tense marker [d]. When generating this suffix in this position in Norwegian, there are no constraint violations by the optimal candidate. This can be seen in (17) below.

(17)

| la/G+T/ | Agree | *Obs$_{[lar]}$ |
|---|---|---|
| ☞a) gd | | |
| b) gt | *! | * |

In this tableau we see that the loser candidate b) violates both the constraint Agree because the consonant cluster [gt] does not agree in voicing specification and the constraint *Obs$_{[lar]}$ because the suffix is specified for the laryngeal feature. The optimal candidate a) does not violate either of these constraints, and is therefore the correct winner.

After vowels the same situation occurs as after voiced obstruents, and the suffix without laryngeal specification is generated. This can be seen in (18) below.

(18)

| kle+/T/ | MAX$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|
| a) t | | *! |
| ☞b) d | | |

The only constraint that is violated here, is *Obs$_{[lar]}$, which is violated by candidate a) due to the output [t] having laryngeal feature. This leaves candidate b), with no violation marks, as the optimal candidate.

**Agreement marker -t**

The adjectival agreement marker differs from the past tense suffixes in that it triggers *regressive* assimilation, and in that it is fully specified for laryngeal feature underlyingly. This way, the results when it comes to words ending in voiced obstruents and vowels differ from the results in these contexts when preceding the past tense marker. The constraints and the hierarchy remains the same as for the past tense suffixes, though.

In (19) below we can see that regressive laryngeal assimilation takes place in the coda obstruent cluster due to Agree, MAX$_{[lar]}$ >> *Obs$_{[lar]}$.

(19)

| sti/v+t/ | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|---|
| a) vt | *! | | * |
| ☞b) ft | | | ** |
| c) vd | | *! | |

Candidate a) in this tableau violates the high ranked Agree, and is thus eliminated. Candidate c) also dies due to its violation of $MAX_{[lar]}$ by the suffix that loses its laryngeal specification in the output. This leaves candidate b) as the winner as it only violates $*Obs_{[lar]}$ which is ranked below Agree and $MAX_{[lar]}$.

After vowels this suffix also differs from the past tense ending, as can be seen in (20) below.

(20)

| blå+/t/ | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|
| ☞a) t | | * |
| b) d | *! | |

The losing candidate b) in this case only violates the constraint $MAX_{[lar]}$ due to the output losing its laryngeal feature. The winning candidate violates both $*Obs_{[lar]}$, but this constraint is ranked below $MAX_{[lar]}$.

**Nominalizing suffix**

The nominalizing suffix works much the same as the agreement marker because it is fully specified for laryngeal feature underlyingly, hence the outputs follow the same pattern, and voiced obstruents undergo laryngeal assimilation when preceding this suffix. As the Norwegian grammar will be compared to the English grammar further down, I will add a constraint that disallows the segment [z] to appear. This constraint can be seen in (21) below.

(21) *z: No segment [z] is allowed

The introduction of the *z constraint in the Norwegian grammar is simply to provide an effective comparison to English when we get thus far. Even without this constraint, the ranking of the remaining constraints would stay the same, and the same results would be gained. However, it is ranked above the other constraints as the segment never appears in Norwegian. For English it will be ranked below the other constraints as the segment appears frequently.

In (22) below we can see how the *z constraint is introduced to the Norwegian grammar, and how the nominalizing suffix is parallel to the agreement marker as seen in (19) above.

(22)

| fø/d+s/el | *z | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|---|---|
| a) ds | | *! | | * |
| ☞b) ts | | | | ** |
| c) dz | *! | | * | |

Candidate a) violates Agree because the consonants in the cluster show different laryngeal specifications, and thus loses. Candidate c) violates both *z and $MAX_{[lar]}$, and also loses against the winning candidate b), which only violates constraints that are ranked below the crucial constraints for a) and c). Again we see that although the optimal candidate is unfaithful to the root, the fact that the suffix remains the same after all contexts combined with the need for agreement, which causes regressive assimilation, this candidate wins.

**Possessive marker**

As explained under 2.1.2 above, the only way the Hammerfest dialect utilizes the possessive marker is in lexicalized idiomatic expressions. This marker is also fully specified for laryngeal feature underlyingly, and therefore works in the same way as we have seen with the agreement marker and the nominalizing suffix above. An example is given in (23) below.

(23)

| li/v+s/ | *z | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|---|---|
| a) vs | | *! | | * |
| ☞b) fs | | | | ** |
| c) vz | *! | | * | |

Candidate a) loses due to a violation on the Agree constraint. Candidate c) violates both *z and $MAX_{[lar]}$, and so loses against b) which violates lower ranked constraints. For Norwegian the tableaux showed for the language above gives us a ranking of constraints as shown in (24). As with the two previous suffixes, we see that the candidate that shows agreement in addition to faithfulness to the suffix, wins.

(24) Norwegian: *z >> $SO_{[lar]}$ >> Agree, $MAX_{[lar]}$ >> $*Obs_{[lar]}$

### 2.2 The laryngeal phonology of English

In this section we will have a look at the laryngeal phonology of English, particularly the laryngeal feature distribution related to suffixes.

#### 2.2.1 General laryngeal feature patterns in simplex words

As Norwegian, English also contrasts two series of stops, the voiceless aspirated series [$p^h$, $t^h$, $k^h$] with a partially voiced unaspirated series [b, d, g]. As we saw for Norwegian, we also find that in English, when a stop immediately follows /s/, the contrast is neutralized in a voiceless, unaspirated stop.

| | | |
|---|---|---|
| (25) | [$p^h$æn] *pan* | [bæn] *ban* |
| | [$k^h$liːn] *clean* | [gliːn] *glean* |
| | [pɪ$k^h$] *pick* | [pɪg] *pig* |
| | /s$t^h$omak/ ~ [stʌ.mək] *stomach* | |

Postvocalic obstruent clusters must also agree in voicing, as in Norwegian.

| | | |
|---|---|---|
| (26) | [pəʊst] *post* | *[pəʊsd] |
| | [lɒft] *loft* | *[lɒvt]/*[lɒfd] |
| | [kə.læps] *collapse* | *[kə.læbs] |

An additional pattern which correlates with the Norwegian system we have already seen, is that sonorants ‘are often seen to devoice when adjacent to underlyingly ‘voiceless’ obstruents’ (Honeybone, 2005: p. 329). No evidence has been found for this happening to nasal sonorants, although this may be due to a phonotactic restriction saying no nasals can be in onsets with obstruents (*[knot]).

(27) /plant/ [pl̥ɑnt] *plant* /blæk/ [blæk] *black*

/frɛndli/ [fr̥ɛnd.lɪ] *friendly*

/krimson/ [kɹ̥ɪm.sən] *crimson* /greit/ [gɹeɪt] *great*

Unlike Norwegian, English has a fricative series which contrasts in laryngeal feature with the voiceless fricatives; that is, English has voiced fricatives. This means that English has one particular sound which is interesting for our purpose, namely [z]. English also has other fricative pairs which Norwegian does not have ([ʃ, ʒ] and [θ, ð]), but the [z] segment is interesting due to the fact that Norwegian has its voiceless counterpart in its phonetic inventory. The English fricative pair [f, v] is left out of the equation completely, for the simple reason that the Norwegian approximant [ʋ] often behaves as a fricative, and therefore the equivalent English segment should cause no problem for the Norwegian learner of English when it comes to voicing.

### 2.2.2 Voicing patterns in relevant suffixes

English has two suffix forms that are interesting for the research done in this thesis. That is, the past tense or adjectival suffix which alternates between [d] and [t] in addition to the alternation between [s] and [z] which can be seen in the plural of nouns, 3rd person singular present tense, possessive forms and in contracted forms of *is*. These suffixes all trigger progressive laryngeal assimilation, and therefore behave much like the Norwegian past participle marker. There are also English suffixes that trigger regressive laryngeal assimilation (such as <-th>), as in the three remaining Norwegian suffixes, but I will not look into these in this thesis.

### The past tense and adjectival marker [d] or [t]

This suffix, like the Norwegian past participle marker, undergoes progressive laryngeal assimilation. However, the contexts in which the alternative outputs occur are slightly different. [t] occurs after voiceless obstruents only, while [d] occurs after voiced obstruents, sonorant consonants and vowels.

(28) kick[t], rob[d]
play[d], free[d] } in accordance with the pattern in Norwegian
scream[d], call[d] (unlike in Norwegian)

**The [z] or [s] ending**

This ending appears with many different meanings; it is the plural marker on regular nouns, the 3rd person singular present tense marker, possessive marker and the form of the contracted *is*. Like the [d] or [t] suffix, it undergoes progressive laryngeal assimilation, and the voiced/voiceless form occurs in the same environments, that is, [s] occurs after voiceless obstruents only, while [z] occurs after voiced obstruents, sonorant consonants and vowels.

(29) Pete'[s], walk[s], cat[s]
Jed'[z], scream[z]
shoe[z]

### 2.2.3 OT-analysis

OT-analyses of the laryngeal patterns in English have been made by several scholars (e.g. Lombardi (1999), Borowsky (2000) and Grijzenhout (2001)). The analysis provided in this section is not intended as criticism of these analyses, but is rather laid out parallel to the Norwegian analysis given in 2.1.3 for easier comparison of the two languages. In this section I will look at how the OT-analysis for the English past tense marker and the *s*-endings will look.

**Past tense marker [t] or [d]**

The English past tense marker is similar to the Norwegian past tense in that it agrees in laryngeal specification with the preceding obstruent. This means that in English as well as in Norwegian, Agree is ranked high in the hierarchy. The constraint $MAX_{[lar]}$ is also ranked high to disallow laryngeal nodes to be deleted between the input and the output forms. Both of these constraints need to be ranked above $*Obs_{[lar]}$, which is illustrated in tableau (30) below.

(30)

| ho/p+T/ | Agree | MAX$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|---|
| a) pd | *! | | * |
| ☞b) pt | | | ** |
| c) bd | | *! | |

Candidate a) loses because it violates the highest ranked constraint Agree. Candidate c) also loses due to a violation on the constraint ranked equally with Agree; Max$_{[lar]}$. This leaves us with candidate b) as the optimal candidate.

**[s] or [z] markers**

The *s*-endings in English differ from the Norwegian *s*-endings in that they vary between voiced and voiceless depending on which segment they follow. Other than this they follow the same pattern as the past tense ending. The *z constraint is ranked at the bottom of the hierarchy in English to allow this segment to surface. This can be seen in (31) below.

(31)

| do/G+S/ | Agree | *Obs$_{[lar]}$ | *z |
|---|---|---|---|
| ☞a) gz | | | * |
| b) gs | *! | * | |
| c) ks | | *(!)* | |
| d) kz | *! | * | * |

Candidate b) and d) both lose due to a violation of the highest ranked constraint Agree. On the next lower level of constraints in the tableau candidate c) is eliminated due to violations against *Obs$_{[lar]}$. This leaves candidate a) as the optimal candidate, as it only violates the lowest ranked constraint *z.

After sonorants the voiced version of the endings appears in English. This means that the constraint we used to get the right output after sonorants in Norwegian has to be ranked low in the English grammar. *Obs$_{[lar]}$ must be ranked above SO$_{[lar]}$ to disallow unvoiced segments in this context. This is illustrated in (32) below.

(32)

| pe/n+S/ | $*Obs_{[lar]}$ | $SO_{[lar]}$ | *z |
|---|---|---|---|
| ☞a) nz | | * | * |
| b) ns | *! | | |

In this tableau we see that candidate b) violates the constraint $*Obs_{[lar]}$ because the obstruent [s] has a laryngeal feature. This leaves candidate a) as the optimal candidate and winner here.

After vowels the endings are voiced. This is similar to the past tense pattern seen in for Norwegian, as the voiced segment surfaces in this context, but different from all Norwegian *s*-endings because the segment [z] is not allowed in Norwegian. This is illustrated in tableau (33) below.

(33)

| free+/S/ | $*Obs_{[lar]}$ | *z |
|---|---|---|
| ☞a) z | | * |
| b) s | *! | |

Candidate b) loses due to a violation of the constraint $*Obs_{[lar]}$, which is ranked above the constraint *z which is the only constraint the winning candidate a) violates. For English, these tableaux give evidence for a ranking of constraints as shown in (34) below.

(34) English: Agree, $Max_{[lar]}$ >> $*Obs_{[lar]}$>>, $SO_{[lar]}$, *z

## 2.3 Algorithms for language acquisition

In this section I will give a brief outline of the two main learning algorithms that will be discussed in this thesis, error driven constraint demotion as presented by Tesar and Smolensky (1998) and the gradual learning algorithm as presented by Boersma (2000). The algorithms give different predictions about how learners will acquire a second language, as we will see in section 2.4 below.

### 2.3.1 Error-Driven Constraint Demotion

Constraint demotion is an error-driven principle introduced by Tesar and Smolensky (1998) to explain how learners get to the target grammar when learning a language. The learner first has to realize what the optimal output in the target language should be. The algorithm compares the winning candidate to one loser candidate at a time in so-called mark-data pairs. Then all the constraints favouring the loser (marked by L) are demoted below at least one of the highest ranked constraints favouring the winner (marked by W). By comparing candidates like this the subset problem and the absence of negative evidence can be avoided as the positive data does not give the learner the information about the correct ranking by itself, but '[e]ach piece of positive evidence, a grammatical structural description, brings with it a body of *implicit negative evidence* in the form of the competing descriptions' (Tesar and Smolensky, 1998: p. 238). This way the negative evidence is observed side by side with the positive evidence, and can help the learner avoid unwanted structures. This also implies that only constraints that get loser-marks go through demotion.

This algorithm does not assume any particular initial hierarchy, as it performs well with either initial ranking. However, over the last years more people (e.g. (Davidson et al., 2004; Gnanadesikan, 1996; 2004) have argued for the universality of markedness above faithfulness (M>>F) initially when children learn their native language. From this it follows that the initial state is not empty, but has a range of constraints that have been demoted to a stratum where they do not affect the grammar when the children reach the target grammar. This also implies that the learner of a second language starts off with the native language constraint ranking and that this grammar contains universal constraints that have the potential of becoming visible in a new grammar.

### 2.3.2 The Gradual Learning Algorithm

According to Boersma (2000), when a child learns its first language, it starts off with an empty grammar. The grammar evolves through steps in which different aspects of the grammar are added. As we are dealing with second language acquisition in this thesis, this is not applicable, and we are assuming the L1 ranking to be the initial ranking in the L2 system development. However, the initial state does make a difference, as the Gradual Learning Algorithm (GLA) only allows for constraints that are already present in the native language when acquiring a second language. This leaves the learner with a more limited set of constraints to rearrange in the inter language than the constraint demotion principle.

Another important aspect of the GLA is that the constraints in a constraint hierarchy cannot be ranked on ties because each constraint occupies a certain part of the constraint scale, and that in this way, constraints may overlap and cause variation due to constraint fluctuation. This way, if there are two constraints A and B, and there is variation between the output, let's say 70% in favour of A>>B, and 30% in favour of B>>A, according to the GLA constraint A and B do not occupy the same space in the hierarchy, but rather that A is generally ranked above B, but that they have a certain amount of space where they overlap and the output may appear as a result of B fluctuating above A.

When constraints move about in the hierarchy based on the rules dictated by the GLA, the constraint with violations in favour of the loser candidate moves down while the constraint with violations in favour of the winning candidate moves up. These moves happen in small steps, and the process is therefore predicted to take longer than the Constraint Demotion seen under 2.3.1 above. As with constraint demotion, only constraints that get violation marks are triggered to go through constraint reranking. However, Tesar and Smolensky (1998) have proven that constraint promotion causes problems for the learners. They refer to the problem as the 'disjunction problem' (Tesar and Smolensky, 1998: p. 244) due to the fact that if there is more than one constraint that violate the loser, and therefore would be predicted to move up the hierarchy, the constraints are in a disjunction (Constraint A *or* Constraint B may move), and the learner has no way of knowing which one to promote. Constraint demotion deals with this problem more elegantly simply because *all* constraints that violate the winner must be demoted below the highest ranked constraint violating the loser.

### 2.4 Predictions

According to Honeybone's classification of languages (Honeybone, 2005) as seen under 2, and from what we have observed in section 2.1 for Norwegian and 2.2 for English, both languages belong to the same language type; type A.

If we compare the two languages as they are presented in the two previous sections, we see that they are similar in that they have the same specification for the laryngeal node, [spread glottis]. We also see laryngeal assimilation in all relevant suffix cases, which means Agree is high in both grammars. Although regressive assimilation does not occur in the regular English suffixes that we have looked at in the English section, this does indeed appear in the relevant Norwegian suffixes (the agreement –t, nominalizing marker and the possessive –s). Regressive laryngeal assimilation only appears to happen in the –th suffix (five-fifth) and in irregular forms such as –t (*cleave~cleaft*) and the –z suffix (thief~thieve[z]). In addition, both Norwegian and English are underlyingly unspecified for the laryngeal feature for the past tense morpheme. However, while English remains unspecified for the *s*-markers as well, Norwegian remains fully specified underlyingly for the relevant *s*-endings. From an OT perspective, there is also the issue of different constraint rankings. These issues leave us with different predictions for what may happen when Norwegian speakers learn English as a foreign language. The simplest prediction is given below. We will see what would happen if the learners assume an underlyingly unspecified suffix, as for both past tense suffixes, and a Norwegian constraint ranking.

Now that we have seen how the different suffixes behave in Norwegian and English we may make predictions about what the Norwegian learners of the English suffixes may produce. With respect to this, we must separate the predictions in two and differentiate between the past tense suffixes and the *s*-endings.

### 2.4.1 Predictions for the past tense suffix

The past tense endings in Norwegian and English are realized the same in all context but one: after sonorants. Therefore we assume that the Norwegian learners will have problems with this context initially, as the Norwegian pattern will be transferred to the inter language. This pattern is a result of ranking $SO_{[lar]}$ above $*Obs_{[lar]}$. The learners should not have problems with producing the correct past tense output after the other contexts, as these are the same as in Norwegian.

The correct output is predicted to appear after voiceless obstruents, as Norwegian and English distribute voicing after this context similarly. Agree and $MAX_{[lar]}$ ranked above $*Obs_{[lar]}$ makes sure the ending with laryngeal feature, which agrees in laryngeal specification with the stem can appear here. This is illustrated in (35) below.

(35)

| ho/p+T/ | Agree | MAX$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|---|
| ☞a) pt | | | ** |
| b) pd | *! | | * |
| c) bd | | *! | |
| d) bt | *(!) | *(!) | * |

In this tableau we see that we get the right optimal output because the constraint *Obs$_{[lar]}$ is ranked below both Agree and MAX$_{[lar]}$, as is the case for both Norwegian and English. b) and d) lose because they violate Agree, and d) loses because it violates MAX$_{[lar]}$.

After vowels we predict the correct output segment [d] to appear, as the optimal candidate in this context does not violate any constraints that are used in this analysis. This is illustrated in (36) below.

(36)

| free+/T/ | MAX$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|
| a) t | | *! |
| ☞b) d | | |

The violated constraint *Obs$_{[lar]}$ is the only constraint that would get a violation mark after vowels in both languages, yielding the right result no matter what the ranking is.

The only context we expect the Norwegian learners to encounter problems with the past tense form is after sonorants, as this is the only context where the Norwegian and English distribution of the past tense suffixes do not overlap. For this context the ranking of two relevant constraints are opposite. In Norwegian SO$_{[lar]}$ is ranked above *Obs$_{[lar]}$ to allow unvoiced segments to appear after sonorants, while it in English is ranked below *Obs$_{[lar]}$ to avoid such a marked pattern. How this may affect the inter language of Norwegian learners is illustrated in (37) below.

(37)

| moa/n+T/ | SO$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|
| 💣a) nt | | * |
| ☹b) nd | *! | |

The optimal candidate for the target language b) is violated by the high ranked constraint $SO_{[lar]}$, and therefore loses to the suboptimal candidate in a), which only violates the lower ranked $*Obs_{[lar]}$.

### 2.4.2 Predictions for the *s*-endings

The *s*-endings are different from the past tense endings because these endings vary between the segment [s] and its voiced counterpart [z] which is not present in the Norwegian segment inventory. As Norwegian does not have this voiced segment, but its counterpart [s], I will assume that the learners will find it more difficult to acquire this voicing pair than voicing pairs such as [ʃ] and [ʒ] or [θ] and [ð] where both segments of each pair are novel to the new grammar. The fact that it is more difficult to learn a target language structure that is similar to the native language than one that is significantly different is discussed by Eckman et al. (2003) who claims that it easy for a learner to 'substitute the native language sound for the target language sound, and no further learning takes place' (Eckman et al., 2003: p. 173). The situation with Norwegian that possesses [s] but lacks [z] is not the most difficult situation to learn (that would include Norwegian having both segments, but their distribution being different), but it is apparent that this distribution also causes great problems for the learners.

Because the *z constraint is ranked high in the Norwegian grammar, it is predicted that the Norwegian learners will have problems producing the correct version of the *s*-endings in all contexts where the voiced segment would occur. This constraint needs to be moved below $*Obs_{[lar]}$ for [z] to appear in the inter language.

With *z ranked high in the hierarchy, and Agree ranked above $*Obs_{[lar]}$, we expect regressive assimilation to take place and leave an input with a voiced stem as fully devoiced in the output. This means the optimal candidate according to the Norwegian ranking will have undergone the typically Germanic assimilation, that is, it has assimilated towards voicelessness. This leaves a completely unfaithful candidate as the optimal output. This is illustrated in (38) below.

(38)

| do/G+S/ | *z | Agree | *Obs$_{[lar]}$ |
|---|---|---|---|
| a) gs | | *! | * |
| ☹b) gz | *! | | |
| 💣c) ks | | | ** |
| d) kz | *! | * | * |

Candidate a) correctly loses due to the Agree constraint, and candidate d) also correctly loses due to the *z constraint. This leaves candidates b) and c). Due to the high ranked *z constraint the optimal candidate b) loses, and we get the wrong output in the realization of c), which violates the low-ranked constraint *Obs$_{[lar]}$. From this we see that *z need to be below *Obs$_{[lar]}$ to give the right result.

Also after vowels the wrong output will appear due to the *z constraint being ranked above *Obs$_{[lar]}$. This can be seen from (39) below.

(39)

| free+/S/ | *z | *Obs$_{[lar]}$ |
|---|---|---|
| 💣a) s | | * |
| ☹b) z | *! | |

In this tableau candidate b) violates the highest ranked *z constraint and (wrongly) loses to candidate a) which only violates the lower ranked *Obs$_{[lar]}$ constraint.

As we saw for the past tense forms, the ending after sonorants is predicted to be realized wrongly. This is also true for the *s*-endings. Even without the *z constraint being ranked above *Obs$_{[lar]}$, the Norwegian learners will have problems with this context due to SO$_{[lar]}$ being ranked above *Obs$_{[lar]}$ as well. This makes producing the segment [z] after sonorants even more unlikely for the Norwegian learners than producing this segment after vowels. This is illustrated in the tableau shown in (40) below.

(40)

| moa/n+S/ | *z | SO$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|---|
| 💣a) ns | | | * |
| ☹b) nz | *! | * | |

In this tableau candidate b) wrongly loses because it violates both the high ranked *z constraint and the $SO_{[lar]}$ constraint. The optimal candidate in this case, a), only violates the low ranked $*Obs_{[lar]}$.

### 2.4.3 Predictions related to the two learning algorithms

From what we have seen above, we may predict that the constraint demotion algorithm provides the learner with ‘quick-fixes’, as the demotions happen in large steps as soon as the learner realizes that the current output is wrong. According to this algorithm, learning the correct laryngeal specification in contexts after sonorants may also be more of a challenge than other after other contexts, as learning this pattern requires two constraints to demote (*z and $SO_{[lar]}$), instead of just one (*z), which is the case for the other contexts where this is relevant. What might save this algorithm, however, is the opening in the theory for universal constraints to appear.

The gradual learning algorithm predicts slow learning, as the constraints move up and down the hierarchy in small steps. However, this algorithm does not allow for universal constraints to appear in the L2 grammar, as they are not already present in the native grammar of the learner.

# CHAPTER 3

# METHODOLOGY

To get a precise account of when and how Norwegian students of English learn the difference of laryngeal feature distribution in the suffixes we are looking into in this thesis, the most appropriate data collecting method would be by following a specific group of students in a longitudinal study. However, due to the limited time that was available for research in preparing this thesis, a cross-sectional investigation had to be conducted. As Lalleman (1996) mentions, the 'most important drawback of cross-sectional studies […] is that we do not know for certain whether different levels of proficiency really represent different phases of the acquisition process', while the disadvantage of longitudinal studies 'is that generalizations are often impossible: The developmental features that are found may be specific for the (small group) of individual speakers'(Lalleman, 1996: p. 9).

In this chapter we will see how this study was carried out. We will see what ethical issues I came across, what age-groups the data was gathered from and what had to be changed for the main study after the pilot study had been carried out and analyzed.

### 3.1 Subjects

For the main study a total of 27 students were interviewed, of which 9 pupils were from a 9$^{th}$ grade, 10 from the first year English class at Videregående Skole (upper secondary school), and 8 from the third year English class of Videregående Skole. In this thesis I will refer to these three classes as U9, GK and VKII respectively. The students from the same classes have been given the same amount of English instruction (counted in years). The level of proficiency varied within the classes, but this has not been taken into account when picking students, which was done randomly.

Only three of the total subject mass had spent time in an English speaking country, and neither of these three had spent more than two weeks of holidays there. The students all had Norwegian as their first language, and none were bilinguals. All but one also came from the same dialectal area; Hammerfest. The last one came from a small town not far from Hammerfest, and it is not likely that the subject's dialectal differences should make the English grammar learning any different from the subjects with Hammerfest dialect. All in all, the three groups were relatively homogenous in terms of their Native language/dialect background and English language learning experience.

### 3.2 Tasks

The subjects were set to make sentences from 27 different pictures. There were three sets of pictures; in the first set (picture 1-9) the subjects had to create sentences in the simple present and inflect verbs in the 3rd person singular. The second set (picture 10-18) contained of much the same pictures, but the subject had to inflect the verbs in the past tense. The third set (picture 19-27) consisted of a picture accompanied by a question. The subject was to answer the question. The possessive was tested for in the last set of pictures, while the plural form was retrieved from all sets.

Instructions were given to make sure the subjects understood their tasks and did not produce progressive forms. The instructions were given in Norwegian not to give the subjects any misleading input. In the cases where English examples had to be given, verbs ending in voiceless obstruents were used to demonstrate the tasks. The subjects were then recorded onto a minidisk player, and the recordings later analyzed.

### 3.3 Items

The target items were a set of 35 English words with the suffixes previously discussed in chapter 2 on background. The items were words whose ending varied between voiced and voiceless obstruents, liquids and nasal sonorants and vowels. An outline of the target items are given in (41) below.

(41)

| | /Obs[-voi]_ | /Obs[+voi]_ | Sonorants | | Vowels_ |
|---|---|---|---|---|---|
| | | | LIQ_ | NAS_ | |
| Past tense | 10(V)<br>11 | 13(-voi)<br>14(+voi)<br>15(L) | 16(-voi)<br>17(+voi) | 12 | 18 |
| 3rd person singular present | 1(V) | 3(-voi)<br>4(+voi)<br>5(L) | 6(-voi)<br>7(+voi)<br>8(L) | 2 | 9 |
| Plural | 9<br>18 | 11<br>27 | 1<br>10 | 21 | 19 |
| Possessive | 25 | 19 | 20 | 21(-voi)<br>22(N)<br>27(+voi) | 23(+voi)<br>24(N)<br>26(-voi) |

Numbers refer to the picture used to obtain the items, and the contents of the brackets refer to what type of segment immediately follows the tested item. V=vowel, L=liquid, N=nasal.

The actual items are given in (42) below.

(42)

| | /Obs[-voi]_ | /Obs[+voi]_ | Sonorants | | Vowels_ |
|---|---|---|---|---|---|
| | | | LIQ_ | NAS_ | |
| Past tense | pick (apple)<br>walk | rob (Peg)<br>rob (Ben)<br>rob (Lisa) | call (Peg)<br>call (Ben) | scream | play |
| 3rd person singular present | pick (apple) | rob (Peg)<br>rob (Ben)<br>rob (Lisa) | call (Peg)<br>call (Ben)<br>call (Lisa) | scream | play |
| Plural | cat<br>cat | dog<br>dog | apple<br>apple | pen | eye |
| Possessive | Matt | Peg | Bill | Ben (pen)<br>Ben (nose)<br>Ben (dog) | Lisa (bike)<br>Lisa (nose)<br>Lisa (pen) |

As we can see from these figures, the items ending in voiceless obstruents have not been specifically tested with consideration to contexts immediately following them. This is because the suffixes' voicing patterns in these items in English are parallel to the patterns of Norwegian, and we therefore do not expect Norwegian learners to err when distributing voicing after them. The plural suffix has not been tested for these contexts either, as it was difficult to control these environments, and as testing the two other *s/z* suffixes should be sufficient to make claims about whether the immediately following segment makes a difference to the suffix's voicing. As we can see, the remaining suffix contexts have been checked.

### 3.4 Analysis

After the recordings were done, they were transferred to a computer, and the sounds were analyzed using Praat (Boersma and Weenink, 2006). Praat is a computer program for speech analyses. It breaks down speech into pitch, formant, spectrogram and cochleograms, and thus enables the user to analyze data fairly objectively. This is particularly useful in our case, as the researcher is not a native English speaker, and may therefore have difficulties distinguishing relevant sounds from each other, such as the voicing distinction between the English [s] and [z].

### 3.5 Ethical issues

To maintain the subjects' anonymity and protect their rights in their participation in the project, informed consent forms were obtained from all subjects. In the U9 and GK classes, the subjects were under the majority age, and therefore the forms had to be signed by their parents as well. For the VKII subjects, this was not an issue. The informed consent form was adapted from Mackey & Gass (2005: p. 33), and translated into Norwegian for the comprehension convenience of the subjects involved.

During the tests, each subject was given a code for the researcher to be able to identify the subject. Subjects K-S are U9 subjects, A-J are from the GK group and T-Æ are VKII subjects. These codes also help maintain the subjects' anonymity, as this prevents their names from being used in the report.

### 3.6 The pilot

Prior to the main study, a pilot test was conducted at a lower secondary school in Tromsø. A total of nine pupils, 3 from each of the classes 8, 9 and 10, were tested for this purpose. These were also native speakers of Norwegian, who had never spent more than a couple of weeks of holiday in an English speaking country.

For this study the target items were a set of 33 English words that took the suffixes that were tested for in the main study in addition to the contracted *is*. The items were controlled for pre-suffixal segments, but not for segments immediately following them. The items for the pilot study can be seen in (43) below.

(43)

| | /Obs[-voi]_ | /Obs[+voi]_ | Sonorants | | Vowels_ |
|---|---|---|---|---|---|
| | | | LIQ_ | NAS_ | |
| Past tense | pick<br>walk | rob | call | scream | play |
| 3rd person singular present | pick<br>walk | rob | call | scream | play |
| Plural | cat | dog | apple | pen | shoe |
| Possessive | Matt | Peg | Bill | Ben | Lisa |
| Contracted is | cat<br>bike | flag<br>dog | apple | pen | Lisa |

The results of the pilot can be seen in (44)-(48) below.

(44) Pilot results - Past tense

| PIC | output | | 10th grade | | | 9th grade | | | 8th grade | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | segm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 7 | 8/8 | Obs[-voi] | t | t | t | t | t | t | ~~ed~~ | t | t |
| 8 | 7/8 | Obs[-voi] | | $\boxed{\text{ass}}$ | t | t | t | t | ~~ed~~ | t | t |
| 9 | 8/8 | NAS | t | d | t | d | d | | ~~ed~~ | t | t |
| 10 | 7/8 | Obs[voi] | d | d | t | d | | $\text{ɖ}^{h}$ | ~~ed~~ | t | t |
| 11 | 8/8 | Vowel | d | d | d | d | d | $\text{ɖ}^{h}$ | ~~ed~~ | d | d |
| 12 | 8/8 | LIQ | t | $\text{ʔ}^{d}$ | t | d | d | $\text{ɖ}^{h}$ | ~~?~~ | d | d |
| | 43/45 | | | | | | | | | | |

White areas: correct suffix output form

Shaded areas: incorrect suffix output form

Crossed out areas: discarded results

As we can see from (44), the success rate for Norwegian learners of English when it comes to the right voicing of past tense suffixes is high. The only problem that occurred with this test was when subject 7 produced the vowel+d suffix in most contexts, perhaps as a result of the stressful test situation.

(45)Pilot results - 3rd person singular present

| | output | | 10th grade | | | 9th grade | | | 8th grade | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PIC | | segm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 8/9 | Obs[-voi] | s | s | s | s | s | s | | s | s |
| 2 | 9/9 | Obs[-voi] | s | s | s | s | s | s | s | s | s |
| 3 | 8/9 | NAS | s | | s | s | s | s | s | s | s |
| 4 | 8/9 | Obs[voi] | s | s | | s | s | s | | s | s |
| 5 | 9/9 | Vowel | s | s | s | s | s | s | s | s | s |
| 6 | 8/9 | LIQ | s | s | | s | s | s | s | s | s |
| | 49/54 | | | | | | | | | | |

In (45) we see that the subjects have a high score of suffix realizations in the case of 3rd person singular present, although the output form itself is not necessarily correct.

(46) Pilot results - plural

| | output | | 10th grade | | | 9th grade | | | 8th grade | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PIC | | segm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1 | 8/9 | LIQ | | s | s | s | s | s | s | s | s |
| 2 | 8/9 | Obs[voi] | | s | ks | s | s | s | s | s | s |
| 5 | 8/9 | Obs[-voi] | s | s | s | s | s | s | s | | s |
| 7 | 8/9 | LIQ | s | s | s | s | s | s | | s | s |
| 8 | 6/9 | Obs[voi] | | s | s | s | s | s | | s | |
| 11 | 8/9 | Obs[-voi] | s | s | s | s | s | s | s | | s |
| 13 | 9/9 | Vowel | s | s | s | s | s | s | s | s | s |
| 15 | 8/9 | NAS | | s | s | s | s | s | s | s | s |
| | 63/72 | | | | | | | | | | |

As with (45) we see that the subjects realize the suffix in most instances, although the correct voicing does not always occur.

(47) Pilot results - possessive

| | output | | 10th grade | | | 9th grade | | | 8th grade | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PIC | | segm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 13 | 8/9 | Obs[voi] | s | s | s | s | s | s | | s | s |
| 14 | 9/9 | LIQ | s | s | s | s | s | s | s | s | s |
| 15 | 9/9 | NAS | s | s | s | s | s | s | s | s | s |
| 18 | 8/9 | Obs[-voi] | s | s | s | s | s | s | | s | s |
| 19 | 9/9 | Vowel | s | s | s | s | s | s | s | s | s |
| 21 | 9/9 | NAS | s | s | s | s | s | s | s | s | s |
| | 52/54 | | | | | | | | | | |

This suffix is the one that the students scored best with when it came to the rate of suffixes realized. As with (45) and (46) we see that the success rate of the voicing is not necessarily equally high.

(48) Pilot results - contracted *is*

| | output | | 10th grade | | | 9th grade | | | 8th grade | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PIC | | segm | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 14 | 1/9 | Obs[-voi] | | s | | | | | | | |
| 16 | 0/9 | Obs[voi] | | | | | | | | | |
| 17 | 0/9 | LIQ | | | | | | | | | |
| 18 | 1/9 | Obs[-voi] | | s | | | | | | | |
| 19 | 2/9 | NAS | | s | | | | | | s | |
| 20 | 2/9 | Vowel | | s | | | | s | | | |
| 21 | 2/9 | Obs[voi] | | s | | | | s | | | |
| | 8/63 | | | | | | | | | | |

As we can see from (48), the rate of contracted auxiliaries that were realized for this set of tests is not particularly impressive. The students were all more prone *not* to contract these, even though they were instructed to do so, and so only three of the nine subjects contracted to some extent.

After analyzing the results of the pilot, it became clear that certain changes had to be made. Some of the pictures had to be changed to control the outputs better. For instance, a picture from set 3, where the question was 'Which colour are Peg's shoes' obtained answers that were difficult to interpret. In a sentence such as 'Peg's shoes are black' the possessive suffix tended to assimilate with the following segment when it came to place of articulation. To prevent this, the following word was controlled to start with a vowel. This was done to maximize the difference between the manners of articulation of the two adjacent segments. In addition, to further check what kinds of impact the following segment might have on the voicing of the suffix, the four different types of contexts (voiceless obstruents, voiced obstruents, sonorants and vowels) were controlled for in every environment. This was done for all suffix types except the plural suffix, which was found too difficult to control for these contexts, and hence we have to rely on the 3$^{rd}$ person singular present tense and possessive suffixes for the [s/z] voicing pattern. The contexts are not controlled for after suffixes tagged to unvoiced obstruents, because the results from these items in the pilot were so good that it was felt to be unnecessary.

When it comes to the problem seen in (48), where the output rate of the contracted third person auxiliary is only 8/63, this part of the test was excluded from the main test. This is defended by the fact that we have three other *s*-endings to test, which should give us sufficient grounds to make predictions about how the Norwegian learners deal with this kind of pattern.

# CHAPTER 4

# RESULTS

In this chapter the results from the main study will be presented. First we will see what impact the preceding segments have on the laryngeal feature of the suffixes. Then the results from the segments immediately following the suffix will be presented. This will all be linked to the learning curves of the different endings and how the different age-groups cope with the different patterns, depending on whether they are similar or different in Norwegian and English.

## 4.1 Impact of the preceding segments for the suffix voicing

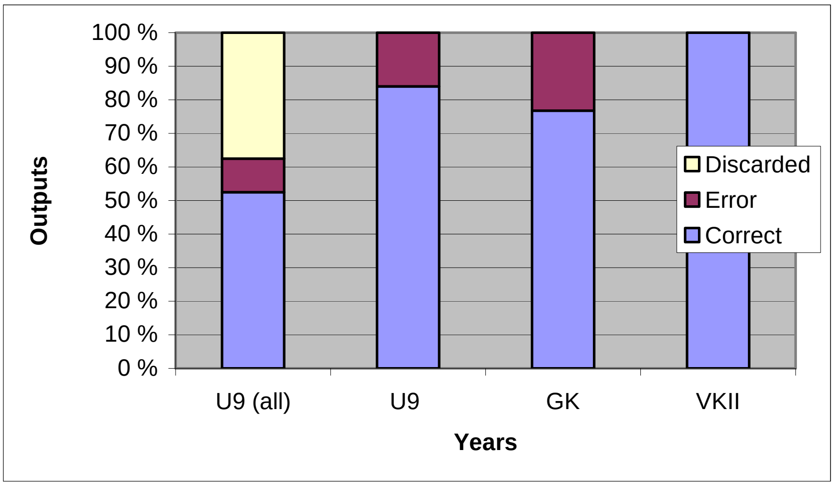
The main part of the tests conducted was to check how the segments preceding the suffixes impact the laryngeal specification of these endings. For the past tense suffix I presumed that initially there would be problems with the endings after sonorants, since this is where the patterns are different in Norwegian and English, but that this would improve in the older age groups. For the *s*-suffixes I predicted that the learners would have problems with the voiced suffix in all contexts because Norwegian does not have any voiced fricatives, and because there were similar patterns in Norwegian where the unvoiced fricative appeared in all contexts. And, as we saw in chapter 2, (40), the right result after sonorants would be difficult even where the *z constraint was not ranked high, due to $*Obs_{[lar]}$ being ranked below $SO_{[lar]}$, and thus there would be less realizations of [z] after sonorants than after vowels and voiced stops.

### 4.1.1 Past tense

As we saw in chapter 2, the past tense suffixes in Norwegian and English overlap in all contexts but one; after sonorants. From this it was predicted that if the learners simply transfer the Norwegian pattern to English, they would produce the right outputs after unvoiced and voiced obstruents and vowels, but err after liquid and nasal sonorants. This should, after all, be quite likely seeing that the suffixes carry the same meaning and look almost identical. In this section we will see how the subjects dealt with the past tense suffix in contexts that overlap in English and Norwegian, and in the context after sonorants, which is the only context for the past tense suffix that does not overlap between the two languages. The overall pattern for how the subjects dealt with the suffix after obstruents and vowels, where the languages overlap, can be seen in (49) below. The pattern that appeared after sonorants can be seen in (50) further down.

In the graphs in this chapter, the 'discarded' results are results produced by the U9 learners as [ed]. These have been included because the shape of the learning curve depends on whether these results are discarded or not. This will be discussed further down. The 'error' results are the results produced by the subjects that do not match with the grammar of the target language, and the 'correct' results are the results produced by the subjects that match the English grammar.

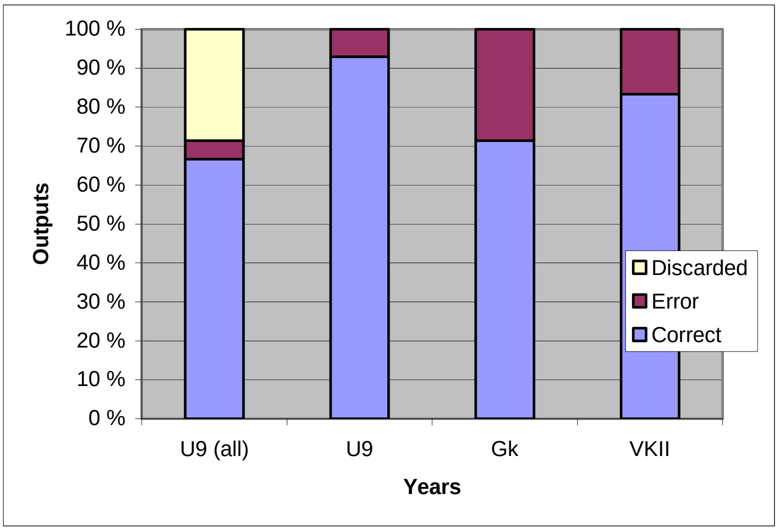
(49) Past tense suffix in context where Norwegian and English overlap




From the graph in (49) we see that if we do not take into consideration the discarded endings from the U9 group, the acquisition of the past tense suffix in contexts where the English and Norwegian patterns overlap is in fact u-shaped, as there is regression in proficiency between the U9 and the GK groups. If, however, we do take into consideration the [ed] endings that were produced by the U9 group, the shape of the learning curve is more straight, and there is no regression between the U9 and GK groups. From the graphs in (49) we also see that the subjects from the VKII group produced all the suffixes in these contexts correctly. If we compare the results where the patterns in the two languages overlap with the results after sonorants, where the two languages differ, we see that the error rate is much larger after sonorants, as seen in (50).

The sonorants are the only segments after which the past tense suffix patterns do not overlap in Norwegian and English. Therefore it is predicted that this is the context where Norwegian learners will have the most difficulties. Three items of this kind were given to each subject. The first ended in a nasal [m] from the verb ‘scream’. The second and third were both instances of the liquid [l] from the verb ‘call’. The results of the sonorant tests can be found in (50) below.

(50) The past tense preceded by sonorants



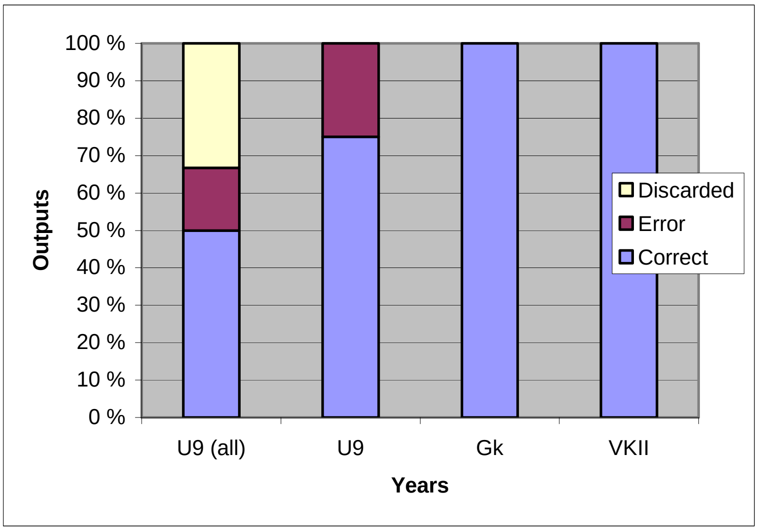

In this graph we see that after discarding the [ed] outputs from the U9 group, 92.9% of their outputs are correct. The correct result cannot be said to have been influenced by the following segment in this case, as the correct output score for both the segments followed by a voiceless and a voiced obstruent are 100%.

As we can observe above, we find that there has been a regression in proficiency between the U9 and GK group. In this case the GK group again has a correct output rate of only 71.4%. The result of this group is, however, less surprising than the U9 group, as the subjects from the GK group show good control over producing the suffix form, although it comes out with the Norwegian pattern. The U9 group seems more confused about how the suffix is formed, and it is therefore surprising that so many of the outputs are correct.

In the VKII group there is only one subject that consistently transfers the Norwegian pattern of [t] after sonorants to English. Other than this there is one instance of a wrong output made by a different subject. This makes the correct output rate 83.3%, an increase from the GK group.

For unvoiced obstruents preceding the past tense suffix, the subjects were tested with two items, both [k]. After this segment the predicted ending is an unvoiced [t] following both the Norwegian and English grammar, as they overlap in this context. The first item is from the verb ‘pick’ and the second from the verb ‘walk’. The results can be seen in (51) below.

(51) The past tense ending preceded by unvoiced obstruents

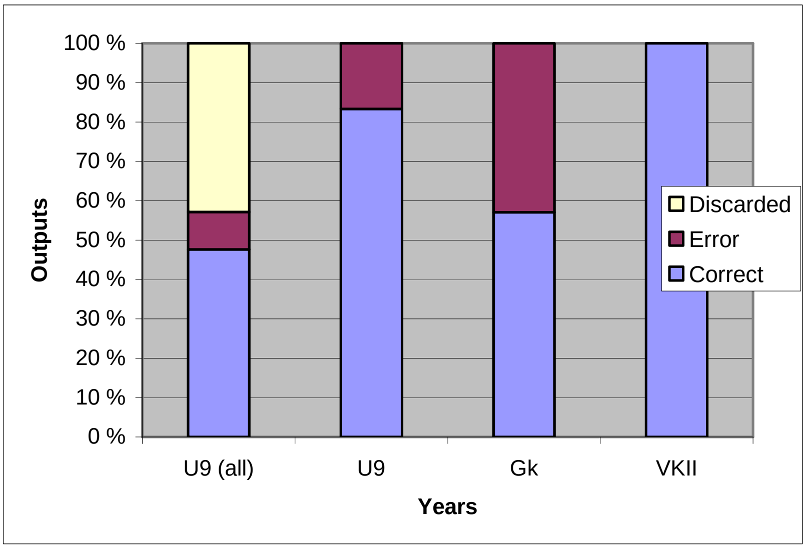



The errors in this graph refer to the instances of realization where the students produced the suffix with the wrong voicing specification, in this context as [d]. The correct outputs are [t]’s as is expected from both the Norwegian and English grammar. From this graph we see, as we have seen before, that the learners from U9 have problems with the past tense form. Four of the outputs had to be discarded because the suffixes cannot be used as results for the tests we are doing, as they were realized as [ed]. This is more than likely direct influence from the written language. Two other items are not realized. This leaves 75% correct outputs after discarding the [ed] outputs.

In this context where the suffix voicing pattern overlaps in Norwegian and English, the GK group does not appear to have any problems. They produce 100% correct outputs in this context. This also applies for the VKII group, as we can see from (51).

After voiced obstruents the Norwegian and English past tense suffix patterns overlap, as they both take the voiced suffix [d]. Due to this, we would expect to find a pattern which is similar to what we found in (51). Voiced obstruents before the suffix are tested in three items in the past tense form. These items end in [b] from the verb 'rob'. The results from these tests can be seen in (52) below.

(52) The past tense ending preceded by voiced obstruents



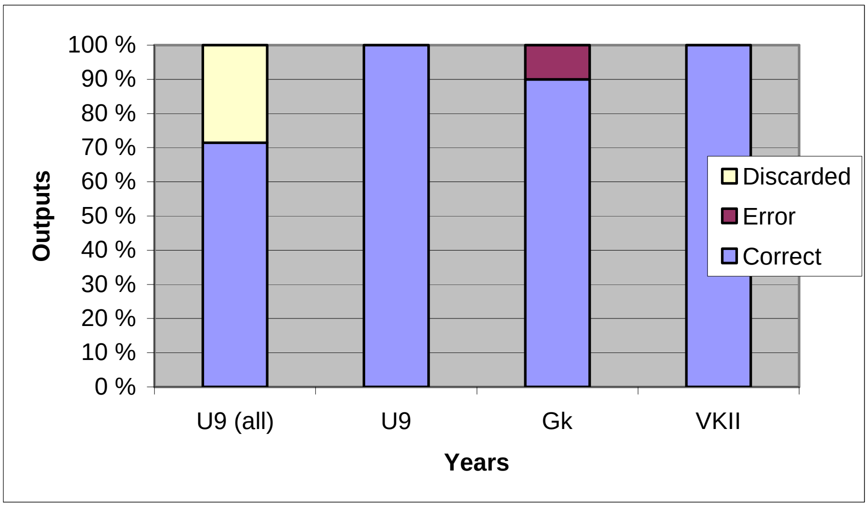

With the U9 group we again find that all the outputs of three of the subjects have to be discarded due to invalid suffix outputs. This gives us 83.3% correct outputs for this group after discarding the [ed] results. The group produces two incorrect outputs, which is surprising due to the fact that the pattern should be predictable for Norwegian learners, and because these outputs appear in contexts where there are no segments in the immediate surrounding that would trigger devoicing.

As suggested previously in this chapter, we can see a regression in proficiency when it comes to the GK group's use of the past tense suffix. In this graph we see that the correct output is only 57.1%. Again it is surprising to see that the wrong output in a context where the pattern overlaps with Norwegian should be so high. It is also difficult to suggest that the following segment has something to say for the result, as the correct scores for b_p, b_b and b_L respectively are 50%, 50% and 70%. Hence, the voiced and voiceless obstruents following the suffix do not make any difference, and it would therefore be peculiar to suggest that the liquid would have something to do with the picture.

Also in this case we see that the jump in proficiency between the GK and VKII group when it comes to the past tense suffix is great. In this graph we find 100% correct outputs. Indeed, where we would expect the cases in (51) and (52) to be quite similar, the tests show evidence for voicing after voiced obstruents to be a pattern which is more difficult to learn than devoicing after unvoiced obstruents.

The last context in which the Norwegian and English voicing pattern for past tense suffixes overlap is after vowels. Here both languages realize the suffix as a voiced [d]. Vowels before the past tense suffixes are tested for in one item for each subject. This is realized as a diphthong [eɪ] in the verb 'play'. The results from this test can be found in (53) below.

(53) The past tense ending preceded by a vowel



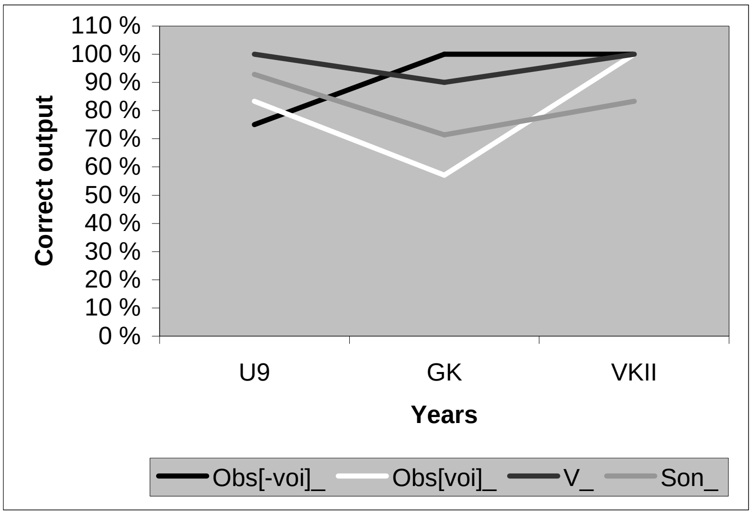

From this graph we see that of the suffixes that were realized properly by the U9 group, 100% were correct. Two of the outputs had to be discarded, however, making up 30% of the total outputs for this group.

We also see that the GK group have 90% correct outputs. This is almost as good as seen for the unvoiced obstruent preceding the same suffix. The VKII group again shows 100% correct outputs in the past tense form.

To conclude, we see that the learning curve for the past tense suffix is u-shaped, particularly when it comes to the forms that appear after sonorants (50) and voiced obstruents (52). Unvoiced obstruents and vowels preceding the past tense suffix are generally the contexts where the students do not appear to have many problems generating the correct output voicing for the suffix

The differences are most prominent in the U9 and VKII groups. In (54) below we see the overall shape for the learning of past tense voicing in English by Norwegian learners.

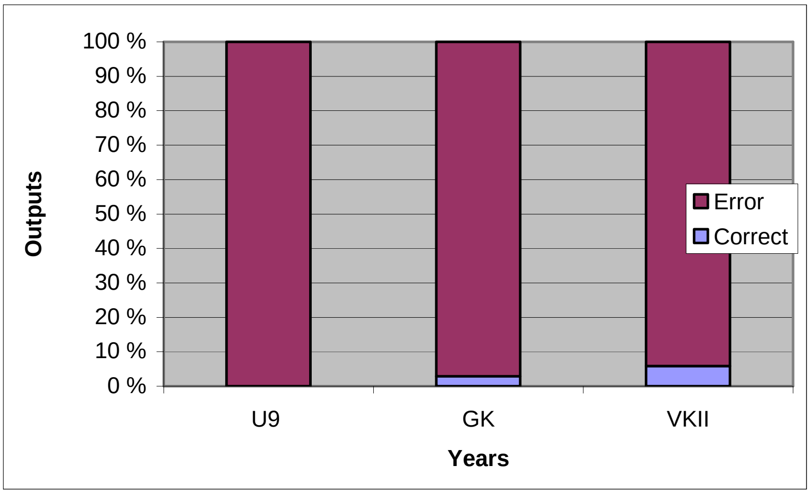
(54) Learning curves for the past tense suffix




### 4.1.2 *s*-endings

As described in chapter 2, the *s*-endings found in Norwegian and English differ somewhat due to the simple fact that Norwegian does not have any voiced fricative segments in its phonetic inventory. This means that the unvoiced [s] surfaces in all contexts where such a suffix occurs in Norwegian. In addition, this suffix, in some cases, triggers regressive assimilation unlike the English *s*-endings that we have looked at which trigger progressive voicing assimilation. For English three such endings were tested for; the third person singular present, the plural and the possessive. The results from all three endings will be presented together, and if there are any striking mismatches between the three, they will be commented on further down. First I will give an overview of how the s-endings are realized in contexts where the Norwegian and English pattern do not overlap. This can be seen in (55) below.

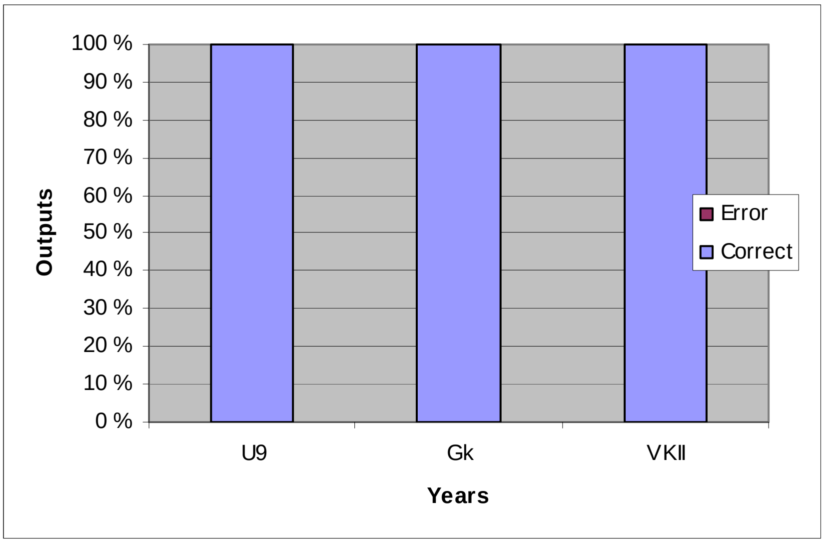
(55) *S*-endings in contexts where Norwegian and English do not overlap




From the graph we can see that the learning curve for the s-endings in the contexts where Norwegian and English do not overlap is quite straight. There are no signs of regression as we saw for the past tense ending. Compared to the context after voiceless obstruents, as seen in (56), which is the only context where Norwegian and English overlap when it comes to this suffix, the difference in mastery between the two are dramatic.

The first context that will be presented here, is the one context where the s-suffixes in English and Norwegian overlap; namely, after unvoiced obstruents where both languages have unvoiced [s] surfacing. For the third person singular present an item ending in [k] ‘pick’ was tested. For the plural the item ‘cat’ ending [t] was tested twice per subject, and finally, for the possessive, the proper noun ‘Matt’ ending in [t] was tested once per subject. Because this pattern overlaps with Norwegian, and Norwegian learners are predicted to have problems with the voiced counterpart to [s], the learners were anticipated to only produce [s] segments in this context. The results are shown in (56) below.

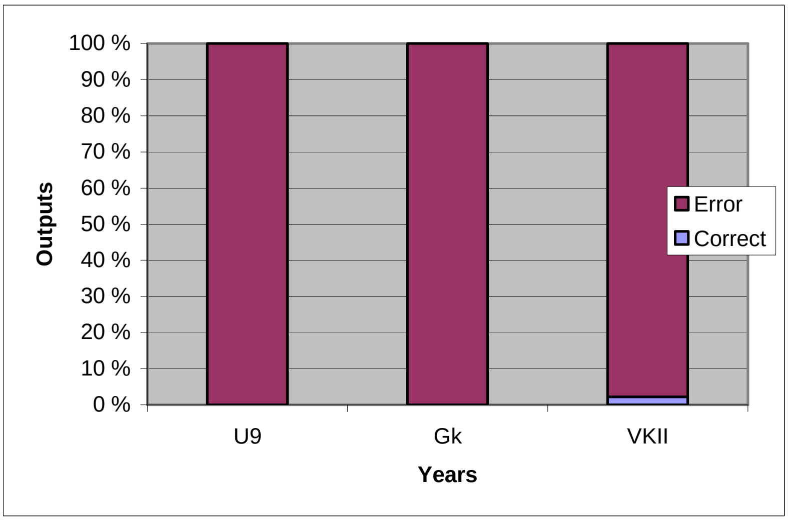
(56) *S*-endings preceded by voiceless obstruents




From this graph we see that the correct outputs are 100% for all three groups. What cannot be seen from the graph is that the plural form seems to be causing some trouble for the U9 subjects, as 35.7% of the possible output forms are missing. So we see that where the Norwegian and English suffix patterns overlap, the outputs are always correct.

The remaining contexts before the s-endings do not overlap with the Norwegian system, however, and are therefore likely to cause more trouble for the learners. First off, we will have a look at the results from the contexts with voiced obstruents preceding the endings. For the third person singular present, this context was tested for three times with the segment [b] in the word 'rob'. These were also controlled for different contexts after the ending, as we will see under 4.2.2 below. For the plural, the context was tested twice with the segment [g], both times in the word 'dog'. Finally, for the possessive, this was tested once with the segment [g] in the proper noun 'Peg'. This item was also controlled for the context immediately following the ending with a vowel. The results from this test are seen in (57) below.

(57) *S*-endings preceded by voiced obstruents

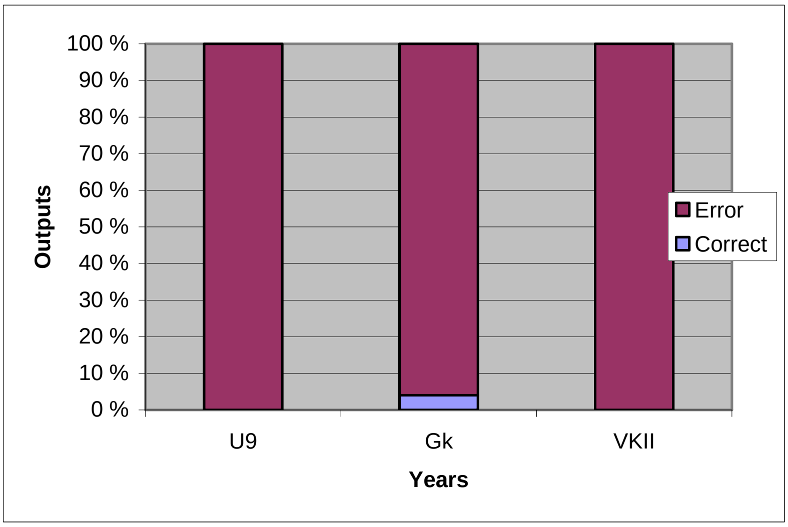



For both the U9 and GK groups the correct outputs for this context is 0%. For two of the items we find that two subjects from the GK group produce regressive devoicing, as one would get in some of the *s*-suffixes in Norwegian. Thus ‘peg’s eyes’ is realized as *pe[ks]eyes* and ‘dogs’ is realized as *do[ks]* once each.

For the VKII group there is actually evidence that the subjects pick up the English voiced fricative form at some point during the course of their L2 learning. The one instance of the correct output only makes up 2,2% of the outputs, but this instance of [z] gives us evidence that the learners do not just transfer the Norwegian pattern when it comes to the *s*-suffix.

The second context where the pattern is different from the Norwegian one, is after vowels, where we also would get [z] as the output in English, but the unvoiced counterpart in Norwegian. For the third person singular present this context has been tested once per subject with the diphthong [eɪ] from the word ‘play’ preceding the ending. For the plural ending the context was tested once as well, with the diphthong [aɪ] from ‘eye’ preceding the ending. And finally, for the possessive, it was tested three times, all items with [ə] from the proper noun ‘Lisa’. These three instances were also controlled for the following segment, as seen in 4.2.2 below. The results of the tests involving vowels preceding the *s*-endings can be seen in (58) below.

(58) *S*-endings preceded by vowels



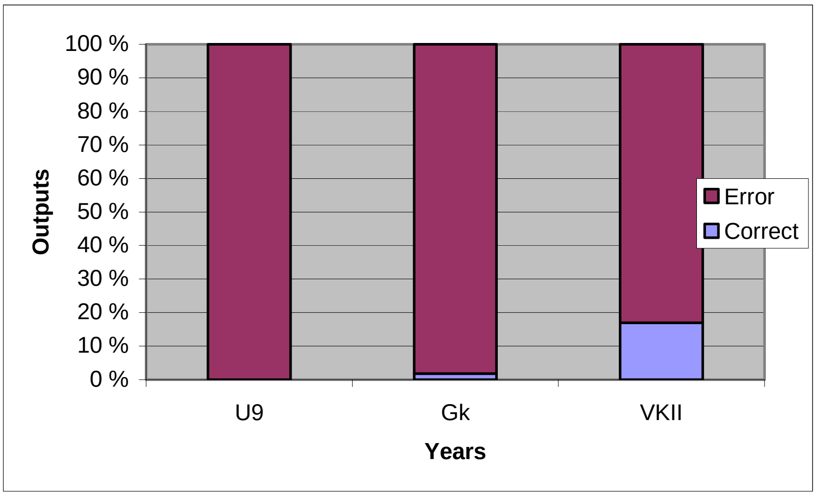

Also in this graph we see that the U9 group has good control over the production of the endings, but the correct output forms still remain at 0%.

From the U9 group in (58) we see a slight increase in correct outputs in the GK group, as one of the subjects from this group voices two of the endings in this context. This gives 4% correct output forms. This particular subject, however, has an impressive correct output of 40% after vowels. The correct outputs are found in contexts that are fully voiced, that is, with a voiced segment both preceding and immediately following the *s*-ending; either V_b or V_N.

The VKII group shows slightly worse results than the GK group in this case, as they have 0% correct outputs.

The last *s*-ending pattern that does not overlap in English and Norwegian is after sonorants, where we would find [z] in English, and of course [s] in Norwegian. The sonorants have been tested with both liquid sonorants and nasal sonorants. The results will be presented separately for both kinds of sonorants. First we will have a look at the liquids, which are tested three times for the third person singular present, twice for the plural and once for the possessive. For the present tense, the liquid [l] from the verb ‘call’ was used. This was also controlled for the immediately following segments to check whether this made any difference for the output. For the plural the word ‘apple’ was used to control the environment, and for the possessive, the proper noun ‘Bill’. The results from these tests can be found in (59) below.

(59) *S*-endings preceded by liquids




From this we see that the correct output rate for the U9 group again is 0% in a context where the voiced segment [z] should occur in the English grammar.

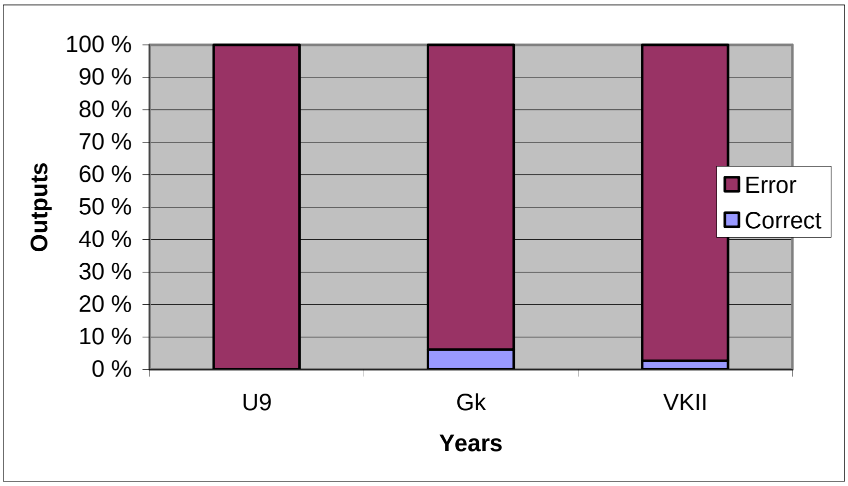
The GK group has 1.8% correct outputs after liquids. As under (58), one of the subjects provides us with evidence of the group learning the voiced [z] segment in this position, although there is only one instance of this. As with the voiced instances under (58), the environment where we find the voiced ending in this case is also fully voiced, with a voiced sonorants liquid preceding it, and a voiced obstruent immediately following it.

The VKII group produces impressive 17% correct outputs in this context. Here we see clearly that there is an increase in proficiency when it comes to voicing of this suffix segment between the VKII group and the two years younger GK group. Also in the cases where we find voicing here, most of the instances occur in contexts that are fully voiced, that is with either a voiced obstruent or a voiced liquid immediately following the segment in addition to the voiced liquid before. However, there is one instance produced by a subject where the voicing occurs even before an unvoiced stop.

Finally, the last group of sonorants that were controlled and tested for before the *s*-endings, were nasals. This was tested once in the third person singular present, once for the plural, and three times for the possessive. For the third person singular present the segment [m] from the verb ‘scream’ was used, and for the plural the [n] from ‘pen’ was used to control the environment preceding the endings. For the Possessive

[n] from the proper noun ‘Ben’ was used in all three instances and these were also controlled for the immediately following segment as well. The results from these tests can be found in (60) below.

(60) *s*-endings preceded by nasals



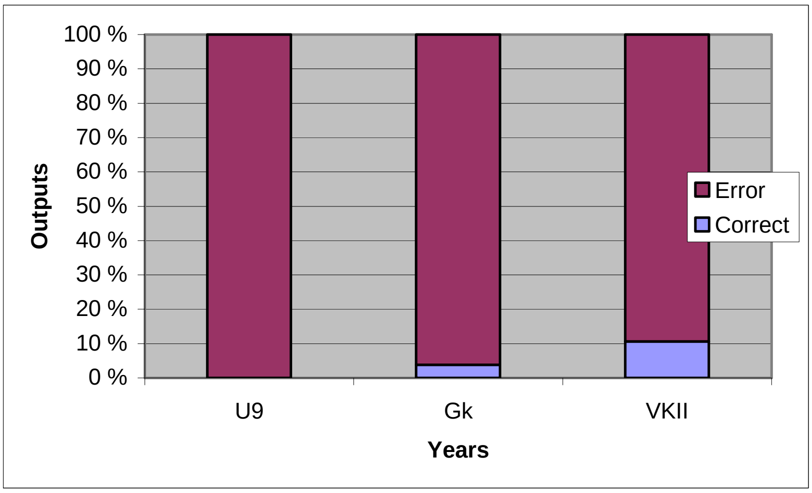

In this graph we see that the U9 group produces 0% of the output forms with the correct voicing.

We also see that there is an increase in proficiency for the *s*-ending after nasals, as the GK group produce 6.1% correct outputs in this context. Two out of three of these are produced in fully voiced contexts, as mentioned before, either between two nasals, or with a voiced obstruent following the ending.

From (60) we see that there is not much change from the GK group to the VKII group, although the results for the VKII subjects are in fact slightly weaker than the younger group after nasals. 2.6% of the outputs in this context are correct.

To give a clearer picture of the overall situation with the sonorants, the graph in (61) has been provided. There we can see that the learners show steady increase in proficiency when it comes to producing the correct laryngeal feature in *s*-endings after sonorants.

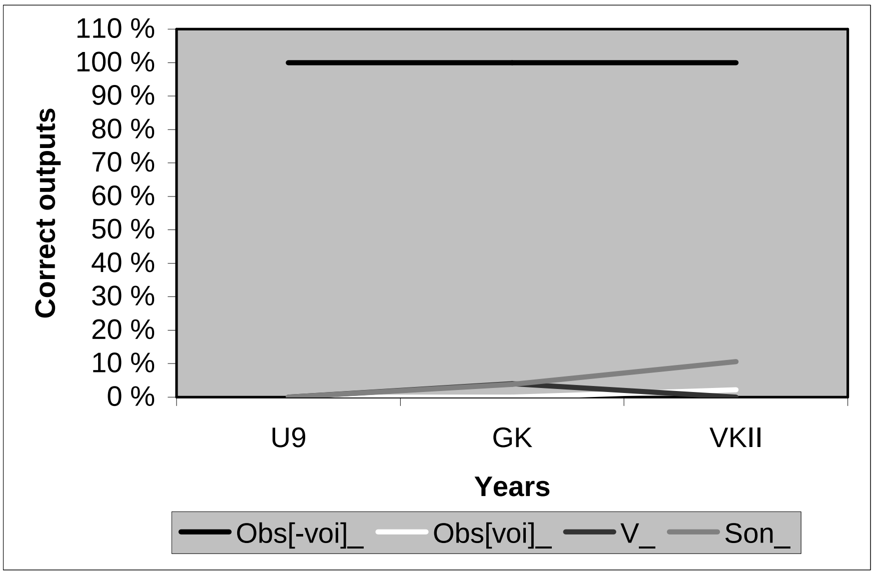
(61) *S*-endings preceded by sonorants




From the tests done with the s-endings, we find evidence for the voicing of the preceding segment to have an impact on the voicing of the ending. The results of the segments following the unvoiced obstruents do not tell us much, as it was predicted that [s] would follow these segments. Not only because this voicing pattern overlaps with Norwegian in this context, but also because the voiced segment [z] does not exist in the Norwegian grammar. However, the stronger is the evidence when we do find occurrences of [z] by the subjects. These can be found after all remaining types of segments, but most of all after liquids.

The general learning curve for the s-endings can be seen in (62) below.

(62) The learning curve for *s*-endings




What is interesting to note is where the [z]'s occur. This is shown in (63) below.

(63) Contexts where [z] occurs with Norwegian learners of English:

$C_{[voi]\_}$: 1 = 6.25%

$C_{[-voi]\_}$: 0 = 0%

L_: 9 = 56.25%

N_: 4 = 25% } 81.25%

V_: 2 = 12.5%

Total = 100% [z] segments

As we can see 81.25% of all realizations of [z] appear after a sonorant segment. It seems that Norwegian learners find it easiest to apply the voiced segment [z] for the *s*-endings just after sonorant consonants. This shows us that the Norwegian learners do not simply transfer the Norwegian past tense or *s*-suffix paradigms to the English grammar, but pick up the English paradigm for these endings and apply them to the inter language. This is clear because the voiced segment [d] for the past tense will not occur after sonorants in Norwegian, and therefore [z] would not occur after these segments if the Norwegian past tense paradigm was simply transferred to the English language's *s*-endings. However, the subjects had about twice as many chances to produce *s*-endings after sonorants compared to after voiced obstruents and vowels. This does not make a difference to the percentages seen, though.

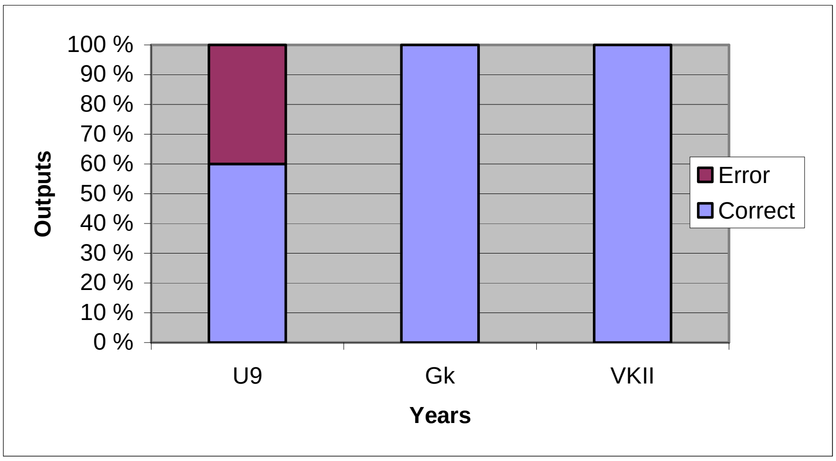
### 4.2 Impact of following segments for the suffix voicing

After conducting the pilot test, the issue of whether the learners would find it easier to generate the correct output in ideal contexts, that is with both preceding and following segments to support the suffix output was addressed and the decision was made to research the impact of the following segments in addition to the preceding contexts. As Norwegian has regressive assimilation in most of the suffix forms that we looked into in chapter 2, it is not unreasonable to believe that this pattern might transfer to the learner's English grammar, as we also saw in chapter 2 under (38) (do/G+S/=do[ks]) when *z >> *Obs$_{[lar]}$.

#### 4.2.1 Past tense

For the past tense suffix [t] or [d] the subjects were tested for one item where the following segment was the vowel [æ] from the word 'apple'. The results from the different groups can be seen below.

(64) The past tense suffix followed by a vowel



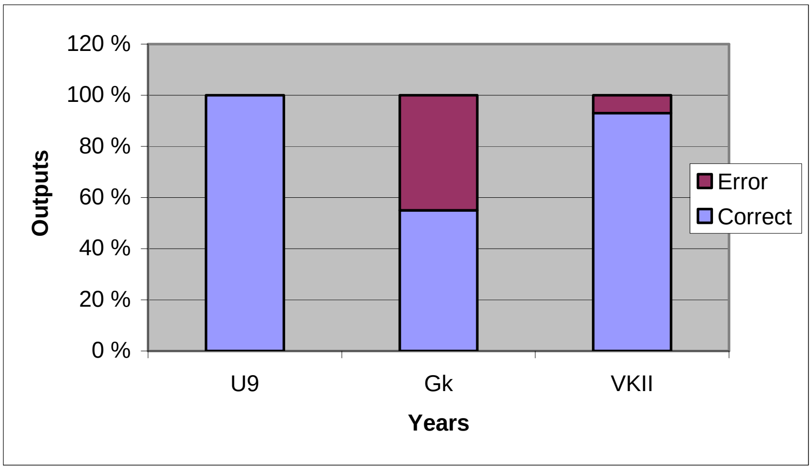

From this table we see that the U9 group produces the correct output in 60% of the cases when a vowel immediately follows the suffix. When dealing with the impact of voicing from segments following the past tense ending, I will not include the discarded results as in 4.1.1 above.

In the case of the GK group, only one of the subjects did not produce a past tense ending with this item. Here we find that the correct output (of the realized ones) is 100%.

The VKII subjects had 100% correct output. The good results found in the GK and VKII groups may not be a direct result of the vowel following the suffix segment as the preceding segment, which in this case was an unvoiced obstruent [k], would predict the suffix to follow the same pattern as Norwegian, which is the same for English in this case.

The subjects were given two items each for the past tense suffix where an unvoiced obstruent [p] in ‘Peg’ followed the suffix segment; the theory being that this might cause regressive devoicing as the Norwegian adjectival agreement marker for neuter singular does. This context was tested after suffixes following the voiced obstruent [b], after which the Norwegian and English pattern are similar and would trigger a voiced suffix, and following a liquid [l] from ‘call’ where a grammar following the Norwegian pattern would trigger an unvoiced suffix, whereas the English pattern would show a voiced suffix. The results from this test can be seen in (65) below.

(65) The past tense suffix followed by an unvoiced obstruent



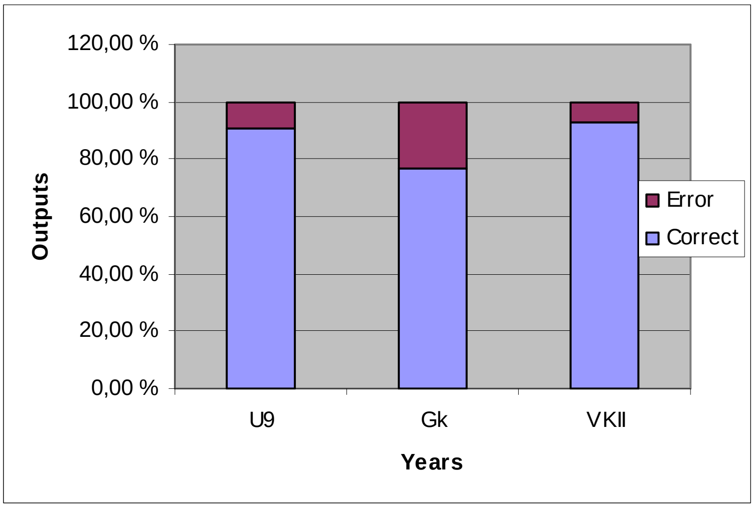

As in (64) above, we find that three of the subjects from the U9 group have problems producing a past tense ending that is not influenced by the written language. In the instances where a valid suffix ending is produced, though, all are correct and have not gone through regressive assimilation which could have been triggered by the following segment. 100% of the valid output is correct for this group.

For the GK group we see that the learners' proficiency in producing this suffix has decreased from the two years younger learners seen in U9. However, the GK group has a 100% valid output rate, and the subjects do not produce endings that are influenced by the written language anymore. The correct output rate is only 55%. One of the subjects from this group also produces progressive voicing assimilation, as the learner produces the unvoiced [p] in 'Peg' as [b] after the voiced suffix giving *call[db]eg* for 'called Peg'.

We see great alternation in proficiency between the GK and VKII group. The VKII learners have 93% correct outputs. However, the one instance of wrong output form from subject Y is not evidence for regressive assimilation, as the segment preceding the suffix, the sonorant [l], will trigger a voiceless output if subject Y follows a Norwegian grammar. And indeed, as can be seen from other data provided by this subject as well, this subject does produce voiceless past tense suffixes after all sonorants, which is an indication that this learner does not produce regressive assimilation, but rather follows the Norwegian pattern of past tense marking.

In Norwegian, as we have seen in the background chapter, there are no voiced suffixes that trigger regressive assimilation. Therefore, it is not predicted that the voiced obstruents should have such an impact on the suffixes that have been tested for. The subjects were given two items each that were controlled for a following voiced obstruent [b] for 'Ben'. The first follows a suffix tagged to a voiced obstruent [b] from the word 'rob', where we would expect a voiced suffix as a result of both a Norwegian and English grammar. The second [b] follows a liquid sonorant [l] from the word 'call', where one would expect an unvoiced [t] in a Norwegian grammar and a voiced [d] if the learner uses the English pattern. The results can be seen in (66) below.

(66) The past tense suffix followed by a voiced obstruent



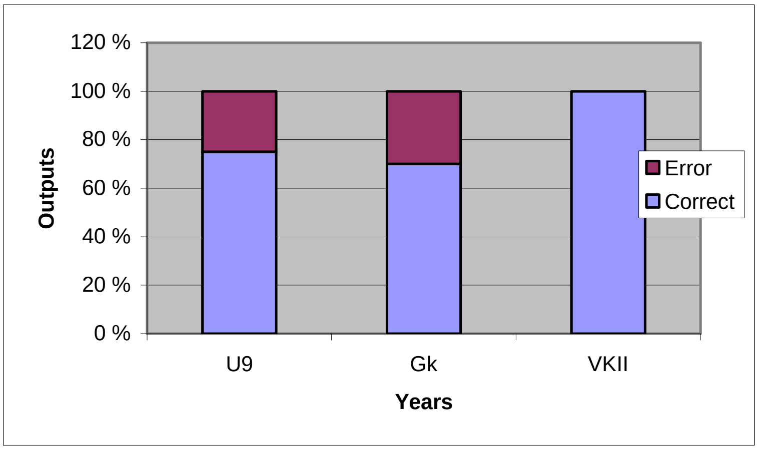

As we have seen before from the U9 results under (64) and (65), some of the subjects produced past tense endings that were unexpected in this test. Other than this, the results are very good for these contexts. The correct output is 90.9% of the outputs that were not discarded. Two results from this group are surprising, however. First of all one of the subjects produces an unvoiced [t] after the voiced obstruent, where one would assume the right output result due to the Norwegian and English grammars concurring in this context. This cannot be said to be an effect from the following segment, however, and will not be discussed here. The second surprising result is produced by a different subject, where the segment we have controlled for in this test, [b], has been devoiced creating *rob[d]pen* for 'robbed Ben'. There does not seem to be any reason for this, as neither of the surrounding segments would encourage this.

Also in this graph we see a regression in the learning curve from the U9 group to the GK group. The GK group does, however, have a higher valid output rate than the U9 group this time as well. For the GK group 76.5% of the outputs are correct. As with the U9 group we find the wrong output segments in the contexts where one would expect a learner with a Norwegian grammar to have no problems, that is after voiced obstruents, whereas the second context, after sonorants, which in theory should cause more problems, are 100% correct. In this situation, as with the U9 group, it is not possible to blame the segment following the suffix, as this segment should have triggered the correct voiced suffix output.

As seen under (64) and (65) above, the VKII group does a major proficiency jump compared to the GK group. Here we can see that the correct output again is 93%, where the only mistake is not likely to be caused by the following segment, as it occurs after a sonorant, which may be the cause of devoicing.

Finally, for the past tense, sonorants following the suffix have been tested before one item in the form of a liquid [l] from ‘Lisa’. This was preceded by a voiced [b] from ‘rob’, after which one would expect voiced [d] from both the Norwegian and the English grammar. The results of these tests are found in (67) below.

(67) The past tense suffix followed by a sonorant




In the U9 group, after discarding three of the results, only one of the outputs was wrong. This leaves a correct output rate of 75%. The wrong output, a voiceless [t], may have been triggered as a result of the following liquid, although there are no sonorant suffixes in Norwegian to support this hypothesis. And certainly there are words in Norwegian, such as ‘mandler’ (almonds) where the correct consonant sequence does occur.

The GK group has a larger output rate than the U9 group. Three of the outputs were wrong, which leaves 70% correct outputs for this group. This also means that for this context the results are closer to the U9 group than in the previous cases in (64) to (66).

As with the three cases above, the VKII group also scores very high in this case. The 100% output rate of which everything is correct shows that the following segment does not make a difference for this group.

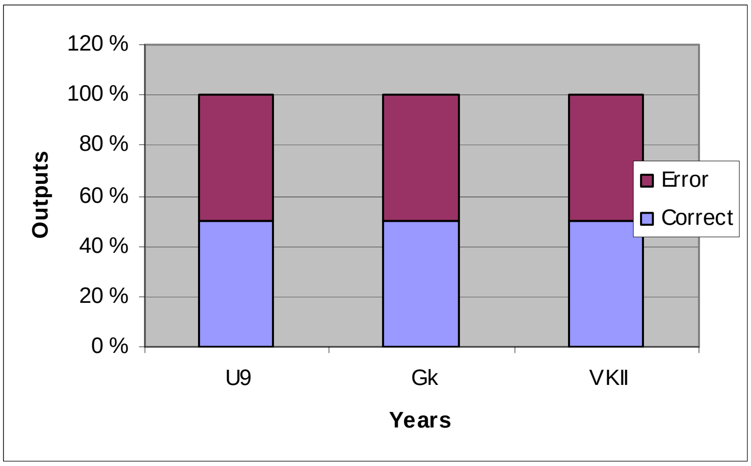
As we have seen in the tables in (64) to (67) above, there is no evidence suggesting that the voicing of the segment immediately following the past tense suffix has any impact on the voicing of the ending itself.

### 4.2.2 *s*-endings

The *s*-endings were also tested for the same contexts immediately following the suffix sound as the past tense suffix to see whether any type of segment would influence the realization of the suffix. In addition to a liquid sonorant, there were also instances of nasal sonorants in this position. As mentioned in chapter 3 on methodology the items that took the plural form were not controlled for these different environments due to the problem of properly controlling for this, so that the two *s*-endings that were tested for the following segment were the third person singular present verbs and the proper nouns that took the possessive form.

First the results where a vowel followed the ending are presented. For the third person singular this vowel was [æ] from the word ‘apple’, which followed an unvoiced obstruent [k] from the verb ‘pick’. Following unvoiced obstruents we expect an unvoiced suffix to occur in both the Norwegian and English grammar. For the possessive, the diphthong following the ending was [aɪ] from the word ‘eye’. This was preceded by a voiced obstruent [g] from ‘dog’. After voiced obstruents we expect a voiced suffix following the English grammar, but Norwegian does not have this segment. The results from this test are shown in (68) below.

(68) *S*-endings followed by vowels



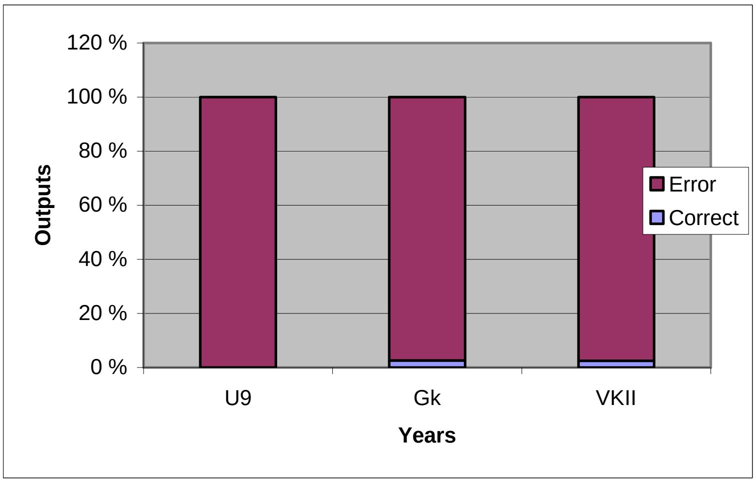

From this table we see that when the following segment is a vowel, it does not make a difference to the ending. The subjects from the U9 group produced [s] in both contexts, and hence there is a 50% correct output.

The GK group shows the same pattern as the U9 group, as the correct output is 50%, where the wrong outputs are in contexts where the English grammar generates an output segment that is not present in the Norwegian grammar.

Also for the VKII group, the ending does not seem to be affected by the following segment, as the correct outputs occur where the English and Norwegian pattern overlap and the wrong outputs are where the [z] should occur. As for the U9 and the GK group above, the correct outputs in this context are 50%.

For unvoiced obstruents following the ending, the subjects were tested on four items each. For the third person singular present, the two items that followed the ending was [p], both in the form of a proper noun ‘Peg’. This was preceded by a voiced obstruent [b] from the verb ‘rob’ in the first instance, after which we would expect a voiced suffix ending following both the Norwegian and the English pattern. The second instance was preceded by a liquid [l] from the verb ‘call’, after which a voiced [z] should follow if the learner has utilized the English grammar, and a [s] should follow when using a Norwegian grammar. For the possessive ending, the two segments that followed were also [p]’s, but from the noun ‘pen’. In the first instance this was preceded by a nasal [n] in the proper noun ‘Ben’, after which a voiced ending should occur according to the English pattern, and the opposite would appear following the Norwegian grammar. The second instance was preceded by a vowel [ə] in the proper noun 'Lisa'. This would be followed by a voiced [z] in the English grammar, but an unvoiced [s] in the Norwegian grammar. The results from this test can be seen in (69) below.

(69) *S*-endings followed by unvoiced obstruents




From this graph we see that the U9 group produce no correct outputs for any of the endings. This may not be due to the fact that the segment following the endings is unvoiced, but simply because they do not produce any voiced segments for these endings at all at this point.

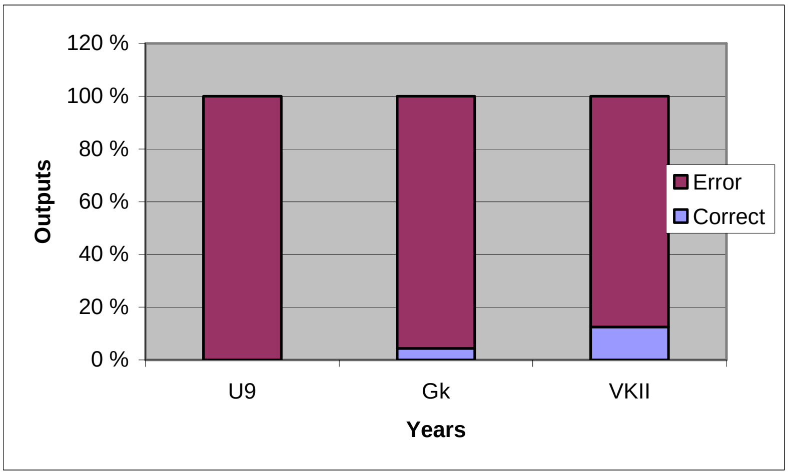
From the GK group we see evidence for that when the following segment is an unvoiced obstruent, it does not affect the voicing value of the ending, as there is one occurrence of a voiced segment after the nasal before the voiceless obstruent by subject H. This only gives 2.6% correct outputs, but the wrong outputs can be predicted from the Norwegian grammar, and therefore the following segment cannot be said to have any direct impact on these results.

Also in the VKII group evidence can be found that the following unvoiced obstruent does not have any impact on the voicing output of the ending. Here we find that the correct output is 2.5%, being one occurrence of [z] after a sonorant by one of the subjects.

The subjects were tested for five items where the following segment was a voiced obstruent. Two of these occurred after a verb in the third person singular present, and three after a possessive noun. The two instances after the verbs were voiced obstruent

[b]'s from the proper noun 'Ben', where one occurred after a verb ending in a voiced obstruent [b] in 'rob', and the other after a liquid [l] in 'call'. After both of these one would expect a voiced [z] to occur if the learner follows the English pattern and an unvoiced [s] if the learner is following the Norwegian pattern. Of the three instances following a noun in the possessive, two are [b]'s from the word 'bike', and the last segment is a [d] from the word 'dog'. The first instance follows a noun ending in a liquid [l], the second a vowel [ə] and the third a nasal [n] after all of which one would expect a voiced output [z] in the ending if the learner follows the English pattern, but an unvoiced [s] if the learner has transferred the Norwegian pattern. The results can be seen in (70) below.

(70) *S*-endings followed by voiced obstruents



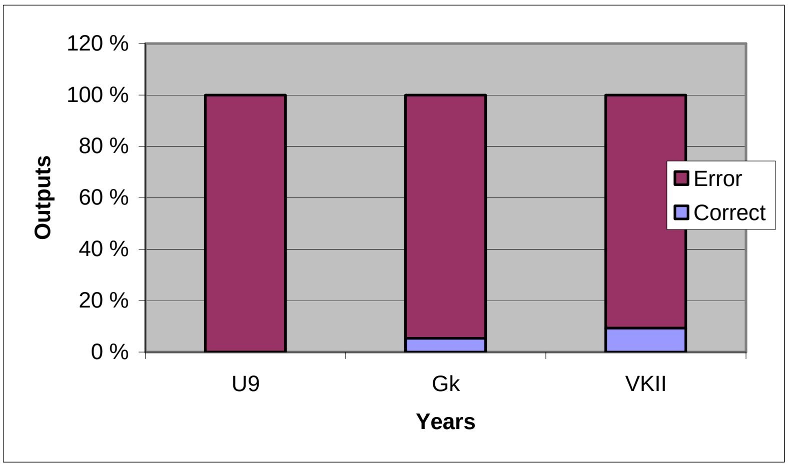

From this graph we see that with the U9 group the fact that the following segment is a voiced obstruent does not make a difference for the ending, as it follows the Norwegian pattern in all cases where it is realized. There are no correct output forms for either of these two endings.

In the GK group one of the subjects produces two instances of correct output, which gives the whole group 4.4% correct outputs in this context. Another subject has realized an unvoiced [p] where the voiced [b] should occur after the s-ending, which cannot be accounted for in any other way than by suggesting this is progressive devoicing from the suffix [s].

The VKII group shows 12.5% correct outputs in this case. For this group one of the subjects has picked up the English pattern better than the rest, as three of the five instances of correct outputs are produced by the same person. From the results seen above, it is possible that the voiced obstruent following the ending has positive influence on the voicing of the suffix. However, it does seem like the voicing occurs after similar contexts; after liquids for the most part, so that the effect of the following segment may only play a secondary role, and work as an extra booster for the voicing.

The test for the sonorants following the endings are divided in two; the subjects were given two items that were followed by liquids, and two items that were followed by nasals. The liquids were realized as [l]'s in the proper noun 'Lisa', and occurred only in the third person singular. First the liquid appeared following a verb ending in a voiced obstruent [b] in 'rob', and secondly following a verb ending in a liquid [l] in 'call'. After both these segments it is predicted that the ending is voiced when following the English pattern, and unvoiced following the Norwegian pattern. The nasals were realized as [n]'s in the noun 'nose', and occurred only after possessive nouns. First the nasal appeared following a proper noun ending in a nasal [n] in 'Ben', and secondly it appeared following a vowel [ə] in 'Lisa'. After both these segments it is also predicted that the ending is voiced when following the English pattern and unvoiced following the Norwegian pattern. The results can be seen in (71) below.

(71) *S*-endings followed by sonorants




From this we see that for the U9 group the sonorant consonants following the ending do not make a difference for the voicing of the ending. The Norwegian pattern is in use everywhere. Again neither of the endings gets any correct outputs in this context.

For the GK group the overall correct output is 5.3%. However, both of the rightly produced endings appear as a possessive ending, which makes the correct output for the possessive 10%, and 0% for the 3rd person singular present.

The VKII group has correct outputs for 9.3%. Again the right output appears particularly in context in between sonorants; that is either in between two liquids, or two nasals.

For the *s*-endings we have seen that when a vowel or unvoiced obstruent immediately follows the ending, nothing can be found in the results to suggest that these have any substantial impact on the voicing of the preceding suffix. When voiced obstruents and sonorants take this position, the results are more unclear. We see that these are positions where voicing rather occurs than anywhere else, but the voicing also never appears after segments where it should not occur in English; that is, the distribution of the voiced segment [z] where it occurs is always correct. The tests of the effect of the segment following the suffixes may also be affected by the fact that there is no assimilation across word boundaries in Norwegian that we could expect to transfer to the acquisition of English. There is only regressive assimilation from suffixes which are specified for underlying laryngeal representation in Norwegian, as the adjectival marker.

### 4.3 The preceding and following contexts combined

In this section we will see how the contexts preceding and following the suffixes may work together to affect the realization of the suffix.

#### 4.3.1 Individual cases

When analysing the data from the tests, it became a task to find out how the native speakers would realize the voiced [z] in suffix positions. Therefore, three native speakers were consulted, one from Canada, one from the United States and one from Great Britain. Even though the geographical and dialectal ranges between these are great, the same pattern appeared within all their realizations of the crucial segments; neither subjects voiced their *s*-endings in either of the contexts where this segment should appear as voiced. Following from this, it is not surprising that the Norwegian learners should not pick up the laryngeal feature pattern of the *s*-endings as quickly as one might expect if they only have to transfer the voicing paradigm from the past tense endings, and learn a new sound [z]. However, some input with voiced [z]'s after the appropriate segments must occur for the results that we have seen above to develop, and therefore there must exist native speakers who behave like the textbooks claim they would, at least to some extent. The learners may get this input from tv, music from other native speakers etc.

The grammar of three of the subjects will be given a brief outline of here. That is E and H from the GK group, and W from the VKII group. E shows a grammar that has a 100% correct output rate for the past tense form, realizes three [z] segments and has an overall output rate of 100%. The voiced fricative endings are realized in the contexts l_b, V_b and V_N respectively.  H, on the other hand, has a more unclear grammar. For the past tense suffix, the grammar looks like what is shown in (72) below.

(72) Subject H

| k_V | k_ | m_ | b_p | b_b | b_L | l_p | l_b | V_ |
|---|---|---|---|---|---|---|---|---|
| t |  | t | t | d | d | t | d | d |

As we can see, the suffix follows the Norwegian pattern and is realized as voiceless stops after the sonorants [m] and one of the liquids. There is also an instance of a voiceless [t] after a voiced obstruent [b]. Both the voiceless stop after [b] and [l] may be due to regressive laryngeal assimilation from the following segment. This might be supported as the suffix after the liquid before a voiced obstruent is realized as a voiced obstruent [d]. What is surprising with the grammar of this subject is that two voiced fricatives are realized in the possessive, both after nasals, where the same subject went wrong with the past tense pattern earlier. The [z]'s are produced preceding a voiceless stop [p] and a nasal respectively, and the fact that the unvoiced [p] does not cause regressive assimilation in this instance might therefore suggest that the [p] following the past tense suffix as seen in (72) may not have had something to do with the devoicing of these two segments either.

W is another subject who has 100% correct outputs for the past tense. This subject also realizes four [z] segments; three in the third person singular present and one for the possessive. These all appear in completely voiced contexts, either between two voiced obstruents, two liquids or a mix of the two. This again supports the theory that the following segments may simply add as a secondary trigger for which voicing occurs in the suffix forms, so that if a segment is realized in a fully voiced context, the likelihood for the ending to be voiced is larger than if it was only preceded but not followed by a voiced segment.

# CHAPTER 5

# ACQUISITION THEORIES AND ANALYSES

In this chapter the results presented in chapter 4 above will be applied to the two learning algorithms as outlined in section 2.3. We will see how these cope with the different patterns that appeared both when it comes to the shape of the learning for the two different suffix types and the variation that occurred within the speakers of each group. It will become clear which of the two fares better with the data collected from the Hammerfest informants.

## 5.1 Error Driven Constraint Demotion

First we will see how constraint demotion as described in section 2.3.1 above can account for the data seen in chapter 4.

### 5.1.1 *S*-endings and Constraint Demotion

As we saw in chapter 4, the *s*-endings were acquired steadily through the year groups that were tested. We also found that the voiced suffix occurred sooner after sonorants than after vowels and voiced obstruents. However, as the acquisition of the voiced *s*-ending was still in its beginning phase even for the oldest group that was tested, we see that the laryngeal contrast of the *s*-endings is acquired very slowly and at a late stage of the second language acquisition.

First we will have a look at how constraint demotion may account for the acquisition of *s*-endings after voiced obstruents. If we assume that the Norwegian learners take as their starting point the constraint ranking that applies to the *s*-suffixes in Norwegian that take regressive voicing assimilation, the result may look like what we see in (73) below.

(73)

| do/G+S/ | | SO$_{[lar]}$ | AGREE | MAX$_{[lar]}$ | *z | *Obs$_{[lar]}$ | *z |
|---|---|---|---|---|---|---|---|
| a. gz~gs | | | W | | L | | |
| b. gz~ks | | | | | | W | L |

Given that the Norwegian learners start off with this constraint ranking, *doks* would be the most harmonic output before applying constraint demotion. If we apply constraint demotion to this starting point, the most frequent output for the Norwegian learners in this context, *dogs*, will not be predicted to be produced by the learners at all, as the *z constraint is the only constraint which is triggered to demote. When *z demotes below Agree, there is nothing left to yield *dogs* from these constraints. It is unfortunate to predict *doks* in this context, as this pattern only occurs in 2 out of 64 items within the GK group. To get the right result in this case we need a constraint which blocks the high ranked Agree constraint and secures the root faithfulness. This constraint can be either OO-FAITH which makes sure the output is faithful to the previously generated output, and therefore does not work on the suffix which has not been through the evaluation before, or a constraint ROOT-FAITH, which makes sure the root output is identical to the root input. For now I will assume OO-FAITH to be the needed constraint. As the possessive marker is the only productive *s*-ending we have in Norwegian, and UEN is the dialect with most influence over the Northern Norwegian dialect, it is plausible to assume that, although speakers of the Hammerfest dialect do not use this suffix in everyday normal speech, they are able to use it correctly in situations where this would be desirable. In (74) we see a tableau that shows how the Norwegian constraint ranking would generate do[gs] rather than do[ks].

(74)

| do/G+S/ | *z | OO-FAITH | Agree | *Obs$_{[lar]}$ |
|---|---|---|---|---|
| a) gz | *! | | | |
| ☞b) gs | | | * | * |
| c) ks | | *! | | ** |

As we see from the tableau in (74), candidate a), which is optimal in the target language, loses because it violates the high ranked constraint *z. Candidate c), which would win with the ranking seen under (73) above, loses because it violates the constraint OO-FAITH, due to devoicing of the voiced segment [g] in the root. This ranking gives us as the optimal output candidate b), which is the most common type of output seen in the results from chapter 4 in this context. Therefore, I will assume the constraint ranking for the possessive ending in Norwegian to be the one that is transferred initially to the English inter language when Norwegian learners start producing *s*-endings. This can be seen in (75) below.

(75)

| do/G+S/ | | OO-FAITH | $SO_{[lar]}$ | Agree | $MAX_{[lar]}$ | *z | $*Obs_{[lar]}$ |
|---|---|---|---|---|---|---|---|
| a. gz~gs | | | | W | | L | |
| b. gz~ks | | W | | | | L | W |

From the tableau in (75) we see that the starting point for the constraint demotion is correct, as the OO-FAITH constraint makes sure the candidate which is faithful to the root is the optimal candidate. *z then moves to the stratum below Agree and $MAX_{[lar]}$, as this is as far as it has evidence to move. The constraint going through demotion can only move down to the stratum immediately below the highest ranked constraint that is violated by a losing candidate, in this case Agree.

For the contexts where the *s*-endings are preceded by a vowel, the situation when applying constraint demotion to account for the acquisition will look like the tableau in (76) below.

(76)

| play+/S/ | | OO-FAITH | $SO_{[lar]}$ | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ | *z |
|---|---|---|---|---|---|---|---|
| z~s | | | | | | W | L |

Here we see that after vowels, the only constraint that needs to demote to obtain the correct output result, is *z. In the original ranking this constraint blocks the voiced suffix from appearing in its right context, and yields the voiceless suffix, as it would in Norwegian. This constraint is moved to the very bottom of the hierarchy as the constraint violation which is favouring the winner, $*Obs_{[lar]}$, is ranked in the bottom stratum originally.

In (77) below we see how constraint demotion accounts for the acquisition of the voiced suffix ending after sonorants.

(77)

| be/n+S/ | | OO-FAITH | | Agree | MAX[lar] | *Obs[lar] | SO[lar] | *z |
|---|---|---|---|---|---|---|---|---|
| nz~ns | | | | | | W | L | L |

The tableau in (77) shows us that again both *z and SO[lar] need to demote to make sure the learner produces the right optimal output according to the native English grammar. In this case they have to move to the stratum below *Obs[lar], as this is the only constraint that is violated which is in favour of the winner.

The tableaux in (73)-(77)suggest that for the learners in question it should be more time consuming to learn to produce the right output after vowels and sonorants than after voiced obstruents, as the constraint *z has to move further down the hierarchy to yield a voiced suffix after vowels, and in addition the SO[lar] constraint needs to be moved to a lower stratum for the ending after sonorants to be produced correctly. From the results we saw in chapter 4, we see that this does not concur with the facts. The learners have a high output rate of voiced suffixes after sonorants, but the rate of voiced suffixes after vowels and voiced obstruents is much the same (see section 4.1.2). In fact, the process that CD predicts should take longest, that is [z]'s after sonorants, is the process that is learnt first.

This is a problem that can easily be fixed by applying a universal constraint to the native Norwegian grammar. Because Constraint Demotion assumes an initial ranking with Markedness over faithfulness (Prince and Tesar, 2004), all grammars have many constraints that are ranked too low to make a difference in the grammar of the given language. Markedness over faithfulness as the initial ranking in child grammars is also given evidence for in work by Gnanadesikan (1996; 2004) who also argues that the phonological constraints are universal and innate due to the emergence of the unmarked in child languages. According to the theory of the emergence of the unmarked, these constraints that remain 'hidden' in the native grammar may be activated again in the acquisition of a second language. For instance, speakers of Mandarin, where no obstruent codas are allowed, show a tendency to devoice final voiced obstruents when learning English as a second language (Broselow et al., 1998).

The data we have seen produced by the Norwegian learners of English show evidence for the emergence of the unmarked after sonorants, where the Norwegian grammar, through the constraint SO$_{[lar]}$, makes sure a voiceless obstruent occurs, while the data shows that the learners more easily produce the voiced obstruent [z] in this context rather than after voiced obstruents and vowels. According to Pater (1999), in clusters with a nasal followed by an obstruent the obstruent is more likely to be voiced than unvoiced. In Norwegian, as we have seen previously, it is unvoiced. Children also tend to produce unvoiced obstruents after nasals at a later stage than voiced obstruents. Therefore there is a universal constraint *NC̥ (No nasal/voiceless obstruent sequences) (Pater, 1999: p. 5). This constraint may have appeared in the inter language grammar of the Norwegian learners of English. However, it must be modified to apply to all sonorant segments, as the pattern is even more likely to appear after liquids than nasals with these learners. I will assume this constraint to be *SC̥ (No sonorant/voiceless obstruent sequences). How this affects the analyses can be seen in (78) below.

(78)

| be/n+S/ | | OO-FAITH | | *SC̥ | *z | SO$_{[lar]}$ | Agree | MAX$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|---|---|---|---|---|---|---|
| nz~ns | | | | W | L | L | | | W |

In (78) we see that if the universal constraint *SC̥ emerges in the second language acquisition, and is in the stratum below SO$_{[lar]}$, the acquisition of [z] after sonorants should happen more quickly than after voiced obstruents and vowels because the constraints with loser marks have a shorter way to travel down in the hierarchy before the optimal output appears.

The ranking of the *SC̥ constraint in the native Norwegian grammar can be explained by faithfulness delay (Prince and Tesar, 2004). They assume that constraints are ranked from the initial ranking M >> F. From this state the markedness constraints are first ranked, and only if this does not give the desired result will markedness constraints be demoted below some faithfulness constraint. For Norwegian the case is that there has been no evidence to demote *SC̥ below any markedness constraint when the ranking SO$_{[lar]}$ >> *SC̥ yields the correct result. *SC̥ is therefore ‘invisible’ to the Norwegian grammar, but becomes visible when looking at second language acquisition of English.

### 5.1.2 Past tense suffixes and Constraint Demotion

In chapter 4 we saw that depending on how we read the past tense results for the U9 group the acquisition path for this suffix looks different. If we disregard the [ed] outputs produced by this group, the learning curve is u-shaped. If, however, we include these results, the learning curve is more gradual and similar to that of the s-endings. The difference between these two endings is that for the past tense the Norwegian learners do not have to acquire a new segment in addition to learning the voicing distribution. We therefore assume, and this is also the pattern seen from chapter 4, that the acquisition of this suffix has advanced to a higher level than the *s*-endings.

For the past tense suffixes we found that in the contexts after voiceless obstruents and vowels, the learners did not have many problems producing the correct output form. Voiced obstruents and sonorant preceding the suffix were the contexts that triggered the most incorrect outputs.

First we will see how constraint demotion works in contexts where the suffix follows voiced obstruents. This can be seen in (79).

(79)

| ro/B+T/ | OO-FAITH | $SO_{[lar]}$ | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|---|---|---|
| a. bd~bt | | | W | | W |
| b. bd~pt | W | | | | WW |

From what we see in the tableau in (79), there is no evidence to demote any of the constraints when the past tense suffix is underspecified. The constraints that are violated are both in favour of the winner, and as the situation is such, there is no way the learner can produce the wrong output. As we saw in chapter 4, (52), the learners show great variation in producing the past tense suffix. The U9 group do very well and produce [d] in most of these contexts, but the GK group has a large proportion of [t] surfacing in this context. Some of the subjects show 100% [t]’s after voiced obstruents, whereas others vary between [d] and [t]. The VKII group shows 100%

correct [d] outputs in this context. Therefore, two things need to be accounted for; first of all the u-shaped learning curve, and secondly the variation within speaker grammars in this context.

To account for the [t]'s being realized in this position by the GK learners, it is possible to assume that they have simply changed the underlying suffix segment from /T/ to /t/, as a result of overgeneralizing the [t] after voiceless obstruents to apply for all contexts. This gives us the tableau in (80) below.

(80)

| ro/B+t/ | OO-FAITH | $SO_{[lar]}$ | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|---|---|---|
| a. bd~bt | | | W | L | W |
| b. bd~pt | W | | | L | WW |

In (80) we see that the mark-data pairs do not trigger any demotion, as there are equal violations of loser candidate violations and winner candidate violations. This tableau gives us variation, which is exactly what we get in this context. 42.9% of the outputs from the GK group in this context takes the unvoiced suffix. To get from this variation pattern to the native-like output, the underlying representation simply changes to the underspecified /T/, as seen in (79).

In (81) below we see how the constraint demotion algorithm fares when it comes to the patterns of the past tense suffix that we have seen after vowels.

(81)

| play+/T/ | OO-FAITH | $SO_{[lar]}$ | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|---|---|---|
| d~t | | | | | W |

Again we find that the original ranking of constraints as the learner would transfer it from the Norwegian grammar, does not give any possibility of error for the learner, as there are no constraints favouring the loser. This fits fairly well with the results that we saw in chapter 4 under (53), as all the learners in all age groups, except one from GK, realized this suffix as [d] in this context. To account for the one person's grammar where the suffix is realized as [t] we may adapt the same technique as for the voiced obstruents, and say that this learner has /t/ underlyingly for the suffix. If this is the case, we get the result as seen below in (82).

(82)

| play+/t/ | OO-FAITH | $SO_{[lar]}$ | Agree | | $*Obs_{[lar]}$ | $MAX_{[lar]}$ |
|---|---|---|---|---|---|---|
| d~t | | | | | W | L |

In this case we have to demote $MAX_{[lar]}$ to the stratum below $*Obs_{[lar]}$. With demotion as seen in (82) a problem occurs, as ranking $MAX_{[lar]}$ below $*Obs_{[lar]}$ leads to neglecting the voicing contrast. This may give us a completely different output in this case, as seen in (83) below.

(83)

| /p/lay+/t/ | OO-FAITH | $*Obs_{[lar]}$ | $MAX_{[lar]}$ |
|---|---|---|---|
| a) p-t | *! | ** | |
| b) p-d | *! | * | * |
| c) b-t | | *! | * |
| ☞d) b-d | | | ** |

Here we see that the demotion as seen in (83) above leads to a grammar that is neither Norwegian nor English, and that neither of the subjects produces. This constraint ranking will give us no unvoiced obstruents. The root that is optimal in the native grammar (as seen in a) and b)) loses because the root violates $*Obs_{[lar]}$ in the first evaluation round, which again leads to an output-output violation in the second round, and hence there is no way for the correct output to appear from this grammar. As we saw under (73) above, the constraint that secures root faithfulness over agreement has so far been assumed to be an output-output faithfulness constraint. However, as we see from this case, it has to be a Root-faithfulness constraint, as the evaluation is then not affected by lower ranked constraints, such as $*Obs_{[lar]}$ in this case. How this saves our data can be seen in (84) below.

(84)

| /p/lay+/t/ | ROOT-FAITH | $*Obs_{[lar]}$ | $MAX_{[lar]}$ |
|---|---|---|---|
| a) pl-t | | **! | |
| ☞b) p-d | | * | * |
| c) b-t | *! | * | * |
| d) b-d | *! | | ** |

In this tableau we see that when Constraint Demotion demotes MAX$_{[lar]}$ below *Obs$_{[lar]}$, we still get the right result as the two candidates in c) and d) violate ROOT-FAITH because the /p/ in the input root has been voiced. As ROOT-FAITH does not require a separate evaluation round for the root itself, it does not matter that *Obs$_{[lar]}$ is above MAX$_{[lar]}$ for these two candidates. For a) and b), the ROOT-FAITH constraint is not violated because these two candidates are both fully faithful to the root. Candidate a) loses in the end because it violates the *Obs$_{[lar]}$ constraint one more time than candidate b).

The last context we have to look at with constraint demotion is the past tense form after sonorants. How this works can be seen in (85) below.

(85)

| cal/l+T/ | ROOT-FAITH | | Agree | MAX$_{[lar]}$ | *Obs$_{[lar]}$ | SO$_{[lar]}$ |
|---|---|---|---|---|---|---|
| ld~lt | | | | | W | L |

As we can see here, the correct output can be gained through demotion of the constraint SO$_{[lar]}$ even with /T/ as the underlying representation. If we assume the same underlying representation /t/ as for the rest of the contexts, we have a situation that looks like the one in (86) below.

(86)

| cal/l+t/ | ROOT-FAITH | | Agree | | *Obs$_{[lar]}$ | SO$_{[lar]}$ | MAX$_{[lar]}$ |
|---|---|---|---|---|---|---|---|
| ld~lt | | | | | W | L | L |

From this tableau we see that three constraints need to move down the hierarchy if the underlying representation is /t/ as for the other contexts, which is reasonable to assume. The algorithm explains the patterns seen for acquiring the past tense suffix in different contexts nicely. After voiced obstruents the error rate is initially quite high when the learners assume /t/ as the underlying representation, and the variation is almost 50/50. However, after correcting this to /T/, it is perfect in VKII. When preceded by a vowel there are two constraints that need to be demoted below *Obs$_{[lar]}$, which is slightly quicker to learn than when preceded by a sonorant, when there are three constraints to demote below *Obs$_{[lar]}$.

An additional surprising pattern is realized by the U9 group after voiceless obstruents. Two of the subjects showed variation between the voiced and the voiceless suffix in this context. The only way we can get this result, is if Agree and $*Obs_{[lar]}$ is ranked equally in the constraint hierarchy. Or, if we follow the principle of variation that the algorithm provides, the Agree and $*Obs_{[lar]}$ constraint is stuck in a loop where these two constraints are continuously ranked below each other for each given output produced by the learner.

From the results we saw in chapter 4, the Error Driven Constraint Demotion algorithm explains the patterns seen nicely. For the *s*-suffixes a universal constraint had to be applied, which the algorithm supports. The results shown for the past tense suffix has also been explained thoroughly within the constraint demotion algorithm.

## 5.2 The Gradual Learning Algorithm

In this section we will see how the gradual learning algorithm as presented in section 2.3.2 fares with the data presented in chapter 4 above.

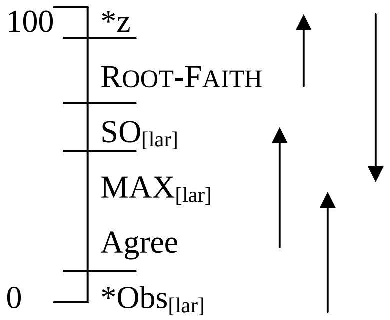
### 5.2.1 GLA applied to s-suffixes

As mentioned under 5.1.1 above, the voicing distinction in the English *s*-endings is acquired gradually by our subjects. We also saw in chapter 4 that the voiced ending appears in contexts following sonorants to a higher degree than in contexts following voiced obstruents and vowels.

I will first apply the gradual learning algorithm to contexts where the *s*-ending is preceded by a voiced obstruent. The result of this can be seen in (87) below.

(87)

| do/G+S/ | *z | ROOT-FAITH | Agree | *Obs$_{[lar]}$ |
|---|---|---|---|---|
| ✓a. gz | *→ | | | |
| b. gs | | | ←* | ←* |
| c. ks | | ←* | | ←** |




After the first reranking we might end up with a ranking looking like this: ROOT-FAITH >> Agree >> *z >> SO$_{[lar]}$, MAX$_{[lar]}$ >> *Obs$_{[lar]}$. This would yield *dogz* instead of *dogs*, and because the constraint Root-Faith has been transferred from the ranking of the possessive marker in Norwegian, we do not get *doks*, as we would without this constraint. GLA therefore accounts for the pattern seen after voiced obstruents made by the learners.

Part two of the figure is there to help the reader picture how the constraints may be predicted to move about in the hierarchy. Although in this case we see the optimal output after only moving two constraints, Agree and *z, the other constraints that have been triggered because they have been violated in favour of the winner, may still move. We do not see any evidence for this thus far though. Considering the restrictions on how these constraints can move to get to the right result after voiced obstruents, we see that we do not need promotion of constraints, as the only constraint that can move anywhere without fatal results for the rest of the English grammar is *z, which has to move down the hierarchy as we saw for constraint demotion under 5.1.1. Hence the promotion principle of the GLA contributes nothing in this case.

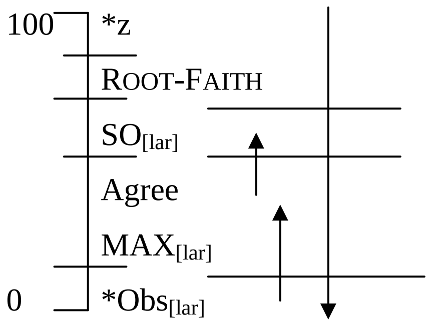
According to what we have seen in (87), the *Obs$_{[lar]}$ constraint is triggered by the GLA to move up in the hierarchy to ensure the right results. To make clearer the results of such a reranking of constraints, (88) below has been added, where we see that *Obs$_{[lar]}$ ranked above *z and Agree gives the wrong voicing in *s*-ending outputs after voiceless obstruents.

(88)

| pic/k+S/ | ROOT-FAITH | *Obs$_{[lar]}$ | *z | Agree | MAX$_{[lar]}$ |
|---|---|---|---|---|---|
| ☹a. ks | | **! | | | |
| 💣b. kz | | * | * | * | |
| c. gs | *! | * | | * | * |

If *z was to move down the hierarchy, and *Obs$_{[lar]}$ to a position above Agree and *z, the optimal output a) would violate constraints that were higher ranked than the loser candidates and therefore the wrong optimal output would be picked. It is therefore crucial that one of the constraints *z or Agree remains ranked above *Obs$_{[lar]}$. The constraint reranking would work approximately as seen in (89) below.

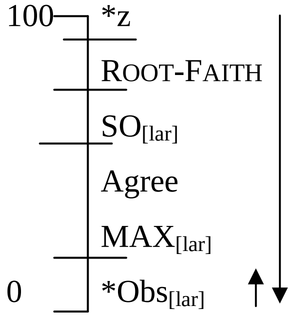
(89)




In (90) below we see how the GLA fares with *s*-suffixes after vowels.

(90)

| play+/S/ | *z | *Obs$_{[lar]}$ |
|---|---|---|
| a. plays | | ←* |
| ✓b. playz | *→ | |

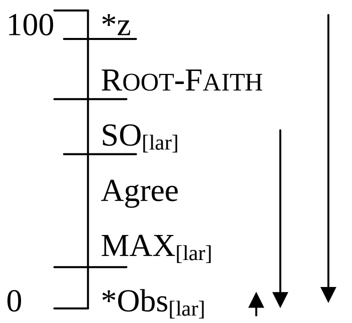


Again we see in (90) that the only constraint that can move to yield the desired result in this case is *z which has to move down. Again the *Obs$_{[lar]}$ constraint has been triggered to move up according to the algorithm, but it cannot move across any constraints, as the closest one is Agree, which again would lead to bad results after voiceless obstruents as seen in (88) above.

For sonorants followed by *s*-endings three constraints are involved in the constraint reranking, as can be seen from (91) below.

(91)

| be/n+S/ | *z | SO$_{[lar]}$ | *Obs$_{[lar]}$ |
|---|---|---|---|
| a. bens | | | ←* |
| ✓b. benz | *→ | *→ | |




In this case we see that two constraints need to be moved down the constraint hierarchy for the output to turn out right. Both SO$_{[lar]}$ and *z needs to move below *Obs$_{[lar]}$ to yield the right result. *Obs$_{[lar]}$ has been triggered to move up the hierarchy again, but also in this case it is not possible for it to move far. Here we see another example of the promotion principle in GLA being of no use, and in fact creating problems for the grammar.

Variation occurs to a small degree in the *s*-suffixes. Most of the variation happens after sonorants, and there are some examples of variation occuring after vowels and voiced obstruents. From (61) in chapter 4 we saw that the VKII group showed the highest rate of correct outputs after sonorants, with 10.2% of all possible [z]'s realized. This can be accounted for in GLA by assuming the *z shares some area in the constraint scale with SO$_{[lar]}$ or *Obs$_{[lar]}$. This has been exemplified in (92) below.

(92)

100

*z *z >> *Obs$_{[lar]}$ /SO$_{[lar]}$ ([bens])

*z, *Obs$_{[lar]}$, SO$_{[lar]}$ (Variation between [bens] and [benz])

*Obs$_{[lar]}$/ *z >> *Obs$_{[lar]}$ /SO$_{[lar]}$ ([bens])

SO$_{[lar]}$

0

From this figure we can see that there is a higher probability for the *z constraint to appear above the *Obs$_{[lar]}$ or SO$_{[lar]}$ constraints in the constraint hierarchy, which produces the voiceless ending after sonorants. There is a small ‘in between’ stage, where the two constraints may swap places and the learner produces voiced endings after sonorants. This will be further explained in (101) and (102) below.

This algorithm does not account for the fact that [z] is realized at a much higher rate after sonorants than other segments by the subjects. As we have seen with the GLA in (87) to (91) above, we would assume that [z] after sonorants is be the pattern that would take longest to acquire. In section 2.1.2 above we saw that this could be accounted for by recognizing a universal markedness constraint *SC̥ as part of the grammar. This issue remains unsolved within the GLA, as there is no such universal markedness constraint already present in the grammar that can be applied to this case because the GLA assumes that second language learning happens through the native language constraint set.

### 5.2.2 GLA applied to the past tense forms

As mentioned above under 5.1.2, the overall picture for the acquisition path of the past tense suffix is dependent on how we regard the results for the U9 group. If we disregard the [ed] outputs produced by this group, the learning curve is u-shaped. If we include these results, the learning curve is more gradual and similar to that of the *s*-endings. The difference between these two endings is that for the past tense the Norwegian learners do not have to acquire a new segment in addition to learning the voicing distribution. The acquisition of this suffix has therefore reached a more advanced level than the *s*-endings.

The learners produced the correct output form for most cases in contexts after voiceless obstruents and vowels. After voiced obstruents and sonorants the subjects had more problems.

For the contexts where the past tense suffix follows a voiced obstruent, we should always get the right result if the past tense suffix is underspecified for voice. This is because neither of the constraints we have violates the optimal candidate. However, as we have seen from the results of the GK group, this is not the case, as this group of learners often produce the unvoiced version of the suffix in this context. It is therefore natural to assume that the underlying representation for the suffix in these cases is /t/. Assuming that the learners have changed the underlying representation for the past tense suffix, and that they start off with a ranking that is similar to the Norwegian grammar for such cases, we will have an initial ranking as seen below:

(93)

| ro/B+t/ | ROOT-FAITH | Agree | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|---|---|
| ✓ a. bd | | | *→ | |
| b. bt | | ←* | | ←* |
| c. pt | * | | | ←** |

In this tableau we see that the ranking of constraints yields variation between voiced and voiceless obstruent in the suffix. Agree and $MAX_{[lar]}$ are initially ranked in the same stratum above $*Obs_{[lar]}$. This means that we have one constraint in favour of the winning candidate and one constraint in favour of the loser in this stratum. ROOT-FAITH will not move, as it is in its ideal position for this context already. The easiest way to fix this grammar, would be for the learner to move Agree and $MAX_{[lar]}$ slightly away from each other, moving them out of the same stratum. This would yield the correct output candidate without variation. Another option is for $MAX_{[lar]}$ to move down slightly and $*Obs_{[lar]}$ to move up slightly so that these two constraints swap places, as this would also yield the correct output without variation. The distance these constraints have to travel to make this happen can be seen in (94) below.

(94)

100 *z

ROOT-FAITH

$SO_{[lar]}$

Agree

$MAX_{[lar]}$

0 $*Obs_{[lar]}$

As we can see, the distance these two constraints have to travel to yield the correct output for the learner is very short, which should mean that the time it takes for the learners to grasp this is also short. This ranking can account for the variation between [d] and [t] in this context, but not the consistent use of [t] only in this context. The problem with this type of reranking, however, is that the learner does not know which of $*Obs_{[lar]}$ or Agree to move up the hierarchy to give the correct result. This has been discussed above in section 2.3.2 and was referred to as *the disjunction problem* (Tesar and Smolensky, 1998: p. 244).

For vowels as well as for voiced obstruents, we can only get the correct target language output forms of the past tense suffix with the given constraints and underspecified underlying representation for the suffix. As we could see in Chapter 4 (53), the voiceless obstruent [t] does occur in this context as well, and therefore we may assume that this learner has changed the underlying representation from underspecified, or without laryngeal feature, to specified for laryngeal feature /t/. In this case, the ranking of constraints would be as seen under in (95).

(95)

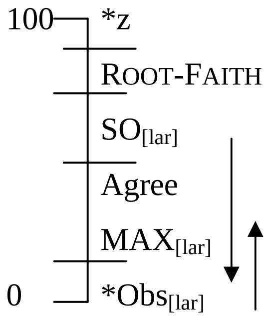
| play+/t/ | $MAX_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|
| ✓a. d | *→ | |
| b. t | | ←* |

Also in this case, it is only necessary for the crucial constraints to swap place to get to the correct result. In one reranking, therefore, we can get to a ranking of constraints that gives us the right optimal output. $MAX_{[lar]}$ has to move down, and $*Obs_{[lar]}$ has to move up, and these have to change place.

For sonorants followed by the past tense suffix the situation is slightly different from the two contexts seen in (93)-(95) above, as the constraint violation favouring the loser is not made by $MAX_{[lar]}$, but $SO_{[lar]}$. This gives the tableau seen in (96).

(96)

| cal/l+T/ | $SO_{[lar]}$ | $*Obs_{[lar]}$ |
|---|---|---|
| ✓a. ld | *→ | |
| b. lt | | ←* |



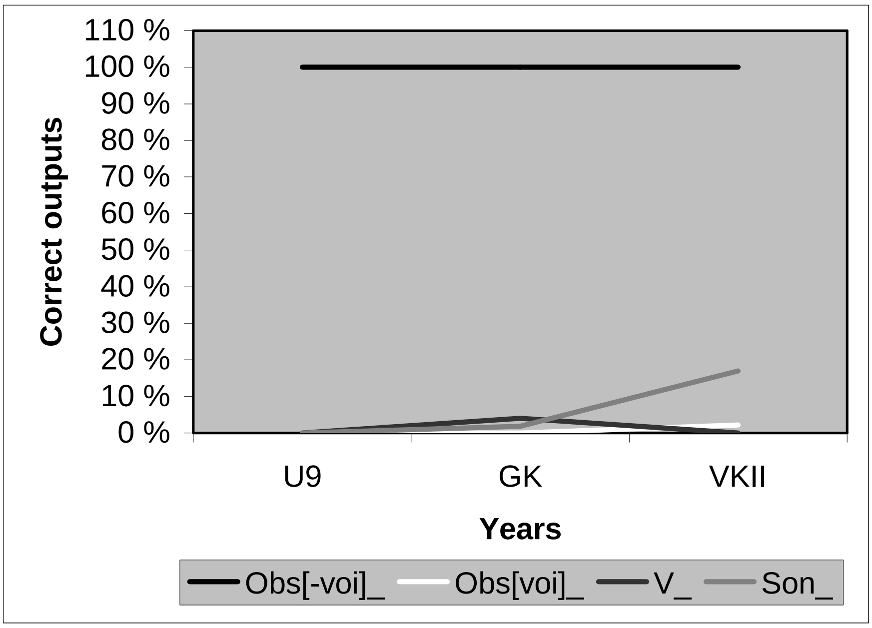

From this we see that the time it takes for the learner to rerank these two constraints should be slightly longer than it takes to rerank the constraints as seen in (93)-(95), as $MAX_{[lar]}$ is in a stratum closer to $*Obs_{[lar]}$ than $SO_{[lar]}$. It may be possible to avoid moving $*Obs_{[lar]}$ past Agree in this case, and create a hierarchy *z >> Agree, $MAX_{[lar]}$ >> $*Obs_{[lar]}$ >> $SO_{[lar]}$, but everything we have seen so far under 5.2.2 is against this, and this context is not able to save the algorithm from making the grammar into chaos due to the rerankings that are apparently triggered.

From what we have seen under 5.2 so far, we may conclude that the gradual learning algorithm cannot account for the patterns we have seen produced by our subjects. The algorithm triggers constraints to move in such a way as causes the grammars to collapse into nothing we have seen produced by the subjects. In most cases it is the sole promotion principle of the algorithm that causes these problems. This is one of the principles of the algorithm that is supposed to make it work better than the Constraint Demotion algorithm. However, as has been pointed out on two occations, constraint promotion will present the learner with nothing but confusion do to the disjunction problem. In addition, the algorithm is unable to account for the quick learning of [z] after sonorants compared to after other segment types due to the disregard of universal markedness constraints.

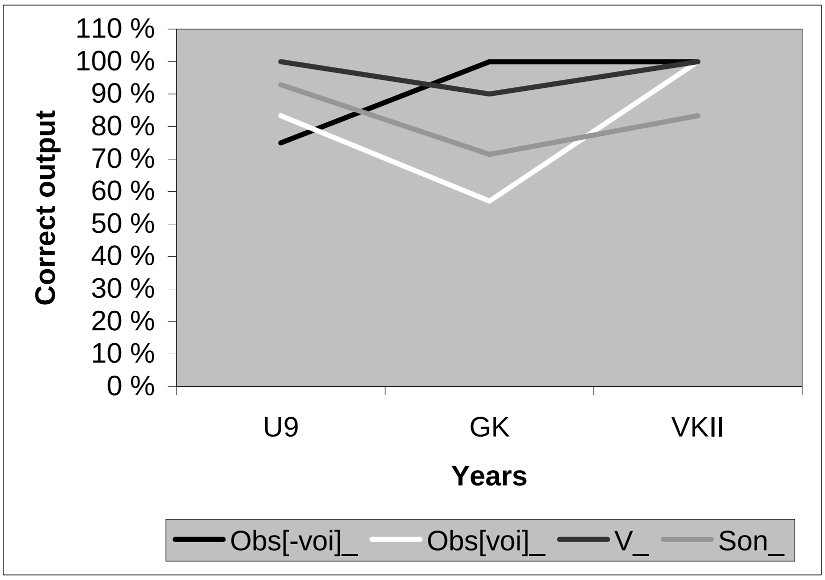
### 5.3 Learning curves

In chapter 4 and previously in this chapter we have seen that the Norwegian learners treat the two parallel English suffixes differently. This can be seen in (97) and (98) below. The figures in (97) below show step by step how the English past tense form may be acquired by Norwegian learners.

(97) The acquisition of *s*-endings by Norwegian learners



(98) The acquisition of the past tense by Norwegian learners




According to Stemberger and Bernhardt (2001) there are two normal developmental paths; the S-shaped and the U-shaped. In (97) we can see the start of an S-shaped curve, or at least a curve that does not show any U-shaped tendencies as of yet, as it is gradually getting better.

The U-shaped learning curve is by Stemberger and Bernhardt (1999: p. 1) considered to occur in 'a minority of developmental changes'. The U-shape occurs as a result of regression in the grammar of the learner, and can occur in both first and second language acquisition. In (98) we see that the development of the acquisition of the past tense suffix in English goes through a period of regression from the U9 group to the GK learners before it progresses to almost perfect again in the VKII group. Regression and variation are two things that cause additional problems for the two learning algorithms we have already looked at.

The problem we encounter with the constraint demotion approach is that only the constraint that is incorrectly ranked too high may be demoted. The learner may not make any changes to the grammar unless it is driven by something that makes the grammar more target-like. In the case of past tense suffixes, then, there does not seem to be any evidence in favour of changing the underlying representation from what it was in the U9 learners, who produced this suffix almost perfectly. However, this decision may be driven by some pattern that cannot be seen from our data. As Stemberger, Bernhardt and Johnson (1999: p. 12) write, there is often a correlation involved in regressions, meaning one aspect of the grammar improves while another worsens. If this is the case, the part of the grammar that does improve from this change cannot be seen from the limited set of data that has been collected for the purpose of this thesis. Also, the /t/ underlyingly may be a result of overgeneralizing the [t] seen after voiceless obstruents to all contexts. In addition, voiceless obstruents in coda position are less marked universally than voiced ones, so this might be an extra trigger for this pattern to occur. When using constraint demotion to account for changes made in a grammar, the change is predicted to be concise and quick due to the fact that the constraint that is demoted below the highest ranked constraint violated by the winner. This happens step by step, as seen in section 5.1 above. This does not provide as quick a fix as first assumed, and it works well with our data.

Boersma's gradual learning algorithm also predicts gradual slow change due to the small steps the constraints involved in reranking take either up or down the hierarchy. The u-shape can be said to be accounted for as a result of the constraints moving around other constraints that are crucial for the wellformedness of the outputs in question. However, as we have already seen, the GLA cannot account for our data for reasons other than the shape of the learning curve. As I have already mentioned, the shape of the learning curve for the past tense suffix is not necessarily u-shaped for our subjects. If we consider the outputs produced by the U9 group that were realized as [ed], the story is different. I will outline two different solutions for the pattern we have observed for the past tense endings. First of all, one based on orthography and lastly one which deals with lexicalization.

In Norwegian, the pronunciation of the past tense suffix we are dealing with is reflected in the orthography. This means that following roots ending in voiceless obstruents or sonorants, the past tense ending is written <-t>, and after voiced obstruents and vowels it is written <-d>. This can be seen in (99) below.

(99)

| | |
|---|---|
| a. bru[kt] <brukt><br>use-PAST, | tje[nt]<br>earn-PAST |
| b. la[gd] <lagd><br>make-PAST | kl[ed] <kledd><br>dress-PAST |

In addition the second type of Norwegian past tense, which does not have a phonological parallel in English, has a vowel appearing before the consonant (Faarlund et al., 1997: p. 481). This can be seen in (100) below.

(100)

| | |
|---|---|
| kaste~kast[et] | åpne~åpn[et] |
| throw~throw-PAST | open~open-PAST |

The two verb classes are normally separated in the Hammerfest dialect as the type we have been using as the foundation of investigation in this thesis is pronounced with the endings as they are written, while the ending as outlined in (100) above is pronounced as [-a] in [kasta] 'threw'. When reading Bokmål, however, it is common to read these words as they would be pronounced in conservative UEN, that is as they appear in (100).

As a result of this, we may suppose that the learners of English transfer the rule of pronouncing the past tense as it is written from Norwegian to English. After all, the subjects are acquiring the second language largely through instruction, of which reading is a large part. This will explain the occurrences of [ed]-endings produced by the U9 group. If we include these endings as part of this group's proficiency with these endings, the learning curve is no longer u-shaped, as the group then shows lower percentages of correct outputs when producing this suffix compared to the GK group. This solution makes the learning curve less complicated than previously assumed.

A different way of explaining the pattern that appears with the past tense suffix is by assuming that the U9 learners are at a stage in their learning of past tenses where every word is lexicalized with the past tense form. In this stage the words are not analyzed, but stored in the learner's mental lexicon as full chunks. The past tense is therefore not productive at this stage, and the reason that the words' endings are produced correctly by this group is that they simply produce these lexicalized items.

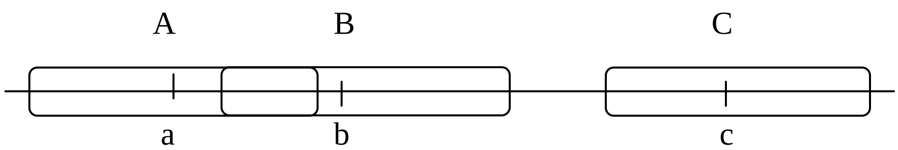
What looks like a regression in the acquisition between the U9 and GK groups is in reality then the beginning phase where the learners in the GK group are starting to break down the words, analyze them and use the endings productively. The learning curve is then steep as the past tense suffix is handled as good as perfectly by the VKII group only two years after the fairly clumsy beginning.

## 5.4 Variation

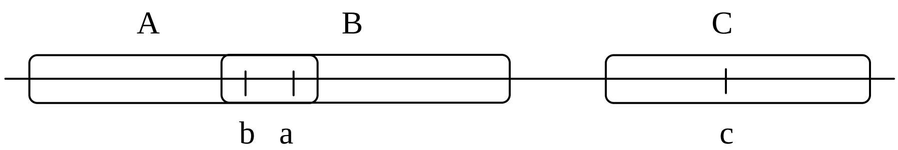
Both of the algorithms we have looked at in this chapter can account for variation within learner grammars in their own way. Of the two, the constraint demotion theory has the weakest account, which is readily admitted under their discussion of learnability and total ranking where they write ‘it is possible for the algorithm to run endlessly when presented data from a non-totally-ranked stratified hierarchy’ (Tesar and Smolensky, 1998: p.249). Their theory supposes that, since the constraint hierarchy is totally ranked, the only way for variation to occur, is by continually reranking two opposing constraints when the two competing candidates are come across in turn. This could run in an endless loop.

The GLA accounts for variation in a more elegant way with continuous ranking, as seen above under 5.2. According to this theory, the constraints each have their own ranking values, and these ranking values have a certain amount of space in each direction where they may float. According to Anttila (2002: p. 232) the evaluation of which candidate is more optimal, may look like what is seen in (101) and (102) below.

(101)




(102)




In these two pictures A, B and C are the conflicting constraints favouring different competing candidates, and a, b and c are their selection points at different evaluations. In (101) we see the most common type of result, where the selection point for A is above that of B, giving the ranking a >> b >> c. In (102) the more rare result has occurred, where the selection points for both A and B have wandered towards the extreme points of their area, and resulted in the ranking b >> a >> c. This way we get variation, and in addition this model can account for variations where one pattern occurs more often than another, as we have seen is the case with the *s*-endings in particular. As Anttila (2002: p. 232-233) writes, ‘the degree of variation will depend on how close the fixed ranking values are to each other. Thus the ranking *a* >> *b* will be more common, *b* >> *a* rare, and C is too far away for *c* to ever rise above either *a* or *b*, i.e. the ranking is categorical’.

# CHAPTER 6

# SUMMARY

In this study we have seen how Norwegian students acquire the laryngeal feature distribution of two different English suffixes. I have shown how the patterns that are similar in the two languages are acquired compared to the patterns that are different and how this can be accounted for within the constraint demotion learning algorithm, but not within the gradual learning algorithm. We have seen that [z] after sonorants, the context that we first predicted would be more complicated for the learners to acquire, was in fact the context after which [z] appeared first and to the greatest extent.

The results found in chapter 4 were applied to two different learning algorithms in chapter 5. Of these the Constraint Demotion algorithm works best with the outlined data set. The algorithm can account for all the acquisition seen without any unnecessary constraint movements as the constraints move minimally. The surprising pattern, that [z] appears to be acquired more quickly after sonorants than in the other contexts is easily accounted for by introducing the universal constraint *SC̥ which is not visible in the Norwegian grammar due to its ranking below $SO_{[lar]}$, but which becomes visible when $SO_{[lar]}$ has to demote below it to account for the speed at which [z] is acquired after sonorants. The reasoning for ranking *SC̥ just below $SO_{[lar]}$ in Norwegian is explained through faithfulness delay under section 5.1.1, p.67.

In chapter 5 we saw that the gradual learning algorithm could not account for the patterns produced by the informants in this study, as it predicted that the [z] segment would appear later after sonorants than after vowels and voiced obstruents. As the algorithm accounts for first language acquisition by feeding constraints into an empty hierarchy, there were no universal constraints that could account for the quick acquisition of this pattern in the second language acquisition, as we saw with the constraint demotion algorithm. The fact that the algorithm operates with constraint promotion did not work in favour of it, as it would encourage the constraint $*Obs_{[lar]}$ to move above Agree or $MAX_{[lar]}$, both of which would leave the wrong grammars. In many cases, the mere demotion of a constraint would work in favour of the algorithm, and then the promotion concept would be vainly applied. In addition, we saw that due to the disjunction problem, the promotion principle would cause problems for the learner in form of not providing clear evidence for which constraint to move.

In chapter 4 we saw that the learning curve of the past tense could be either u-shaped or s-shaped depending on what data was included in the overall picture. I will conclude here that from the data we have seen there is no evidence for u-shaped learning in the laryngeal features of the past tense. If one takes into consideration the data that would leave the dataset u-shaped if it was discarded, the acquisition curve is indeed s-shaped. This data showed evidence for the learners applying orthography to the input representation. This was linked to the fact that the past tense ending is in fact pronounced the way it is written in Norwegian, a pattern which may have been transferred at the beginning stage of the English past tense acquisition.

What can be concluded from this thesis is that Norwegian learners of English acquire the laryngeal distribution of the *s*-endings at a very late stage. It does not appear in the test until the GK group, which is after almost 10 years of learning English as a second language. Part of the problem may be that there is a segment in Norwegian ([s]) that can replace this segment in the English contexts, which is not the case for [ð] or [ʒ] that have no such equivalents and where the laryngeal pairs [ð]-[θ] and [ʒ]-[ʃ] has to be learnt separately. Teachers of English as a second language to Norwegian learners should pay particular attention to this problem area and make the learners aware of the segment at an early stage, and perhaps connect it to the past tense suffix, as this may accelerate the learning process of this laryngeal distribution.

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