Productivity of Finnish Vowel Harmony:

Experimental Evidence

by

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A thesis submitted in conformity with the requirements for the degree of Doctor of Philosophy

Department of Linguistics
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Abstract

Finnish has a well-studied palatal harmony system whereby front and back vowels cannot co-occur in non-compound words and suffixes alternate according to the stem’s harmonic class. Nevertheless, disharmonic forms exist in the language. This thesis examines the phonetic realization of vowels in harmonic and disharmonic loanwords and nonce forms created by a language game in order to establish the productivity of stem and suffix harmony.

With respect to stem harmony, when words were borrowed into Finnish in the past, disharmonic stems tended to be repaired, providing evidence for the productivity of stem harmony. If stem harmony is robust, some degree of harmonization is expected in disharmonic loans and language games. While stem harmonization was observed in existent words and novel forms created by the game, the harmonization rates were lower than would be expected of a robust constraint, indicating that stem harmony is no longer fully productive, at least for some speakers. When harmonization did occur, a strength asymmetry was apparent with [+back] functioning as a stronger harmony trigger.
The examination of the phonetic suffixes indicated that front suffixes were unexpectedly common with all loanword stem types. While co-articulation was a possible cause of some fronting, certain speakers, especially young females, exhibited substantial overlap in the expected front and back suffix categories. For some, this overlap was not exclusive to loanwords but was also observed with compound words. Even in the speech of speakers with discrete front and back suffix categories, front suffixes were unexpectedly frequent in the language game output and occurred even in certain cases where the stem contained no front harmonic vowels to condition the suffix.

The phonetic results indicate that stem and suffix harmony in Finnish appear to be in a state of decline. The change is likely due to internal pressures which occur in Finnish and have been associated with weakening cross-linguistically. These factors include low pitch, stresslessness, and non-modal phonation. This conspiracy of phonetic factors may result in lessened prominence of the suffix vowels. Together, these internal pressures may have conspired to reduce the perceptibility of the harmonic suffix vowels, leading to the weakening of harmony.
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List of Abbreviations

abl. ablative case
ade. adessive case
elat. elative case
Fin. Finnish
gen. genitive case
indef. indefinite
iness. inessive case
nom. nominative case
NS Nykysuomen sanakirja: Vierassanojen etymologinen sanakirja [Modern Finnish dictionary: Etymological dictionary of loanwords]
part. partitive case
pl. plural
sg. singular
SKES Suomen kielen etymologinen sanakirja I-IV [Finnish etymological dictionary, Vols. 1-4]
SSA Suomen sanojen alkuperä: Etymologinen sanakirja 1-3 [Finnish word origins: Etymological dictionary, Vols. 1-3]
Swed. Swedish
Chapter 1
Introduction

The goal of this thesis is to provide insight into the degree of productivity of Finnish vowel harmony using loanwords and nonce words as a test case. Since Finnish vowel harmony in the nativized lexicon is very robust, previous work has largely examined only suffixal harmony in loanwords. This dissertation examines not only suffixal harmony but also the current status of stem harmony, which has been largely overlooked. As earlier studies have primarily utilized written data, the experiments discussed herein aim to also examine the phonetic realizations as well as their correlation with written forms.

1.1 Finnish Vowel Harmony

Vowel harmony is a long-distance assimilatory process whereby all participating vowels within a particular phonological domain, normally the non-compound word, must agree with respect to a certain feature such as backness, height, rounding, and/or tongue root position. Some vowels may be exempt from harmony, particularly if there is no available vowel in the inventory which is identical with respect to all features except the given harmonic feature. These vowels, called ‘neutral vowels’, may be essentially invisible to the spread of the harmonic feature, in which case they are termed ‘transparent’, or they may disrupt the spread, in which case they are termed ‘opaque’.

In many discussions of vowel harmony, the Finnish system is presented as a canonical example of a productive, regular backness harmony system. The Finnish vowel inventory is shown below in (1). All vowel qualities have long and short phonemes which may occur in both stressed and unstressed syllables in most dialects (Suomi, Toivanen, and Ylitalo 2008: 20, 41, 53). As is traditional in the literature on Finnish, the orthographic representation of the vowels, shown to the left of the IPA symbols in (1), will be used throughout this dissertation unless otherwise noted. Long vowels are represented by a sequence of two identical vowel symbols.
In the standard description of Finnish harmony, the ‘front’ vowels [y, ö, ä] and ‘back’ vowels [u, o, a] cannot co-occur in non-compound words (Suomi et al. 2008: 51). Since the harmony system is root-controlled, stem vowels never display any alternations themselves but are subject to a morpheme structure constraint requiring that all harmonic vowels agree in terms of the feature [back]\(^1\). Conversely almost all suffixes with harmonic vowels correspond to the harmonic class of the stem resulting in clear patterns of alternation. The vowels [i, e], which are referred to as ‘neutral’, are transparent and may occur freely with either class but when they occur alone in a stem, suffixes surface as front. These patterns are illustrated below in (2). Note that the following abbreviations are used throughout: F for front harmonic vowels; B for back harmonic vowels; and N for neutral vowels\(^2\).

---

\(^1\) While I use [±back] throughout, the actual nature of the feature(s) marking backness is beyond the scope of this dissertation.

\(^2\) Throughout this dissertation stem types will be abbreviated in the following manner: front harmonic stems as F; back harmonic stems as B; neutral stems as N; and stems containing both harmonic and neutral vowels as FN or BN. Though the disharmonic words discussed herein also have neutral vowels, as it is the harmonic vowels which are relevant, the neutral vowels are omitted in the abbreviations. For example BF refers to both BF and BFN stems and FB refers to both FB and FBN stems. The uppercase vowels represent archiphonemes unspecified for front or back e.g. partitive /-tA/ surfaces as [-tä] ~ [-ta], depending on the stem vowels. Morpheme divisions are represented with dashes and compound elements are separated with = e.g. *kissa-a* ‘cat (part.)’, *koti=kissa* ‘house cat’ from *koti* ‘home’ and *kissa* ‘cat’.
(2) Examples of Stem and Suffix Harmony

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Nom.Sg.</th>
<th>Part.Sg.</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. F-F</td>
<td>pyy</td>
<td>pyy-tä</td>
<td>‘hazel grouse’</td>
</tr>
<tr>
<td>b. B-B</td>
<td>puu</td>
<td>puu-ta</td>
<td>‘tree’</td>
</tr>
<tr>
<td>c. FN-F</td>
<td>tälli</td>
<td>tälli-ä</td>
<td>‘wallop’</td>
</tr>
<tr>
<td>d. BN-B</td>
<td>talli</td>
<td>talli-a</td>
<td>‘stable’</td>
</tr>
<tr>
<td>e. N-F</td>
<td>pii</td>
<td>pii-tä</td>
<td>‘silicon’</td>
</tr>
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</table>

Finnish is an agglutinative language with extensive inflectional and derivational suffixation. Vowel harmony is unbounded within the word and may affect any number of suffix vowels. As shown in (3) below the harmonic feature spreads progressively from the root to all suffixes. Though most inflectional suffixes contain low vowels, all harmonic vowels may occur in suffixes and alternate predictably as seen with the collective derivational suffix /-stO/, the inessive inflectional suffix /-ssA/, the active past participle suffix /-nUt/, and the interrogative enclitic /-kO/.

(3) Harmony with Multiple Suffixes

<table>
<thead>
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<th>Pattern</th>
<th>Word</th>
<th>Gloss</th>
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<tbody>
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<td>a. FN-F</td>
<td>lähi-stö-ssä-kö³</td>
<td>‘in the neighbourhood?’</td>
</tr>
<tr>
<td></td>
<td>jää-nyt</td>
<td>‘staying’</td>
</tr>
<tr>
<td>b. BN-B</td>
<td>saari-sto-ssa-ko</td>
<td>‘in the archipelago?’</td>
</tr>
<tr>
<td></td>
<td>saa-nut</td>
<td>‘receiving’</td>
</tr>
</tbody>
</table>

Outside of a very small number of exceptions harmony is quite regular and pervasive in Finnish and appears fully productive. Disharmony, the co-occurrence of front and back vowels within the harmony domain, while infrequent, does occur, resulting from several sources including irregularly-patterning suffixes, compound words, and recent loanwords. The morphologically

³ Note the interrogative -kO is a clitic and does not harmonize in all dialects. See Section 2.1 for discussion.
conditioned unexpected harmony relates to a small number of derivational suffixes, some of questionable productivity, that surface invariantly as back instead of front with neutral stems e.g. *kivi* ‘stone’, *kiv-ikko* ‘stony soil, mound of stone’ (Anderson 1980: 300). Compounding, which is highly productive in Finnish, produces disharmonic forms since the words retain their original vowel quality e.g. *piimä=kakku* ‘buttermilk cake’. While many loanwords are accidentally harmonic in that their original vowels happen to belong to the same harmonic class without any repair, some are not and include both front and back vowels e.g. *analyysi* ‘analysis’.

1.2 Loanwords as Exceptions to Harmony

As harmony is thought to be regular and pervasive in all dialects throughout the native or nativized lexicon with morphological disharmony being very minimal (e.g. Karlsson 1982: 98-104; Suomi et al. 2008: 51), much of the recent research on Finnish harmony has focused on the adaptations of loanwords to suffix harmony. Though exceptions to both stem and suffixal harmony have been largely eliminated in words borrowed in the past (Skousen 1975: 51; Itkonen and Joki 1981: 526), synchronically unrepaired stem and suffixal disharmony are attested in more recent loanwords. Many disharmonic loanwords have been incorporated into the lexicon, particularly into the class of learned words (e.g. *analyysi* ‘analysis’) and suffixal variation including disharmony, where the suffix vowel does not correspond to the harmonic class of the closest harmonic vowel of the stem, is reported to occur with some disharmonic loanwords (e.g. *analyysi-ää ~ analyysi-a* ‘analysis (part.)’) as well as with back loanwords of four or more syllables with only neutral vowels in the final disyllable (e.g. *karamelli-a ~ karamelli-ää* ‘candy (part.)’) (Ringen and Heinämäki 1999).

Though the current tolerance of disharmony might suggest a deterioration of the harmony system, stem disharmony arising from loanwords is not uncommon cross-linguistically and does not necessarily relate to the overall productivity of the harmony system. In some cases, often involving older monolingual speakers, e.g. Sakha (Pakendorf and Novgorodov 2009: 511; Anderson 1995: 369-70), such disharmony affects only a few words and is typically repaired. More commonly though the disharmony appears to be permanent and produces a class of exceptional stems, e.g. Turkish (Harrison, Dras, and Kapicioglu 2002). While the growing
acceptance of disharmony in a language which previously did not allow such violations is perhaps suggestive of some sort of grammar change, it alone is not sufficient to indicate that there has been any change in productivity.

1.3 Productivity of Harmony in Language Games

Outside of the study of loanwords Campbell (1980: 246-9; 1986) has utilized re-harmonization occurring as part of language games to argue for the synchronic productivity of harmony. For example, in the Finnish language game shown below in (4), the initial C0V of adjacent words are transposed, following which subsequent vowels must re-harmonize to accord with the [back] specification of the new first vowel. In the example in (4) below the transposed C0V sequences are bolded, vowels which re-harmonize are underlined, and morpheme boundaries are shown in the original form (Campbell 1980: 247).

(4) Reharmonization in Finnish Language Games

\[\text{tykkä-n urheilu-sta} \rightarrow \text{ukkaan tyrheilystä}\]

F B B F
*ukkään tyrheilusta ‘I like sports.’

In the example in (4) harmonization is seen to proceed progressively throughout the novel forms, affecting both stem and suffixal vowels. Re-harmonization in this context is not only powerful evidence for the synchronic productivity of stem harmony but it also indicates that harmonization may be ultimately expected in the disharmonic loanwords as they further integrate into the phonological system.

1.4 Disharmonic Stems and Suffix Selection

Disharmonic stems, those with both front and back harmonic vowels, for example syntaksi ‘syntax’ (a FB loanword) and martyryri ‘martyr’ (a BF loanword), also introduce the issue of suffix allomorph selection and suffixal disharmony. When a stem contains both types of
harmonic vowels, which vowel will control the value of the suffix? Previous work on Finnish has established that harmonic strength differs based on vowel quality with back and low vowels exhibiting greater strength than front or high vowels. While words in which the final harmonic vowel is back are reported to exhibit categorical suffix selection allowing only back suffix allomorphs, e.g., syntaksi-a *syntaksi-ä ‘syntax (part.)’, words in which the final harmonic vowel is front are reported to differ in their behaviour depending on the height of the harmonic stem vowels. When the final front vowel is low, suffixes are normally expected to surface as front, e.g., miljonäärä-ä ‘millionaire (part.)’, while when the final front vowel is high, significant variation is expected, e.g., analyysi-ä ~ analyysi-a ‘analysis (part.)’. This strength asymmetry has been explained by appealing to sonority, whereby more sonorous vowels are better triggers (Ringen and Heinämäki 1999), and perceptual impoverishment, whereby vowels for which the given feature is less salient are preferred triggers (Kimper 2011; see also Kaun 1995). In both cases these theories converge on low vowels as being better triggers in backness harmony systems.

The suffixal variation concerning back vowel loanwords of four or more syllables with only neutral vowels in final disyllable (BN loanwords) has also been well-studied. The behaviour of these words is particularly unexpected as they exhibit suffixal variation although there are no front harmonic stem vowels to condition the alternation (e.g., karamelli-a ~ karamelli-ä ‘candy (part.)’). A long-held traditional analysis utilizes the concept of multiple possible harmonic domains to account for the variation. This analysis, which states that stems of four or more syllables may be optionally treated as pseudo-compounds by speakers, has been employed by many to account for this suffixal variation, as well as some of the variation seen in the long disharmonic words (Ringen and Heinämäki 1999: 313; Sadeniemi 1949: 48; Välimaa-Blum 1999: 250). Under this analysis a speaker may analyze any stem of four or more syllables as a single phonological entity or harmonic domain, in which case the suffix would accord with the final harmonic vowel of the stem (e.g. [karamelli-a] ‘candy (part.)’), or may divide the word into smaller domains, allowing the suffix vowel to accord with the final disyllable. Because words containing only neutral vowels are affixed with front allomorphs, when the suffix harmonizes with this smaller neutral domain, the front allomorph surfaces (e.g. [kara][melli-ä]). A related hypothesis proposed by Kiparsky (2003) suggests that it is the secondary stress patterns which instead account for the disparate behavior of different lexical items. In some cases words may
have a fixed underlying secondary stress, which may optionally initiate a new harmonic domain, while others are assigned stress by rule, which is not capable of initiating a new domain (Kiparsky 2003: 115).

1.5 Goals of the Thesis

In this thesis the overall issue of the adaptation of loanwords into the backness harmony system of Finnish is discussed in an effort to understand the synchronic nature of both stem and suffix vowel harmony in the language and factors relevant to their application. Though vowel harmony in Finnish has received a great deal of attention in the literature, there remain outstanding questions with regards to the exceptionality of loanwords which bear on our understanding of the nature of the overall harmony system.

Among the unresolved issues is the question of the vowel quality in disharmonic stems. While older borrowed disharmonic words are known to have harmonized, the synchronic possibility of harmonization has not, to my knowledge, been addressed in the literature. Most studies of Finnish vowel harmony utilize written data and those which use phonetic data have not explicitly examined the stem vowel quality. The nature of the stem vowels and the prospect of harmonization are relevant not only in relation to the suffix allomorph selection but also relate to the question of whether stem harmony remains active in the language and, if so, how the harmonization proceeds.

Suffixal harmony has attracted a great deal of attention and the many studies have uncovered a substantial amount of variation. Various phonological and non-phonological factors thought to be relevant to suffixation have been investigated including stress, vowel quality, domains, and frequency. It is assumed that all speakers utilize these factors in an identical way, treating the loanwords in a uniform manner. However, that a given word or stem type may or may not exhibit consistent behaviour in multiple studies suggests that it is possible different speaker types (gender or age) may employ somewhat different strategies. As many previous studies relied on written responses to questionnaires, an understanding of the relationship between the written and spoken forms is crucial.
To address the issue of stem and suffix vowel quality, two phonetic experiments (Experiment 1 and Experiment 2-A, B, C) were conducted. All vowels were measured and analyzed to establish whether or not harmonization occurred and what suffix allomorph was produced. Any phonetic harmonization discovered was then evaluated to determine what overall tendencies existed concerning the directionality as well as typical targets and triggers. The frequency of harmonization was examined in an effort to determine whether stem harmony remained a robust governing force in the Finnish lexicon. The suffix vowel quality was analyzed in an effort to determine what factors, both phonological and social, might be involved in the variation. As one of the experiments (Experiment 2) included both a written and spoken component the degree of correlation between the written and spoken suffixes could be established.

The disharmonic suffixation is conspicuous to native speakers and so has been subject to prescriptive rules. While some accounts of harmony utilize the normative rules explicitly or allude to their influence, their effects have not previously been examined in detail. Especially since many studies of the suffixation are written and the written medium might be more influenced by such rules, an examination of their effect on behaviour is necessary and was included in Experiment 2.

Finally, with the exception of two corpora studies (Kiparsky 2003; Duncan 2011) all of the investigations of loanword harmony in Finnish have been conducted in a formal experimental setting. While the results of such studies can provide much insight into the nature of the suffixation patterns, they may also be somewhat transparent in experimental purpose. Especially when there also exist prescriptive rules concerning usage, it is useful to obtain less formal data as well.

To distract participants from the nature of the formal experiment a language game was used. The language game, shown in (4), also allowed for the examination of online stem reharmonization, providing further information concerning the synchronic productivity of stem harmony. Additionally it produced suffixed nonce forms. As non-existing words, these forms would be free to select suffixes in accordance with their phonological shape only, eliminating any confounding factors such as frequency which might otherwise affect suffixation.
The results of the two phonetic experiments suggest that synchronically Finnish vowel harmony is not the fully productive process it is typically assumed to be. Stem harmonization was not as frequent as was expected of a robust constraint, even in the context of the language game. Though there were clear tendencies in the suffix harmony of loanwords, suffix vowels were not produced as discrete front and back categories by all speakers, nor did the harmonic class of the suffix vowel always correspond to the final harmonic vowel. The data indicates that harmony in Finnish may be eroding.

The disharmonies associated with the loanwords is unlikely to be the cause of deterioration but more apt to be a consequence of the changes. Instead the weakening of harmony may be primarily due to the perceptual disadvantages specific to the suffixal vowels owing to their word-final position and low height. The weakening of the vowel harmony system in Finnish is consistent with the parallel diachronic development of several related Finnic languages. Backness harmony has been reconstructed as having occurred in Proto-Uralic as well as many of the daughter languages including the Finnic languages (Abondolo 1998: 17; Hakulinen 1961: 6; Viitso 1998: 106-7). The tree below indicates the proposed relationship between the Finnic dialects and languages (based on Viitso 1998: 101-4).

![Figure 1-1: Finnic Dialect Classification](image_url)
While vowel harmony occurred at some point in the history of all of the related Finnic languages and dialects, some languages, including dialects of Estonian, Livonian, and Veps, have ultimately seen their harmony systems collapse or degrade substantially (Grünthal 2000: 56; Viitso 1998: 107). Stem disharmony has occurred as a result of not only loanwords but also non-compositional compounds, co-articulatory effects from adjacent consonants, and reduced vowel inventories in non-initial syllables (Abondolo 1998: 18; Viitso 1998: 108-9; Wiik 1989: 81). Suffixal disharmony has been affected by these processes as well as by final vowel devoicing, reduction, and deletion. Many of these same processes have occurred also in Finnish dialects, as shown in Table 1-1.

### Table 1-1: Processes Affecting Harmony

<table>
<thead>
<tr>
<th>Process</th>
<th>Language/Dialects Observed In 4</th>
<th>Finnish</th>
<th>Other Finnic Dialect/Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced Vowel Inventory in Non-Initial Syllables</td>
<td></td>
<td>not reported</td>
<td>Estonian (Comrie 1981; 111-2)</td>
</tr>
<tr>
<td>Vowel Mergers</td>
<td></td>
<td>possibly e.g. low vowels in Tampere dialect (Kuronen 2000 in livonen and Harnud 2005: 65) possible positional vowel merger (Mahonen 2011)</td>
<td>Ingrian (Kuznetsova to appear)</td>
</tr>
<tr>
<td>Coarticulatory Effects of Consonants Potentially Linked to Reanalysis of [back] Feature</td>
<td></td>
<td>possibly e.g. palatalization in Savo dialects (Kettunen 1940)</td>
<td>North Veps (Viitso 1998: 107)</td>
</tr>
<tr>
<td>Final Vowel Devoicing</td>
<td></td>
<td>yes (Myers and Hansen 2007; Ogden 2001)</td>
<td>Jõgõperä Votic (Ariste 1968: 2, 6)</td>
</tr>
<tr>
<td>Vowel Centralization</td>
<td></td>
<td>yes, in suffixes appended to loans (Välimaa-Blum 1999)</td>
<td>Jõgõperä Votic (Ariste 1968: 2, 6)</td>
</tr>
<tr>
<td>Apocope</td>
<td></td>
<td>yes, especially in Western dialects (Anttila 1972: 80)</td>
<td>Livonian (Tauli 1966: 25-8)</td>
</tr>
</tbody>
</table>

Therefore while vowel harmony is normally assumed to be robust and complete in synchronic varieties of Finnish, the experimental evidence discussed in this dissertation suggests that it is

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4 Note that only a single representative example is given for the other Finnic languages. That a language is not listed here does not indicate that the process in question does not occur presently or has not occurred in the past.
currently in the process of weakening as a result of both external factors, which include disharmonic loanwords, and internal changes such as reductive effects on final vowels. Examination of related Finnic languages suggests that these sorts of changes are typical of this group of languages and may have resulted in the deterioration or loss of harmony in several related languages and dialects.

1.6 Structure of the Thesis

This dissertation is structured as follows. In Chapter 2 previous research on Finnish vowel harmony is presented. Though past work is quite extensive and has uncovered many important factors in the suffixation of loanwords, there still remain a number of outstanding issues which will be highlighted. Experiment 1, a phonetic experiment examining the stem and suffix harmony in BF and BN loanwords, is presented in Chapter 3. This experiment attempts to determine whether the phonological factors found to be relevant for suffix harmony by other researchers, many of which were based on written material, are utilized also in the phonetic realization of suffix harmony. While Experiment 1 does provide some valuable insights, perhaps especially concerning the suffix harmonization patterns in compound words, as there was no written component it was impossible to determine the correspondences between the written and spoken suffix forms. Experiment 2, which is sub-divided into three parts (Experiment 2-A, orthographic behaviour; Experiment 2-B, phonetic behaviour; and Experiment 2-C, language game), includes both modalities, allowing for a comparison to determine whether the written and spoken suffixes are based on the same factors. As well, Experiment 2 examines the influence of the prescriptive rule on behaviour. The written data from Experiment 2 is presented in Chapter 4 and the phonetic data in Chapter 5. Included in Experiment 2 was a language game, the results of which are discussed in Chapter 6. The language game allowed for an examination of active stem harmonization and the suffixation of nonce forms. Chapter 7 discusses the overall findings from the two phonetic experiments and situates the results in the context of diachronic changes in the Finnic language group.
Chapter 2
Background

In languages with vowel harmony, vowels within a certain morphological or prosodic domain must agree with respect to a certain feature. Common harmonic features include backness, height, rounding, and advanced tongue root (ATR). Backness harmony is pervasive throughout the Finnish grammar and is present also in many related Finno-Ugric languages including closely related Karelian and more distant Hungarian. Historical research indicates that harmony has been present in this language family since the Proto-Uralic period, 5000-4000 BCE (Abondolo 1998: 17; Janhunen 2009: 68; Sammallahti 1988: 481; Suihkonen 2002: 165, 169).

This chapter reviews previous research on the harmony system in Finnish in order to situate the experiments presented in this thesis within the current understanding of Finnish vowel harmony, particularly as it relates to loanwords. The synchronic realization of harmony in the Finnish grammar, including its domain, is discussed in section 2.1. The integration of loanwords into the Finnish phonology is discussed in section 2.2. Based on previous literature, section 2.3 presents the behaviour of loanwords in terms of both stem and suffixal vowel harmony. Remaining issues are presented in section 2.4.

2.1 Domain of Finnish Vowel Harmony

This section presents an overview of the domain of backness harmony in Finnish. Harmony extends through the prosodic word with derivational and inflectional suffixes alternating according to the harmonic class of the stem, as was illustrated in (3) in Chapter 1 (Karvonen 2005: 128-131). As shown below in (5), when words are compounded, each retains its original vowel quality and suffix vowels harmonize with the quality of the final element.
Vowel Harmony in Compound Words

a. kesä=loma-a
   ‘summer vacation (part.)’

b. loma=mökki-ä
   ‘vacation cottage (part.)’

While suffixes invariably harmonize, some clitics may as well. Finnish has four enclitics which contain harmonic vowels and though they harmonize in many dialects, including the standard dialect, they may lie outside the domain of harmony in other dialects. Whether or not the clitics are contained within the harmonic domain appears to be dependent on the dialect, the clitic, and perhaps even the sentential environment (Kanerva 1987; Lauerma 1996). To account for the lack of harmony in clitics and compounds, Kanerva (1987: 515) defines the harmonic domain as “not the morphological word, but rather the small post-lexical phonological constituent that contains a morphological word and its phonological satellites”.

Finnish is normally considered to be exclusively suffixing with harmony propagating rightwards from the stem to the suffixes. However, Baković (2000: 7) presents a harmonic prefix /UpO/, which he states has limited productivity e.g. ypö-yksin ‘all alone’, upo-uusi ‘brand new’. While both words above are listed in the Kielitoimiston sanakirja (New Dictionary of Modern Finnish).

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5 Recall from footnote 2 that compound boundaries are marked with =.

6 The harmonizing clitics are as follows: -hAn indicates known information; -kAAn denotes ‘also’ in negative sentences; -kO is a question particle; and -pA indicates emphasis. Hakulinen (1961: 155, 202) notes that -kO/ while fully harmonic in Standard Finnish, may surface as back with front and neutral stems in dialectal Finnish. For example, Standard Finnish minä-kö ‘me?’ and ei-kö ‘no?’ may surface dialectally as minä-ko and ei-ko. Lauerma (1996), through an examination of data from several archives, found that in addition to -kO, -hAn and -pA may also be non-harmonic in some dialects. Neutral stems with back harmonic clitics (which may in some cases be lexicalized) such as nii-han ‘so it is’ and se-pa ‘especially this one’ are more common than those forms in which the harmonic class of the word conflicts with that of the clitic as in jos-hän ‘if’ though they do exist in some dialects (Lauerma 1996). Interestingly Lauerma (1996) notes that non-harmonic clitics are more common when the clitic is followed by a neutral vowel word or a word with the same harmonic class as the clitic.

As shown in the following examples originally from Rapola (1965: 250; 1966: 398), Skousen (1975: 53) and Campbell (1980: 246) note that in fast speech unstressed function words may cliticize to and then harmonize with adjacent content words. In such cases harmony may apply either progressively or regressively e.g. jyvä kō se leikathan → jyvä kō se leikathan ‘grain when it is cut’ and mā tulen → mā tulen ‘I come’. Vowel harmony in Finnish, as is typical of most harmony systems, is lexical and so these examples are perhaps somewhat unusual cross-linguistically, though not unattested (see Hyman 2002: 16-17 for a discussion of harmonization across word boundaries in Somali and Nez Perce).
no other forms with this prefix are listed nor does the prefix occur in the Iso suomen kielioppi (Comprehensive Finnish Grammar) (Hakulinen, Vilkuna, Korhonen, Koivisto, Heinonen, and Alho 2005: 192). However, at least two similar words exist in Finnish, täpö-täysi ‘as full as possible’ and hipi-hilja ‘very quiet’. The four Finnish words together appear to be some sort of intensifying reduplication.7

Another morpheme often suggested to be a prefix is the invariant epä-, which originated as a participial form of the negation verb ei and attaches to nouns and adjectives expressing the meaning ‘un-’, as shown below in (6) (Hakulinen et al. 2005: 192; SKES).

(6) Non-Harmonizing Prefix /epä-/  

a. epä-henkilö ‘non-person’  
b. epä-usko ‘disbelief’

A number of other similar invariant prefix-type elements are given in the Iso suomen kielioppi and/or the Kielitoimiston sanakirja. These include some morphemes which are clearly borrowed e.g. anti- ‘anti’, and others which are native or fully nativized such as ala- ‘sub-’, which is derived from a Proto-Uralic form (Sammallahti 1988: 536; SSA). While some of these elements are not clearly prefixes but may instead be the first element of compounds, others, such as epä- do seem to function as productive prefixes. While few in number, invariant prefixes are not completely unattested in Finnish and therefore present a complication for vowel harmony. Either harmony must propagate exclusively rightwards from the stem or prefixes must be considered

7 In support of this conjecture is the assertion by Hyman, Inkelas, and Sibanda (2009: 307) that reduplicants normally appear on the opposite side of the base than affixes. Since Finnish is suffixing, it is then expected that reduplicants would appear prior to the stem. Moreover Estonian, a closely related language, evidences some limited partial reduplication as in ilu-ilus ‘beautiful-beautiful’ and kank-kanged ‘stiff-stiff’ (Erelt 2008: 272). Tauli (1966: 181) notes that ‘especially well-known in Finnish are the reduplicative particles where the initial consonant of the word as well as the vowel which follows it are the same as in the following adjective, e.g. Finnish pilkunne pimiä ‘very dark’ Olonets Karelian robi rohkei ‘very courageous’. Astide (1968: 121) notes that in Votic ‘superlative words are formed by adding an alliterative pseudo-affix in front of the adjective, e.g. upi-ūsi ‘completely new’, which is almost identical to the Finnish form, puri-puhajz ‘completely clean, very clean’, and eto-ōl(l)ā ‘in very olden times’.”
outside the domain of harmony with suffixes being more closely bound with the root e.g. [prefix[stem+suffix]] (see Hyman 2005: 15).

Conversely suffixes are very common and exceptions to suffixal harmony rare among native or nativized vocabulary. These exceptions consist only of two stems which exhibit harmonic variation in that they select different partitive forms in different dialects, e.g. *meri* ‘sea (nom.)’ *mer-tä ~ mer-ta* ‘sea (part.)’, and a very few affixes which optionally surface as back with some neutral stems, e.g. *hilje-mpa-a ~ hilje-mpä-ä* ‘quieter (part.)’ from *hilja* ‘quiet’ (Anderson 1980; Campbell 1980: 253; Kettunen 1940 map 172; Suomi et al. 2008: 52; Skousen 1973: 120-2).

It appears that Finnish allows a minimal number of pre-stem elements alongside the more numerous post-stem elements. In both cases some elements may be exceptionally outside the domain of harmony while, in the case of suffixes, at least most conform to the expected harmonic alternations.

### 2.2 Finnish Loanwords

Living languages are, of course, always in the process of increasing and/or transforming their vocabulary. Though new words may be created using already available resources, language contact coupled with social factors often results in foreign words entering into a language. This process of lexical borrowing, however, does not ensure that the words will be used or retained long-term. While some words are borrowed and then fade quickly from use, other loanwords ultimately acquire at least some degree of widespread acceptance and thus enter into the lexicon of the borrowing language. These words are then integrated, to varying degrees, with many ultimately becoming indistinguishable from the native vocabulary. Many aspects of the word are subject to potential phonological nativization including regularization of phonotactics, moraic and/or syllabic structure, and stress patterns. The study of loanwords may then focus on which aspects of a loanword are altered and how as well as examining why some loans retain non-native aspects of their pronunciation while others are quickly regularized. Loanwords provide a unique opportunity to enhance our understanding of the native phonology (Kang 2011).
Finnish speakers have long been in contact with neighbouring peoples speaking various Germanic, Baltic, and Slavic languages. For many centuries Swedish was the language of the political and cultural elite while Finnish remained the language of the peasantry, though some Finnish literacy was encouraged by the church as early as the sixteenth century (Laakso 2010: 601). From these many contacts with speakers of unrelated, non-harmony languages, a substantial number of loanwords across all realms of society have been brought into the language (Hakulinen 1961: 232-48).

From the nineteenth century on, Finnish history was characterized by a surge of nationalism which was marked by the belief that the Finnish language and culture were valuable. This attitude was reflected in efforts to purify the language by removing those influences seen as non-native and the conscious replacement of many loanwords with neologisms based on native resources (Hakulinen 1961: 287-304; Laasko 2010: 602).

The linguistic situation in Finland has again changed substantially over the past century. While most Finnish speakers were mono-lingual at the turn of the twentieth century, 66% of speakers are now at least bilingual (Laakso 2010: 610). The influence of English is now such that “experts [are] concerned about English interference in young people’s written Finnish [and] the status of the Finnish language in science and professional communication” (Laakso 2010: 610).

Unsurprisingly, in spite of earlier, often fervent, attempts to eradicate foreign influence, loanwords have remained a part of the lexicon. Though there continues to be discussion in Finland concerning the effects of other languages on Finnish, now especially English, and there is a prescriptive language authority examining and detailing proper usage, attitudes towards loanwords are now perhaps less unfavourable than during the strong nationalist phase. Many current loanwords exist alongside native lexical items with similar or identical meanings e.g. borrowed dokumentti and native compound asia=kirja both ‘document’\(^8\). In such cases, the

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\(^8\) Battarbe (2004: 5) notes that in cases where a native word exists alongside an Anglicism, typically the native term is considered more formal while the borrowed term is more colloquial. This situation appears to contrast with that of the Swedish loanwords which tend to be more formal and learned (Campbell 1980: 249). Differences in the level of formality of loanwords and the attitude towards them may relate to the manner of the borrowing and social factors concerning the relationship between Finnish speakers and speakers of the donor language.
English or other foreign words often have a certain prestige described by Maamies (2008: 186) in the following manner: “Foreign words may be experienced as modern and impressive in the quickly changing superficial culture, susceptible to foreign influence; words from our own language seem too commonplace.”

The loanwords differ among themselves in terms of their frequency, degree of nativization, and lexical stratum. There is a wide continuum of usage with some, such as karamelli ‘caramel, candy’, being relatively frequent words used in colloquial situations and others, such as anhydridi ‘anhydride’, being learned words rarely known or used outside of their specialized spheres.

While some loanwords are accidentally phonologically indistinguishable from native lexical items or have been modified to conform to Finnish phonology, others have remained somewhat resistant to certain aspects of Finnish phonology. Many of the loanwords discussed herein are aberrant not only in terms of harmony, which will be discussed in section 2.3, but also diverge from other aspects of Finnish phonology including maximum word length, secondary stress patterns, and phonotactics.

Apart from harmony, other phonological rules appear to be respected in loanwords for the most part. Quantitative consonant gradation, which degeminates long stops in the onset of a closed syllable, is generally abided by, especially when the syllable is stem-final e.g. Amerikka ‘America (nom.)’ Amerika-n ‘America (gen.)’ (Hammarberg 1974: 172-174; Holman 1975: 139). Kiparsky (2003: 116-7) notes that most assimilated loanwords will accommodate the Finnish phonotactic restriction which prohibits short intervocalic stops following an unstressed light syllable, by geminating the relevant stop e.g. mám.mut.ti *mám.mu.ti ‘mammoth’ from Swedish mammut⁹.

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⁹ Leskinen (1981), in a pilot study concerning the application of Finnish phonological rules to English loanwords, found that stops in this position were typically geminated in speech though the long consonants were not necessarily represented orthographically. For further details see Leskinen (1981).
While loanwords often conform to phonological patterns and may thus inform our understanding of the native phonology, including the synchronic productivity of phonological rules and patterns, they themselves may affect the phonological system. In certain cases the loanwords have been implicated in changes to the Finnish phonology, allowing certain non-native phonological elements and structures to penetrate the Finnish system to varying degrees. Within Finnish, loanwords and foreign influence have been hypothesized to be responsible for the introduction or loss of certain consonant clusters and phonemes (Posti 1953: 87-91; Suomi et al. 2008: 34-6, 60). Moreover Hammarberg (1974: 173) has suggested that the integration of unassimilated loanwords into Finnish has played a significant role in the weakening of qualitative gradation, where short stops are lenited in the onset of a closed syllable cf. native aito ‘authentic (nom.)’, aidon ‘authentic (gen.)’ and borrowed auto ‘car (nom.)’, auton ‘car (gen.)’.

An examination of which phonological processes are not observed in loanwords and which are active, as well as how they are manifested, provides insight into the synchronic phonological system of the borrowing language. Under ideal conditions borrowed words are unencumbered by a history in their new language and so it is assumed that they present a pure, untainted view of the rules or constraints active in the language without vestiges of historical processes. Native words or loanwords already fully integrated into the system may be subject to fossilized patterns no longer synchronically active but new loans are without a history and so any processes in which they engage are assumed to be active. The phonological adaptations that loanwords undergo when entering into a new language thus provide us with information about the productive rules and patterns of the language as well as subtle regularities often difficult to perceive in the native or fully nativized vocabulary (Kang 2011).

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10 The situation may not be as straightforward as stated here. Kiparsky (2004: 140 note 22) states that some loanwords into Finnish appear to have an accent on the syllable which originally received primary stress in the donor language. While this accent is not overtly phonetically realized in Finnish, it may initiate a new harmonic domain. These loanwords therefore appear to have retained some relics of their original phonology. See section 2.3.2.6 for discussion.
2.3 Vowel Harmony in Finnish Loanwords

Vowel harmony in Finnish loanwords, especially unexpected suffixal harmony, has attracted a great deal of attention in the literature. Though stem harmony is by nature a static phenomenon and stems have standardized orthographic forms, affixal harmony affects many morpheme alternations and so violations are perhaps more conspicuous and are potentially subject to greater inter-speaker variation. The nature of stem harmony, which has drawn less theoretical and no experimental attention, is crucial, in part, because suffixal harmony must rely on the stem vowels and so it is necessary to verify their quality. If harmony is synchronically productive, then harmonization is ultimately expected to affect many or most disharmonic words, which is what has been seen in loanwords in the past. If loanwords persist in resisting harmonization long-term, then the productivity of stem harmony itself may come into question. Harrison et al. (2002: 221) state “the degree to which loanwords are mutated to be harmonic provides a possible diagnostic for the state of the harmony system.” If stem harmonization weakens and no longer regularly occurs resulting in a build-up of disharmonic stems, what then would be the implications for suffixal harmony? While it is possible that suffixal harmony could exist without stem harmony, as is sometimes proposed for Turkish (Clements and Sezer 1982; Polgardi 1999), this creates a process whereby the quality of the suffix is driven only by that of the closest stem vowel though the stem itself may contain vowels from both harmonic classes. Conversely suffixal harmony could also weaken without stem harmony being affected. As has occurred in other harmony languages including Moksha Mordvin, a related Finno-Ugric language, morphemes may generalize to a single harmonic class, effectively weakening suffixal harmony while leaving stem harmony intact (Tauli 1966: 225; Zaicz 1998: 189-90). Suffixal vowels may be subject to reductive processes which again would weaken suffixal harmony while

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11 Note that stem harmonization in many harmony languages may be disrupted by widespread bilingualism, the propagation of loanwords via writing, in which their disharmonic nature is maintained, and, in some cases, by the waning proficiency of speakers of these languages as communities switch to other languages. For example though Russian loans into Sakha (Yakut) were formerly assimilated to Sakha (Yakut) phonology, including vowel harmony, as speakers became more familiar with Russian, the loanwords were less likely to conform to the native patterns (Anderson 1995).
disregarding stem harmony. Thus, the disharmony in the loanwords has many potential implications for the overall harmony system.

Though the existence of disharmonic stems and the occurrence of suffixal disharmony have long been recognized, the actual nature of speakers’ behaviour and any associated variation has still not been definitively established, especially concerning possible stem harmonization. The following sections discuss possible patterns of stem harmonization (section 2.3.1) as well as the more robustly studied suffixal harmony (section 2.3.2).

2.3.1 Stem Disharmony

Disharmonic stems do not occur in the native or nativized vocabulary of standard Finnish outside of a single exception, the word tällainen ‘like this’

Aikio (2009: 223) reports that in the Jällivaara and Kuravaara dialects of Meänkieli Finnish, spoken in northern Sweden, there is a tendency towards disharmony e.g. the standard Finnish word äijä ‘old man’ is pronounced as äija in these dialects. Aikio (2009: 223) attributes the disharmony to the influence of Saami, which does not have vowel harmony.
(7) Stem Harmonization of Compounds (Rapola 1966: 398; Anderson 1980: 296)

a. yh.den lái.nen yh.tä.läi.nen

b. mó.ni.ak pää:n mo.ni.ap.pain Längelmäki dialect

c. pää.n á.lai.nen pää.nä.laa.nen ~ pää.nä.lää.nen Laihia dialect

d. i.än kái.ken i.an.kai.ki.nen

e. héi.nä tál.koo hei.nä.ta.la.koo Korpilahti dialect

It is notable that the compound harmonization may occur either progressively, as in (7a)-(7c) or regressively as in (7d) and (7e). Both front and back vowels may serve as the trigger or may be targets. A possible motivation for the directionality is the stress pattern. In the examples with progressive harmonization, the first word has a harmonic vowel in initial position, which receives primary stress, while in the examples with regressive harmonization, the first word has a neutral vowel in this position but a harmonic vowel in the stressed position of the second word. These examples seem to indicate that stressed vowels may be stronger harmony triggers within the stem. The occurrence of harmonization in these formerly compound words provides evidence for the productivity of stem harmony in these dialects at the time of harmonization.

Compounds are extremely productive in Finnish (Bertram and Hyönpää 2003: 616; Hedlund 2002; Pirinen 2009: 89; Suomi et al. 2008: 78) and predictably some have become lexicalized and have

13 Note that there is also a derivational suffix /-lAinen/ which does harmonize.

14 Some dialects or idiolects treat the vowel sequences [ia] as a diphthong (Suomi et al. 2008: 50).

15 See Appendix 1 for a dialect map. Längelmäki and Laihia are in the western dialect area in sub-dialect areas IIb, and III1 respectively while Korpilahti is in the eastern dialect area in sub-dialect area IXa.

16 Note that dialectal epenthesis has occurred in this form creating the additional syllable. The epenthetic vowel may be either schwa-like or may be a copy of the preceding vowel, as shown in this example, dependant on the dialect (Karlsson 1983: 157-8; Skousen 1975: 48-9).

17 An interesting example might be those cases where both words either have a harmonic vowel in the stressed position or a neutral vowel in the stressed position.
lost their compositional sense. While there appear to be very few examples such as those above in (7) which have re-harmonized, there are many more which are non-compositional but disharmonic. Typically forms which are opaque or semi-compositional do not re-harmonize as shown below in (8). These non-compositional compound words are then a source of stem disharmony in the lexicon.

(8) Opaque or Semi-Compositional Compounds

a. jää=kaappi \(^{18}\) ‘refrigerator’ from ‘ice’ and ‘cupboard’

b. kulta=jyvä ‘nuggets of wisdom’ from ‘gold’ and ‘grain’

c. leipä=laji ‘best event’ from ‘bread’ and ‘sort, kind’

As many languages in contact with Finnish lacked backness harmony, borrowed words have always been an additional source of potential disharmony. Historically though disharmonic loanwords entering the lexicon were ultimately assimilated in terms of harmony\(^ {19}\). The productive nature of stem harmony is evidenced in the repair of the disharmonic words borrowed from Swedish, shown below in (9). The first vowel in the word for ‘potato’ was raised to neutral [e], creating a back harmonic word, whereas the word for ‘doctor’ was harmonized progressively to create a front harmonic word (Skousen 1975: 51; Itkonen and Joki 1981: 526). Note that the examples demonstrate that harmonization could occur either by changing the offending vowel(s) into neutral vowels or by changing their harmonic class and otherwise maintaining their quality.

\(^{18}\) The harmonized forms are non-occurring e.g. *jääkääppi or *jaakaappi. At least some of these forms may have adapted to certain stem phonological patterns such as stress. In compound words the expected stress pattern consists of primary stress on the first syllable of the first word and secondary stress on the first syllable of the second word, even when this violates the typical word stress pattern which disallows adjacent stressed syllables e.g. piit=lève ‘diatom (a type of algae)’ vs. püllevé ‘hiding’ (Karvonen 2005: 29, 120). However, Mahonen (2011: 106) found that 33% of the trisyllabic FB compound word tokens in her study (12 tokens of jää=kaappi and pää=rooli ‘leading role’ combined) unexpectedly received stress only on the initial syllable. This may suggest that some disharmonic compounds have lost their compositionality and now conform to non-compound stress patterns while retaining their original vowel qualities.

\(^{19}\) It is unclear whether or not they first existed in a period of disharmony. A diachronic study of harmonization might provide some evidence of whether harmony was immediate and total or if loanwords have always undergone some intermediate stage.
(9) Stem Harmonization of Older Loanwords:

a. Finland Swedish påron → Finnish peruna\textsuperscript{20} ‘potato’

b. Swedish läkare → Finnish lääkäri ‘doctor’

Though both examples above have the same vowel in the initial syllable [ä] and similar sequences of vowels, they harmonize to opposite classes.

More recently loans which have been accepted into the language have typically been allowed to retain their disharmonic form, resulting in stems with either back vowels followed by front vowels, as in (10a), or front vowels followed by back vowels, as in (10b). Though these loans clearly violate stem vowel harmony, they have been accepted into the standard lexicon mostly, though not exclusively, in the domain of learned words (Campbell 1981: 157).

(10) Disharmonic Loanwords

a. BF analyysi ‘analysis’

b. FB tyranni ‘tyrant’

In many cases these words have pronunciations in line with their spelling though some of these loans have varying pronunciations which are not reflected in their orthography. For example, according to Koukkunen (1990: 103), the loan dynamitii ‘dynamite’ has numerous variants and may be either a back harmonic word, a disharmonic word, or a front harmonic word, depending on the dialect and speaker, as shown below in (11). Thus, in these cases, orthography is not sufficient to determine the phonetics of the lexical item and it is necessary to phonetically examine all stem vowels to determine whether any degree of harmonization has occurred\textsuperscript{21}.

\textsuperscript{20} This loanword also evidences a repair strategy commonly used in Finnish loans. Epenthetic vowels are added after word-final consonants, often even following those consonants which are possible word-finally in native words, such as /n/. The quality of epenthetic vowels was previously more varied but presently only [i] is added as an epenthetic vowel word-finally (Suomi et al. 2008: 59).

\textsuperscript{21} There are a number of loanwords for which the regular Finnish grapheme-phoneme correspondences do not apply e.g. <design> [disain] ‘design’ (Campbell 1980: 253; 1981: 157; Kielitoimiston sanakirja 2004). While the
(11) Possible Pronunciations of *dynamit*ti from Swedish *dynamit*:

a. Back harmonic: tinameeti, tinamentti, tinametti

b. Disharmonic: tinamyyti, tynameeti, tynamentti, tynamii(t)i, tynamuutti, tytamiitti

c. Front harmonic: tynämeeti, tynämentti, tynämetti, tynämiini, tynämiit(t)i, tynämintti, tynämyntti

The recent loanwords discussed above are all part of the standard lexicon but are, in many cases, infrequent words. Disharmonic stems, however, were common in Old Helsinki Slang (OHS), which was a mixture of Finnish and Swedish spoken in Helsinki from 1890-1950\(^{22}\). Root disharmony in OHS has two sources. Some originally Swedish unrepaired disharmonic lexemes were borrowed, as shown in (12a), while in other cases originally harmonic Finnish words were truncated and then suffixed with dummy derivational suffixes which did not necessarily harmonize, sometimes resulting in disharmonic words, as shown in (12b) (Anttila 1975: 18; Jarva 2008: 71).

(12) Stem Disharmony in Slang Forms

a. Swed. öga ‘eye’ → OHS ööga

b. Fin. järjestää ‘to organize’ → OHS järkkää, järkkaa

orthographic form has ultimately been changed to accord with the spoken form in some cases, e.g. *<baby>* or *<beibi>* [beibi] ‘baby’, in others it remains unaltered, e.g. *<copyright>* [kopirait] ‘copyright’. For some of these words spelling pronunciations have overtaken those pronunciations more closely associated with those of the borrowing language e.g. [genre] ‘genre’ is currently replacing the previous pronunciation which was more closely aligned with the French (Terttu Nevalainen p.c.). In some cases, these spelling pronunciations result in stem disharmony e.g. [kratsy] ‘crazy’ (Campbell 1967: 3). Such words may evidence variation in their suffix allomorph selection (Campbell 1980: 253). A stem such as *<business>* [biznis] ‘business’ which is suffixed with a front allomorph is orthographically disharmonic but phonetically harmonic whereas when suffixed with a back allomorph, it is orthographically harmonic but phonetically disharmonic.

\(^{22}\) Note that some of the OHS words are still in use. Nuolijärvi (1997: 157) states that harmony was not only lacking in older Helsinki slang but remains absent from current Helsinki slang.
However even these intentionally disharmonic words obey suffixal harmony with inflectional suffixes taking the harmonic class of the final harmonic vowel, as shown in (13) below, indicating that while stem harmony could be potentially disregarded at least in some cases, suffixal harmony was inviolable (Jarva 2008: 71).

(13) Suffix Harmony in OHS

a. järkkä-tään ‘one organizes (passive present)’
b. järkka-taan ‘one organizes (passive present)’

While many OHS disharmonic words were fairly short-lived, others have been retained e.g. *bööna* ‘woman, girl’ (Paunonen 2006: 364).

Slang terms are more likely to be used in speech while the more formal loanwords are often used in writing. Although the disharmonic orthographic forms of the loanwords are standardized, as discussed above, harmonization may occur in speech. As the examples provided above in (9) demonstrate, historically harmonization has occurred both regressively and progressively and both front and back harmonic vowels have served as triggers. Synchronically the same appears to be true, as seen in the examples in (14) (Välimaa-Blum 1999: 248; Mahonen 2011: 48).

(14) Stem Harmonization of More Recent Loanwords and Nonce Forms

<table>
<thead>
<tr>
<th>Orthographic Form</th>
<th>Phonetic Form</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. &lt;Söul&gt;</td>
<td>[soul] or [söyl]</td>
<td>‘Seoul’</td>
</tr>
<tr>
<td>b. &lt;kysta&gt;</td>
<td>[kystä]</td>
<td>‘cyst’</td>
</tr>
<tr>
<td>c. &lt;sopyyri&gt;</td>
<td>[sopuuri]</td>
<td>nonce form</td>
</tr>
</tbody>
</table>

Though, to my knowledge, there has not yet been a large-scale examination of the historical properties of harmonization, several tendencies have been discussed. While Campbell (1980: 246) states that the direction of harmonization is not fixed, according to Skousen (1973: 128; 1975: 51-2, 54), the vowels of disharmonic loans, if harmonized, will harmonize progressively with the first harmonic vowel or primary stressed vowel as trigger. He (1975: 51-52) provides
the example of Swedish affär ‘affair’, which has been borrowed into Finnish and (he states) is pronounced by most as either [áfaari] or [áhvaari] where the stress pattern has shifted to the native Finnish initial stress and harmonization follows whereby the vowels conform to the class of the new primary stressed vowel. However, Skousen (1975: 50-1) also states that educated speakers may instead maintain the second syllable stress and then harmonize the initial vowel to the class of the vowel with primary stress, resulting in [áfääri]. Speakers who have heard the front variant with primary stress on the second syllable may then pronounce the word with initial stress, in keeping with the Finnish stress pattern, while maintaining the front pronunciation resulting in [áfääri] or [áhvääri]. As a result, there is expected to be variation in the stem vowels of the loanwords.

Wiik (1965: 50-52) states that prosodic structure is central to the harmonization and that the domain of harmony is not the word but rather the ‘stress unit’, which is defined as “a sequence of syllables beginning with a primary-stressed or secondary-stressed syllable and possibly followed by one or more tertiary-stressed syllables” (Wiik 1965: 51)\textsuperscript{23}. When the disharmonic vowels are in the same stress unit, speakers are likely to have more difficulty perceiving the different harmonic classes and, therefore, are likely to harmonize such vowels. However, when the vowels are in different stress units, the different harmonic categories are more salient and therefore more likely to be maintained. This suggests that two and three syllable loans, which are expected to have the disharmonic vowels in the same stress unit, are more likely to harmonize than are four syllable loans, which tend to have the disharmonic vowels in separate feet or stress units.

There may also be a sociolinguistic component to the occurrence of harmonization or the maintenance of disharmony though the preferred tendency is disputed. While Välimaa-Blum (1999: 248) states that “there is strong pressure to make disharmonic words conform to the native pattern of root harmony” Suomi et al. (2008: 52) state that “there seems to be no hard

\textsuperscript{23} Word-initial vowels always receive primary stress. Secondary stress is typically assigned to the third syllable and every second non-final syllable thereafter. However, secondary stress may shift from the third to the fourth, non-final, syllable if the third is light and the fourth is heavy. In addition, final syllables in trisyllabic words may receive secondary stress if heavy and preceded by a light syllable (Karvonen 2005: 1; Suomi et al. 2008: 75). However, note that Wiik (1965: 51) treats the trisyllabic word pom.pöö.si ‘pompous’ as comprising two stress units [pom] and [pöösi].
pressure today towards adapting them to the old pattern”. In at least some specific cases, such as the orthographically disharmonic <olympialaiset> ‘Olympic Games’, the harmonized pronunciations may in fact be strongly disfavoured (Suomi et al. 2008: 52).

Moreover, harmonization may not be phonetically complete. Wiik (1995 as reported in Välimaa-Blum 1999: 253) states that the harmonic vowels of disharmonic words may not have the same phonetic quality as those of native words but may instead have an intermediate quality, e.g. the second vowel in olympialaiset ‘Olympic games’ may be neither [y] nor [u] but more central24. This is not likely to be a long-term strategy but may represent speaker uncertainty. In this particular example, the central realization of /y/ may also be related to the greater acoustic space available for this vowel. As the higher vowels are less acoustically crowded than are the lower vowels, it is possible that some such centralization may be common for the realization of [y].

It is unclear whether certain vowels are more likely than others to trigger or undergo stem harmony. As will be discussed in section 2.3.2.2, though vowel quality has been suggested to be relevant for suffixal harmony, I am not aware of any similar claims regarding Finnish stem harmony. In loanwords in Turkish, however, the phonologically more marked vowels [y, ø, ɨ] are less acceptable in disharmonic words25 (Clements and Sezer 1982: 223). As stem harmonization has not yet been systematically examined, it is possible that similar tendencies exist in Finnish.

Stem harmonization has occurred in the past in Finnish not only in loanwords but also sporadically in non-compositional compounds thus revealing its productivity. However, more recently loanwords and slang words have been permitted to remain disharmonic though it is

24 Mahonen (2011: 117, 153-4) found that [y] had a more central phonetic realization (lower F2 value) when unstressed or in disharmonic FB words when the back vowel received secondary stress and that [ö] was centralized when unstressed in BF words or in FB words when the back vowel received secondary stress. The [y] in ó.lym.pi.a.lái.set ‘Olympic Games’ would be unstressed, which may then account for the centralization noted by Wiik (1995) in this word. It is unclear whether the centralization is expected for all harmonic vowels in disharmonic words.

25 This does not mean that these vowels always undergo harmonization to back or even that the resultant word is necessarily harmonic, only that they do not seem to tolerate occurring in disharmonic words. Some change in vowel quality is more likely when disharmonic words include any of these vowels than when they do not (Clements and Sezer 1982: 223).
acknowledged that harmonization may occur in some, largely undefined, circumstances. Therefore it is unclear to what degree stem harmonization occurs synchronically in speech and, if it occurs, what factors govern its application. Not only is this harmonization relevant with respect to the determination of the current productivity of stem harmony but the stem vowel qualities produced are fundamental to an examination of factors involved in suffixal harmony.

2.3.2 Suffix Disharmony

A second type of disharmony, more widely studied, relates to suffixation. Though the restricted distribution of [ö] resulted in some suffixal disharmony in much earlier stages of the language (Hakulinen 1961: 29; Viitso 1998: 106-7), synchronically productive suffixes containing any harmonic vowels assimilate to the harmonic class of the stem and violations are uncommon. However, loanwords present a contradiction to the normal suffixal harmony processes.

Disharmonic loanwords, such as tyranni ‘tyrant’ and analyysi ‘analysis’, contain both front and back harmonic vowels so there is ambiguity concerning which vowel will control harmony. These loanwords will be discussed in sections 2.3.2.1 and 2.3.2.2. An unusual category of loanwords is those with four or more syllables with neutral vowels in the final disyllable and back vowels in any preceding syllables, such as karamelli ‘caramel, candy’. These words also display unexpected behaviour and will be discussed in section 2.3.2.3. The loanwords are subject to prescriptive rules which allow for suffix variation only with those stems with back vowels followed by [y], e.g. analyysi-a ~ analyysi-ä ‘analysis (part.)’; all other words require allomorphs which agree with their final harmonic vowel (Eronen 2000; Moilanen 2005; Sadeniemi 1946: 79-80). The generally expected suffixation patterns are summarized in section 2.3.2.4.

Most accounts abstract away from the variation and do not attempt to predict absolute percentages of suffix allomorphs but rather provide the grammatical opportunity for variation where it is expected to be found. Ringen and Heinämäki (1999) and Kimper (2011) are notable exceptions in that they provide phonological mechanisms which are capable of predicting the degree of variation seen in their experiments. While some accounts concentrate on phonological
factors relevant to the choice of suffix allomorph, others also consider non-phonological factors including style, dialects, and prescriptive rules relevant to the variation. As identical lexical items display sometimes widely disparate behaviour, as shown in section 2.3.2.5, some factors outside of phonology may be necessary to account for the variation.

There are a small number of words which have been included in previous experiments which display suffix allomorph variation but do not fall into any of the above categories being less than four syllables and having only vowels of a single harmonic class e.g. aprilli-a ~ aprilli-ä ‘April Fool (part)’ and timotei-ta ~ timotei-tä ‘Timothy hay (part.)’. The behaviour of these words is presented in section 2.3.2.6.

2.3.2.1 Suffixation of FB Disharmonic Loanwords

Within the theoretical literature the consensus is that FB loans with a back harmonic vowel in the final disyllable display very consistent behaviour. For these stems, the suffix allomorph is stated to be based on the harmonic class of the final harmonic vowel of the stem, surfacing categorically as back, as shown in (15). Campbell (1980: 251) states that front suffixes are, in fact, impossible for such words.

(15) Expected Suffixation of FB Loanwords
a. följetongi-a *följetongi-ä ‘serial (part.)’
b. syntaksi-a *syntaksi-ä ‘syntax (part.)’

The two experimental studies which included such words, Ringen and Heinämäki (1999) and Mahonen (2011), provide confirmation of the tendency for speakers to use back allomorphs with FB words though there may be some variation. Ringen and Heinämäki (1999: 308) in a written test examining suffix choice found that the five FB lexical items tested were suffixed in writing

\[\text{26 Note that FB loanwords with only neutral vowels in the final disyllable are treated below with BN loanwords.}\]
almost exclusively with back allomorphs. Mahonen’s (2011: 141-144) written task\(^{27}\), which allowed participants to select a front or back suffix or to indicate that ‘either’ was possible, indicated that the three FB categories – yB loanwords, yB nonce words and ä/öB nonce words – displayed more variation in categorical suffix selection and also allowed more ‘either’ responses than did the harmonic back categories though the mean percentage of back suffixes for these FB words was high. The mean ‘either’ responses (11.0% B, 18.8%, 21.4% B respectively) were substantially higher than those of the harmonic words, indicating some degree of suffix uncertainty.

In the oral portion of her experiment Mahonen (2011) measured F2 values, which correspond to the front-back dimension of vowels with higher F2 values indicating more front pronunciations. She (2011: 59-61) found that the disharmonic word types with final back vowels (yB loans, yB nonce words, and ä/öB nonce words) had significantly lower suffix F2 values than those word types with final front vowels though the suffix F2 values of yB loans and ä/öB nonce words were slightly higher than the back native words. These results indicate that the FB words appeared to generally suffix phonetically with back allomorphs\(^{28}\).

While the FB loanwords are normally assumed to have categorical behaviour, their suffixation patterns have been subject to little experimental study. The nature of any phonetic allomorph variation associated with this word type will be examined in Experiment 2, presented in Chapter 4-Chapter 6.

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\(^{27}\) Mahonen’s (2011: 138-9) written task was designed to determine speaker uncertainty concerning suffix choice. Participants were asked to select the suffix they thought they had spoken in the prior oral task and then rate the suffix’s quality of fit. Participants were allowed to instead indicate that either suffix was acceptable.

\(^{28}\) A caveat concerning Mahonen’s (2011) acoustic results is that overall 70% of her participants did not display the expected categorical front-back suffix categories; 20% of her participants showed massive overlap between the front and back suffixes and a further 50% showed some significant overlap (Mahonen 2011: 72-5, 135). Mahonen (2011: 87) states “despite the unambiguous harmony of the front and back native words, most participants did not have discrete suffix vowel F2 ranges for these word types. The majority of speakers had at least some overlap between the front and back vowel ranges.” The implications of these results are discussed in section 7.4.2.
2.3.2.2 Suffixation of BF Disharmonic Loanwords

While most researchers assume FB loanwords exhibit categorical suffix selection, it has been stated in the literature that BF loanwords exhibit variation in their suffix choice. This variation is said to occur following stems in which the final harmonic vowel is [y/yy] or [ö/öö] while those stems in which the final harmonic vowel is [ä/ää] are often said to suffix exclusively with front allomorphs, as shown in (16) (Campbell 1980: 251).

(16) Expected Suffixation of BF Loanwords

a. hieroglyfi-ä       hieroglyfi-a       ‘hieroglyph (part.)’
b. amatööri-ä       amatööri-a       ‘amateur (part.)’
c. hydrosfääri-ä    *hydrosfääri-a    ‘hydrosphere (part.)’

Prescriptive rules though tend to treat only [y] in BF loanwords as having anomalous behaviour in disharmonic loanwords while all other stem vowel combinations require suffixes corresponding to the final harmonic vowel of the stem. Most such rules state that, alongside [i] and [e], the vowel [y] may be treated as neutral in disharmonic loanwords (Sadeniemi 1946: 79-80; Eronen 2000; Moilanen 2005). Variation would then be expected only with words such as *hieroglyfi ‘hieroglyph’. Under this rule the vowel [y] is treated as neither fully harmonic nor neutral and is therefore unlike either the neutral vowels [i] and [e] or the harmonic vowels [ö] and [ä]; its phonological status is dependent on the other vowels in the root. Ringen and Heinämäki (1999: 306) report that many subsequent Finnish grammars have essentially reiterated the same rule though Välimaa-Blum (1999: 249) noted that the prescriptive rule taught in school may extend the neutrality to all front vowels in disharmonic stems.

The normative rule has been employed in a number of discussions of suffixation. Campbell (1980: 250-1) hypothesizes that in By and Bö stems back allomorphs are considered more prestigious while front allomorphs are more colloquial; suffix variation is therefore dependant on

29 Kiparsky (as reported in Steriade 1987: 354) states that suffix variation is possible also with Bä stems.
style. Likewise Steriade (1987: 353-4), Halle and Vergnaud (1981: 7-8), and Nevins (2009: 214) employ either style or dialect or some combination thereof to account for the variation.

Several experiments including Levomäki (1972), Ringen and Heinämäki (1999), Kimper (2011), Välimaa-Blum (1999), and Mahonen (2011) examine the variation in disharmonic stems in which the final harmonic vowel is front. The methodology was very similar across all experiments requiring participants to complete (orally or in writing) written sentences which would compel the suffixation of the loanword, written in the unsuffixed nominative case in brackets, to conform with the sentential context. While the other researchers used exclusively written studies, Välimaa-Blum (1999) and Mahonen (2011) used exclusively spoken responses or spoken responses in addition to the written forms respectively.

Though the methodology was similar across the different studies, phonologically similar or identical words did not necessarily behave identically. While Levomäki (1972) found all the BF loanwords were affixed with front suffixes by more than half of the respondents, different loanwords received varying percentages of front allomorphs. There did not appear to be any discrete groupings but instead a fairly steady increase in the percentage of front suffixes from 52.0% to 98.0%. As the words were not sufficiently similar so as to enable comparison between different vowel sequences, it was difficult to determine if the exact rate of front suffixes was conditioned by the phonological shape of the word alone. However the two words which contained an identical lexeme, psykoanalyysi ‘psychoanalysis’ 71.0% F and analyysi ‘analysis’ 81.4% F, displayed differences in suffixation as did words with the same vowel sequence, e.g. e.lek.tro.lyy.si ‘electrolysis’ 89.6% F and ste.re.o.tyy.pi³⁰ ‘stereotype’ 97.3% F, though in neither case did the percentages of front suffixes differ by much more than 10%.

Although most of the disharmonic loanwords studied by Levomäki (1972) contained [y] as the final harmonic vowel, four had either [ö] or [ä] as the final harmonic vowel. Outside of vulgääri

³⁰ Note that both stereo ‘stereo’ and tyyppi ‘type’ are loanwords in Finnish which may contribute to the higher percentage of front suffixes for this word.
‘vulgar’, with 59.8% front, the other three Bö/Bä words displayed strong preferences for front allomorphs, as expected (70.2, 83.1, and 98.0% F). However, all Bö/Bä words except *konduktööri* ‘conductor’ (98.0% front) did select a greater percentage of back suffix allomorphs than would be expected if only final [y] allowed variation. Contrary to expectations, there did not seem to be a great deal of difference between words based on the quality of the front vowel. BF words with final [y] varied from 52.0-97.3% front while those with final [ö] or [ä] varied from 59.8-98.0% front. Though there was clearly a great deal of lexical variation, the average percentage of front allomorph selection for the two words types was almost identical, with those with final [y] suffixing with front allomorphs 78.8% of the time and those with final [ö] or [ä] 77.8% of the time. Within each group though, there appears to be variation which must be due either to the lexical item or phonological features of the word other than harmonic class of the final harmonic vowel.

In Ringen and Heinämäki’s (1999) series of experiments subjects were allowed to write both front and back allomorphs if they felt both were acceptable, allowing for an examination of intra-speaker variation. Participants in the first test were told to select the suffixes which sounded most natural and the percentage of exclusively front suffixes ranged from 42.0% to 100.0% with those lexical items with final [y] receiving substantially more back allomorphs as well as more ‘either’ responses than those lexical items with either final [ö] or [ä].

In the second test where participants were told to use the ‘correct’ form, Ringen and Heinämäki (1999: 309-10) state that for six of the nine lexical items the percentage of front responses was higher than seen in the first test, contradicting Campbell’s (1980: 250-1) assertion that the back forms are more prestigious.

The third test examined the behaviour of a group of participants who completed the same test twice with an interval of one month. Here the overall pattern of a greater percentage of front responses with the [ö] and [ä]-final words continued but there was a much greater amount of

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31 This word has two alternative orthographic forms, <vulgääri> and <vulgaari> (*Kielitoimiston sanakirja*), which may have accounted for the higher percentage of back allomorphs.
intra-speaker variation for the test words; the percentage of variation \(^{32}\) ranged from only 4.0% for *hydrosfäärri* ‘hydrosphere’ to 48.0% for *analyysi* ‘analysis’.

Ringen and Heinämäki’s (1999) results indicate that those stems with a final [y] clearly allow more back allomorphs than those with either final [ö] or [ä], especially when subjects are tested on multiple occasions. Though the difference is not as apparent, stems with final [ö] are slightly more likely than those with final [ä] to be suffixed with back allomorphs \(^{33}\). Only when the respondents completed the test on more than one occasion was the significant suffix variation visible for most lexical items, especially for the mid and low vowel final stems. Though the variation is greatest for those stems which are [y] final, some stems with other final vowels, such as *amatööri* ‘amateur’ and *afääri* ‘affair’, also displayed a considerable amount of variation.

Ringen and Heinämäki (1999) attributed the suffix variation in their results to the confluence of several factors influencing suffix allomorph choice. The output of a grammar with unranked constraints requiring suffix harmonic agreement with the harmonic category of the vowel with primary stress, the vowel with secondary stress, the most sonorous vowel in the stem, and the final harmonic vowel of the stem results in suffix allomorph variation very similar to that seen in their experimental results \(^{34}\). Ringen and Heinämäki’s (1999) analysis is very successful at utilizing the same constraints required for native harmony to explain not only the existence of the suffix variation but also to predict the degree of variation seen in individual lexical items in their experiments. However, these percentages of front vs. back suffixes are not necessarily shared by other studies, though this may be attributed to other factors such as a difference in the modality of the experiment (written vs. spoken), grammatical changes having occurred in the time elapsed between experiments, or sociolinguistic differences between participant groups. While Ringen and Heinämäki (1999) did not find suffixal variation with FB words and so their account does

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\(^{32}\) Here variation refers to speakers who provided both suffix alternatives on one or both tests or who provided different responses on the two tests.

\(^{33}\) Kimper (2011: 85) performed statistical analyses on Ringen and Heinämäki’s (1999) data and found that the effect of vowel height is significant.

\(^{34}\) Ringen and Heinämäki (1999: 324) also utilize the concept of the prosodic compound, which is discussed in section 2.3.2.3.
not allow such vacillation, Mahonen (2011) did uncover some written variation in these stems, which would require modifications to the account.

Kimper (2011) conducted an online written questionnaire focusing on the suffixation of disyllabic BF nonce words. Unlike other work which has been constrained by the available lexical resources, Kimper (2011: 187-8) was able to construct a fully balanced word set with all possible vowel qualities and lengths. As in Ringen and Heinämäki’s (1999) first test, participants were asked to select the suffixed form which sounded most natural rather than that which they felt was ‘correct’. The survey results were analyzed for 179 participants, who were almost exclusively female and resided across Finland. As each lexical item was presented only a single time and subjects were not permitted to select both allomorphs, intra-subject lexical variation could not be examined.

Overall Kimper (2011: 190) found that front responses were “substantially more frequent than back suffixes, across all conditions”. However, he also found that vowel height was significant for both V₁ and V₂ and vowel length for V₂. More back responses occurred as the height of V₁ lowered from high to mid to low. For V₂ mid and low vowels patterned together and more back responses occurred when the second vowel was high than when it was either mid or low. The relationship between height and suffix selection is highly consistent with the findings of Ringen and Heinämäki (1999) though [ö] and [ä] were conflated in Kimper (2011).

Kimper (2011) analyzes vowel harmony in general and in Finnish specifically as a competition between triggers. In a disharmonic sequence V₁V₂-V₃ where V₃ is a suffix and harmony is progressive, both the non-adjacent V₁ and the adjacent V₂ may compete to spread their harmonic feature to V₃. Though V₂ is given some preference for locality, V₁ may still spread if it is a better trigger. Better triggers in V₂ are more likely to initiate their own harmonic domain while worse triggers are more likely to be transparent, allowing V₁ to spread its own feature value.

The disharmonic BF forms in Finnish represent this sort of competition. Both the back vowel and the front vowel attempt to spread their feature value to a suffix and which value surfaces is determined by the strength of the triggers. In a backness harmony system low vowels serve as better triggers because, following Kaun (1995), Kimper (2011: 99) assumes “that segments which are perceptually impoverished with regard to the harmonizing feature will be preferred as
triggers.” Since low vowels have less articulatory space to realize the feature [back] and [±back] variants are therefore closer, the [back] feature is less salient for low vowels than for higher vowels, which have more space in the phonetic area. Thus, when the spread of the back and front vowels is evaluated, the quality of each vowel, alongside rewards for locality and potential harmonic dominance of a feature value, determines how likely each variant will be to surface.

The studies of Levomäki (1972), Ringen and Heinämäki (1999), and Kimper (2011) all relied exclusively on written data and demonstrated that orthographic suffix variation occurred with BF stems, especially when the front vowel was high. To determine the precise phonetic values of the suffixes Välimaa-Blum (1999) conducted an acoustic study of the speech of three women of different ages which included three BF lexical items – analyyttinen ‘analytical’, konduktööri ‘conductor’, and analyysi ‘analysis’. Välimaa-Blum (1999: 252-254) found that, impressionistically, some of the loanwords, but no native words, selected a vowel that she was unable to classify as either front [æ] or back [ɑ]. Instead this vowel, which she classified as [a], seemed to be of an intermediate quality36. Acoustic analysis of the data from one of the speakers indicated that the F2 means were statistically different between the vowel pairs [æ] vs. [ɑ] and [ɑ] vs. [a] while the difference in F2 means between [æ] and [a] was marginally significant (p=0.08).

Overall 84% of the 135 BF tokens were suffixed with the front allomorph, 4% with the back, and 5% with the central vowel. Though Välimaa-Blum (1999: 266) does not discuss any lexical patterning or provide detailed information concerning individual speaker behaviour she does note that the central vowel was not more common in the speech of any given speaker and therefore seems to represent a stable treatment of such disharmonic words.

35 The lexical item analyyttinen might be more properly discussed with words with a final neutral disyllable. However, as Välimaa-Blum (1999) discussed the percentages of front allomorphs for groups of words rather than individual lexical items, it will be discussed in this section.

36 Perception tests with more speakers would provide a more neutral and broader picture of how these vowels are classified by speakers.
To account for the variation in BF loanwords, Välimaa-Blum’s (1999) analysis relies on the optional re-ordering of feature spreading rules. Back vowels may spread [dorsal], the feature she uses for backness, both locally and non-locally while front and neutral vowels are marked with [coronal], the feature she uses for frontness, the spread of which is strictly local. In native words, harmony is ordered with any [dorsal] feature spreading occurring before [coronal] may spread. In disharmonic loanwords though, either harmony feature may spread first. Välimaa-Blum (1999: 263) states that the choice of which harmony spreads is based on “still poorly understood factors such as speech rate, rhythm, information structure, style, etc.”.

Under Välimaa-Blum’s (1999) analysis suffixal harmony in disharmonic loanwords is distinct from that in native words in that it allows for a re-ordering of the spreading rules. This re-ordering results in a major divergence from native harmony in that neutral stem vowels in words containing harmonic vowels may control the harmonic class of the unspecified harmonic suffix. For example, Välimaa-Blum’s (1999: 264) account allows for the front suffix allomorphs in trisyllabic FB loanwords such as ty.ran.ni ‘tyrant’ where the [coronal] feature of the final neutral vowel may spread locally to the suffix vowel, causing the front allomorph to surface. Though this notion is capable of explaining the variation seen with FB words in Mahonen (2011), it runs counter to most traditional conceptions of transparent vowels in harmony. Under this view, the vowels [i] and [e] are as actively harmonic as the front vowels and differ only in that they may co-occur with back vowels within stems. Finally, though Välimaa-Blum (1999: 263) suggests sociolinguistic directions in which to search for the absolute degrees of variation, her analysis does not attempt to explain these factors.

Though the medium is different, the overall percentage of front suffix vowels for BF stems found by Välimaa-Blum (1999) (84%) is slightly higher but similar to the average front responses reported for the BF stems by Levomäki (1972) (77.8% for [ö] and [ä] final and 78.8% for [y] final), Ringen and Heinämäki (1999) (test 1: 78.9% for all BF stems), and Kimper (2011). As Välimaa-Blum’s participants did not also complete a written questionnaire, it is unclear how they might have chosen to represent the central vowel in writing as there is no separate grapheme for a central vowel.
Mahonen (2011) examined both the written and oral suffixation of Bä/ö and By loanwords and nonce words. In the written portion of the experiment, all BF word categories patterned significantly differently than the harmonic categories. They evidenced a high percentage of ‘either’ responses, ranging from 28.7-50.2%, and also a high percentage of categorical back suffixes, ranging from 16.7-44.6% (Mahonen 2011: 141, 144). This variability is substantially different in terms of quantity than that seen in Ringen and Heinämäki’s (1999) study where a similar degree of variability was visible only when the same subjects were tested on two separate occasions. In spite of this, the overall pattern of more back written allomorphs for words with final [y] than for those with final [ö] or [ä] was again found. Notably the BF nonce words evidenced greater variability than the BF loanwords.

The acoustic analysis indicated that suffix vowels typically correspond with the final harmonic vowels of the stem for all word types including the disharmonic loanwords and nonce words (Mahonen 2011: 61, 152). Notably no differences were found between the Bä/ö word type and the By word type (Mahonen 2011: 61). However, the disharmonic word types, especially the [y]-final words, evidenced the greatest suffix variation in backness (Mahonen 2011: 61-2, 152-3).

Though Mahonen (2011: 88) states that she did not find evidence of the distinct central suffixal vowel reported by Välimaa-Blum (1999), possibly due to the overlap of the suffix vowels of native words, she notes that some centralization of the suffix vowels was apparent which she attributed to unstressed vowel reduction. Mahonen (2011: 84, 88) also notes that among the disharmonic words the centralized suffix vowels were more common in the nonce words than in

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37 Overall nonce word types demonstrated greater variability than their phonologically similar native word types e.g. front harmonic nonce words 9.1% B and 20.7% ‘either’ vs. front harmonic native words 0.7% B and 0.5% ‘either’ (Mahonen 2011: 144-5, 148, 151). Mahonen (2011: 164-5) states the differences between the harmonic native words and nonce words “reflected the increased harmony choice difficulties that participants faced when learned lexical effects were removed.” These results are unexpected if harmony is a robust phonological rule based solely on the harmonic class of the stem vowels.

38 See footnote 28 concerning the suffixal overlap seen in Mahonen (2011).
phonologically similar loanwords, which may indicate that the centralization is potentially a consequence of speaker uncertainty in relation to unfamiliar words.\footnote{Note that there was no check to ensure that speakers knew all of the native and borrowed words; some of these may also have been unfamiliar. Additional work is necessary to examine the effect of word knowledge on suffix vowel centralization.}

In summary, previous work on loanwords indicates that while BF stems typically select front allomorphs, suffixal variation with this stem type is more common than with FB stems. As the percentage of front responses differs widely by lexical item and may differ according to word knowledge, there are likely factors other than simply the final harmonic vowel relevant for the determination of the allomorph. The nature of the phonetic allomorph variation associated with disharmonic words and potentially relevant factors will be examined in the two experiments presented in Chapter 3-Chapter 6.

### 2.3.2.3 Suffixation of Back Neutral Loanwords

In this section the experimental findings of Levomäki (1972), Ringen and Heinämäki (1999), and Välimaa-Blum (1999) will be presented as will the corpus-based results of Kiparsky (2003) and Duncan (2011). This section discusses loanwords which have only neutral vowels in the final disyllable and at least one back vowel preceding. While some of these stems include both front and back vowels in the non-final disyllable e.g. *hypoteesi* ‘hypothesis’, others have only back vowels or back and neutral vowels in this initial disyllable e.g. *karamelli* ‘caramel, candy’ and *omeletti* ‘omelette’.

Since the neutral vowels are transparent to harmony, words with a back vowel (or a front then back vowel) in an early syllable and only neutral vowels in the final disyllable are expected to select only back suffixes. However, variation in the harmonic class of the allomorph selected is reported to occur e.g. *arkkitehti-a* ~ *arkkitehti-ä* ‘architect (part.)’. That they may select front suffixes at all is unexpected since, in most cases, there is no front harmonic vowel to condition the front allomorph and even when one does appear, it is followed by a back harmonic vowel.
However, unexpected front allomorphs in loanwords of this type appear to have a long history in the language. Already in old written Finnish the following three and four syllable examples were recorded in the work of the early writer Sorolainen and in Agricola’s bible translation:\(^{40}\):

- *majesteti-sä* ‘in the majesty (iness.)’,
- *Testamenti-sä* ‘in the testament (iness.)’,
- *Nazreti-stä* ‘from Nazareth (elat.)’,
- *Naemi-ldä* ‘from Naomi (abl.)’,
- *Moabiti-läinen* ‘Moabite’,
- *Israeli-llä* ‘Israel (ade.)’,
- *Samueli-ldä* ‘from Samuel (abl.)’ (Rapola 1965: 251).

Though these BN loans have garnered significant interest in the literature and are thought to be remarkable in terms of vowel harmony due to their suffixal variation, there is also some evidence that they are not without precedent in the native synchronic grammar. Rapola (1965: 251) provides an example, reproduced below in (17), which shows a Finnish word from the modern Luopioinen dialect with the identical structure to the BN loanwords appearing with a front allomorph. No translation is provided.

(17) Native Finnish BN Word with Front Suffixes

\[
/keskuhiitti-i-stA/ \quad \text{késkuhittista}^{41} \quad \text{‘? (elat. pl.)’}
\]

So this phenomenon is not unknown within Finnish, both synchronically as well as diachronically, and even appears to have a history as far back as the earliest written records.

Long harmonic loanwords, like the disharmonic loanwords, have also been subject to prescriptive rules. Sadeniemi (1946: 79) asserts that only the back allomorph is acceptable\(^{42}\) in long BN words though he acknowledges that ambiguity may arise as some such words may be seen as compounds by speakers. More recent prescriptive rules concerning these lexical items confirm that they are to be treated as monomorphemic back vowel words and suffixed with back

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\(^{40}\) English glosses were not provided. Translations by author.

\(^{41}\) Interestingly this word also does not seem subject to quantitative consonant gradation, a process which lenites geminate consonants in the onset of a closed syllable. If gradation applied, *[keskuhiittistä]* would be expected.

\(^{42}\) Sadeniemi (1946: 79) notes though that a majority of the BN words may be suffixed with front allomorphs in the material collection of *Nykysuomen sanakirja*. 
allomorphs accordingly (Eronen 2000; Moilanen 2005). Anderson (1980: 316) though reports that, in Groundstroem’s (1971) opinion, the prescriptive rule requiring back allomorphs is “somewhat contrary to the feeling of the language”.

Levomäki (1972) experimentally examined the written suffixal variation seen with both disharmonic and harmonic stems with only neutral vowels in the final two syllables. Those disharmonic stems with a final front harmonic vowel followed by at least two neutral syllables, e.g. *polymeeri* ‘polymer’, were suffixed with front allomorphs between 65.5-89.0% of the time, which was similar to the results for the BF stems. The three FB disharmonic stems with a final back harmonic vowel followed by at least two neutral syllables, e.g. *dynamiitti* ‘dynamite’, displayed 28.6%, 29.2%, and 56.2% front suffixes in spite of the lack of front vowels in the stem to condition the front allomorph. Harmonic BN words of four or more syllables with only neutral vowels in the final disyllable displayed a wide range of lexical variation with some words, such as *artikkeli* ‘article’ 4.2% F, suffixing almost exclusively with back allomorphs and others, such as *arkkitehti* ‘architect’ 73.0% F, clearly preferring front allomorphs.

As was seen with the disharmonic stems, even when forms contained the same element and a compound analysis was extremely likely due to the existence of a related free morpheme, the percentages of front allomorphs may still differ between lexical items e.g. *heksametri* ‘heksameter’ 60.8% F compared with *kilometri* ‘kilometer’ 80.0% F and *barometri* ‘barometer’ 81.0% F. Overall, as compared to the BF words, harmonic BN words though were less likely to suffix with front allomorphs. Similar to the BF words included in the experiment, the degree of variation by lexical item was quite smooth with no apparent groupings (4.2-73.0% F).

Conversely Ringen and Heinämäki’s (1999: 313) results indicated two separate groups of BN loanwords exist. While one group suffixed almost exclusively with back allomorphs, displaying very few categorical front allomorphs and little intra-speaker variation, the second group received 8.0-20.0% categorical front suffixes and displayed intra-speaker variation. Ringen and

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43 Levomäki (1972: 255) also included a set of BN words which were more likely than others to be considered compounds e.g. *kilometri* ‘kilometer’. These words were suffixed with front allomorphs 60.8-98.7% of the time.
Heinämäki (1999: 313) interpret these results as an indication that only those words which are phonotactically plausible compound words may be affixed with front allomorphs.

Many accounts of the variation including Campbell (1980: 252), Välimaa-Blum (1987: 515; 1999: 263), and Ringen and Heinämäki (1999: 324) have appealed, at least in part, to the long-standing ‘prosodic compound’ hypothesis discussed by Sadeniemi (1949: 48) whereby polysyllabic words may be treated by speakers as pseudo-compound words. As discussed in section 2.1, suffixes appended to compound words agree in backness with the final element of the compound e.g. koivu=metsä-ä ‘birch forest (part.)’, metsä=kana-a ‘grouse (part.)’. Under the prosodic compound hypothesis loanwords of four or more syllables such as arkki.tehti ‘architect’ may be optionally parsed by speakers into smaller, disyllabic prosodic units or domains. A suffix may then harmonize to the entire word, as in (18a), which results in a back allomorph, or to the smallest adjacent unit, as in (18b), which results in a front allomorph. The optional analysis of the word using different harmonic domains accounts for the reported suffixal variation.

(18) Prosodic Compound Analysis

a. [arkkitehti-a] monomorphemic analysis
b. [arkki][tehti-ä] prosodic compound analysis

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Though it is unclear who originated the compound hypothesis, it has been suggested at least as far back as Sadeniemi (1949: 48), who noticed that the stress patterns of these long loanwords were similar to those of compounds.

Karvonen (2005: 164) notes that such pseudo-compound structures have also been posited for Icelandic and Pima (see work by Árnason (1996) and Hayes (1995) for Icelandic and Munro and Riggle (2004) for Pima) and the concept has also been utilized by Martin (2005) for Malagasy and Prince (1980: 544) for Estonian. As in Finnish the pseudo-compound analysis does not appear to be obligatory in the other languages for which it has been hypothesized. Árnason (2011: 273) notes that only some loanwords are subject to the pseudo-compound analysis, while others behave as monomorphemic stems. Munro and Riggle (2004: 119) note that in Pima there is inter- and intra-speaker variation in their treatment of loanwords. As well there appears to be a tendency for both lexicalized etymological compounds and especially pseudo-compounds to undergo reanalysis to conform with the Pima’s phonological rules for mono-morphemic words (Munro and Riggle 2004: 188-9).
The prosodic compound hypothesis rests on the fact that roots in Finnish are typically disyllabic and monomorphemic roots of more than three syllables are rare or absent\(^{46}\) (Karvonen 2005: 23, 149; Suomi et al. 2008: 71). Lehiste (1964: 179) found that in Finnish “all words consisting of more than three syllables seem to be built of disyllabic or trisyllabic components, whose quantity patterns are similar to those of disyllabic or trisyllabic words.”\(^{47}\) Similarly Välimaa-Blum (1999: 250) states that “when the word has four or more syllables, speakers of Finnish intuitively analyze them prosodically into smaller constituent parts so as to make the word conform to the native pattern”\(^{48}\).

Ringen and Heinämäki (1999: 313) postulate that this pseudo-compound analysis is likely only available when each resultant prosodic unit forms a licit disyllabic word. For example, both arikki and tehti are phonotactically possible Finnish words thus permitting the compound analysis for arkkitehti ‘architect’ while it remains prohibited for a word such as artikkeli ‘article’ as the initial unit artik would violate Finnish word-final phonotactics. Ringen and Heinämäki (1999: 313)

\(^{46}\) In Finnish there is a tendency towards heavy initial syllables (Karlsson 2005: 68; Suomi et al. 2008: 69-70, 77). As many longer disharmonic loanwords have a long third syllable vowel due to the stress patterns in the original language, which is normally Swedish, this may also provide impetus for speakers to analyze the longer words as compounds.

\(^{47}\) However, see Skousen (1973: 124) concerning the differing behaviour of two and four syllable neutral vowel stems concerning atypical derivational suffixes. In these cases the four syllable stems do not behave as disyllabic units. Perhaps polysyllabic words may be optionally treated as disyllabic/trisyllabic units depending on the process.

\(^{48}\) Sadeniemi (1949), as reported in Välimaa-Blum (1999: 250), found phonetic cues later discussed by Lehiste (1964) which are typically associated with the juncture between elements of compounds between the first and second half of long loans. Duncan (1999: 100-5) found that the compound markers discussed by Lehiste (1964) appeared to be speaker dependant and optional for compound words but were largely absent from the loanwords studied. Similarly Välimaa-Blum (1999: 254) found only “sporadic application of such an analysis in her data”. Unfortunately it is not clear whether those tokens which exhibited the pertinent cues were the same as those which were appended with front allomorphs. The phonetic cues associated with compound words which Lehiste (1964: 174-9) discusses occur only in very specific circumstances, most of which are not applicable to most of the loanwords. The vowel quality and length differences were observed only when a compound boundary occurred between two vowels e.g. lintu=ansa ‘bird trap’ vs. lintu-a-ansa ‘his/her bird (part.)’. Laryngealization occurred between two vowels but also when a consonant was syllabified as the coda of the first element and followed by a word-initial vowel rather than when the consonant was an onset e.g. puu-n=eliö ‘tree organism’ vs. puu=neliö ‘tree square’. When this consonant was nasal, nasalization did not occur on the following vowel as would be expected when the nasal was an onset. Unfortunately, only two words in Välimaa-Blum (1999) have vowel hiatus, a.te.is.ti and hy.a.sint.ti, and though several words have a nasal in the relevant position, it seems unlikely that the nasal would ever syllabify as a coda, leaving the following vowel onset-less e.g. ka.ram.el.li instead of ka.ra.mel.li. It is perhaps not unexpected then that the phonetic correlates discussed by Lehiste (1964: 174-9) were not found by Välimaa-Blum (1999).
note that stems which are phonotactically possible compounds are treated as such approximately 25% of the time while those stems which are phonotactically improbable compounds are never treated as such. Though this accords well with their loanword data, it is contradicted by some of Levomäki’s (1972) findings. For example the contrasting behaviour in Levomäki (1972) of a.mu.let.ti ‘amulet’, which could be a compound but is affixed with front suffixes 9.2% of the time, and ark.ki.teh.ti, also a possible compound but is affixed with front suffixes 73.0% of the time, is unexplained. The lexical item fa.kul.teet.ti ‘faculty’, which is a possible though unlikely compound49, still receives 32.2% front suffixes in Levomäki’s (1972) study but only 4.8% front suffixes in Ringen and Heinämäki’s (1999) study.

Kiparsky (2003) modifies the prosodic compound hypothesis somewhat to account for the fact that some polysyllabic BN loanwords exhibit suffixal variation while others do not. Based on morphological and phonological patterns, Kiparsky (2003: 113) posits two types of secondary stress: rhythmic and lexical50.

Under the typical stress pattern in Finnish, termed ‘movable’ or ‘rhythmic’ by Kiparsky (2003: 111), primary stress is always on the initial syllable and secondary stresses fall on every other syllable thereafter, normally excluding the final syllable though these may be optionally stressed if heavy. Secondary stress shifts from a light syllable to a following heavy syllable, as shown in the examples below in (19) from (Anttila 2010: 1).

(19) Finnish Stress Patterns

a. /kalastele-t/ [ká.las.tè.let] ‘you are fishing’

b. /kalastele-mme/ [ká.las.te.lèm.me] ‘we are fishing’

49 Though [l] is possible word-finally, it is very uncommon (Suomi et al. 2008: 59).

50 Though Kiparsky (2003) does not address harmonic suffix variation in disharmonic loanwords, only harmonic loans, elements of his analysis could be extended to these words as well. Note that secondary stress remains understudied phonetically in Finnish and future work may wish to examine and compare the phonetics of the secondary stress patterns in native words and loanwords.
While some loanwords have the expected stress pattern allowing the stress shift, others maintain an underlying secondary stress on a particular syllable, regardless of the weight, as shown below in (20) (Kiparsky 2003: 111-3). The difference between the typical rhythmic stress and this second invariant stress pattern is not apparent in the nominative case but is visible in various morphological and phonological alternations sensitive to stress (see Kiparsky 2003 for details).

(20) Comparison of Rhythmic and Fixed Secondary Stress

a. Rhythmic/Movable Stress Pattern

ártikkeli ‘article (nom.)’

ártikkeli ssa ?*ártikkeli ssa ‘in the article (iness.)’

b. Fixed/Lexical Stress Pattern

ésplanada ‘esplanade (nom.)’

ésplanada ?*ésplanada ‘on the esplanade (adess.)’

For the purposes of the phonology (and morphology), the main difference is that the lexical stress is visible to the morphology and stem-level morpho-phonology while the rhythmic stress is not (Kiparsky 2003: 115). As vowel harmony occurs at the stem level, the secondary stress, which is visible, may optionally initiate a new harmonic domain. Therefore those stems such as arkkitehti ‘architect’, which have fixed stress, may select either front or back allomorphs while those such as artikelli ‘article’, which have rhythmic stress, are predicted to lack variation and select only back allomorphs (Kiparsky 2003: 115).

(21) Stress Patterns

a. Fixed Stress: árk.ki.tèh.ti árk.ki.tèh.dil.la árk.ki.tèh.dil.lä

b. Movable Stress ártik.kè.li ártik.ke.lìl.la ?*ártik.ke.lìl.lä

Sadeniemi (1949: 48) hypothesizes that the fixed stress on these loanwords is derived from the primary stress in the donor language. Though not explicitly discussed in Kiparsky (2003), the
lexical stress pattern seems to be exclusive to loanwords and some borrowed suffixes. As native Finnish mono-morphemic words tend not to be polysyllabic, lexical stress would not occur in native words simply due to the typical word length. While Kiparsky (2003: 116) treats some borrowed suffixes such as -isti ‘ist’ as having a fixed stress, no native suffixes have been reported to have lexical stress though some optionally draw stress to the preceding syllable (Karvonen 2005: 2).

The lexical stress pattern is strongly reminiscent of the compound stress pattern where the initial syllable of each lexical item retains a fixed stress. The common compound words from Karvonen (2005: 122), shown below in (22), behave analogously to the loanwords with fixed stress in (20b) in their failure to undergo stress shift when affixed with the inessive suffix /-ssA/. This compound stress pattern is retained in very frequent, well-established compounds and even those which are arguably no longer synchronically compositional have not been reported to modify their stress pattern to conform to the rhythmic pattern.

51 The possibility of a relationship between a given loanword’s stress pattern, its frequency, and its degree of assimilation remains for future work.

52 Other languages which appear to utilize some form of pseudo-compound analysis also seem to base the analysis on the stress patterns of the loanwords, which more closely resemble those of compounds, and other phonological or morpho-phonological patterns result from the compound analysis (Martin 2005; Munro and Riggle 2004).

53 However, Mahonen (2011: 106) found that some three syllable FB compounds, such as jää-kaappi ‘ice box’, did not seem to have the expected secondary stress on the first syllable of the second element. Mahonen (2011: 105, 156) examined the secondary stress patterns of three and four syllable disharmonic loanwords and nonce words. Stress determinations were based on auditory judgments coupled with spectrographic measurements of pitch, intensity, and duration. It is unclear though that pitch and intensity are phonetic correlates of stress in Finnish. Suomi et al. (2008: 76) state that “stress is not realized tonally…stress is realized by variations in segment durations”. Accent, which, like primary stress is typically associated with a word-initial syllable, is, however, realized tonally and may also be associated with intensity (Suomi et al. 2008: 79, 112).
(22) Fixed Stress in Common Compounds

a. sá.la=sá.na secret=word, ‘password (nom.)’
   sá.la=sá.na-s.sa *sá.la=sa.nà-s.sa ‘password (iness.)’

b. kó.ti=ky.lä home=village, ‘home village (nom.)’
   kó.ti=ky.lä-s.sä *kó.ti=ky.là-s.sä ‘home village (iness.)’

Since compounds are quite frequent in Finnish, the fixed stress pattern is not uncommon.

Though Kiparsky’s (2003) analysis very insightfully explains morphological and phonological variation associated with only some of these BN polysyllabic words, it is unclear whether it can explain the degrees of variation seen for example in Levomäki’s (1972) data. For example, both mannekiini ‘mannequin’ and karamelli ‘caramel, candy’ are listed by Kiparsky (2003: 113, 115) as having lexical stress but in Levomäki’s data, they receive 36.4% and 52.6% front suffixes respectively. Kiparsky (2003: 116) notes that stems with -isti ‘ist’, -iitti ‘-ite’, and -iivi ‘-ive’, though they have lexical stress on the penultimate syllable, are not expected to select front allomorphs as they are treated as derivational suffixes but in Levomäki (1972) elatiivi ‘elative’ and transitiivi ‘transitive’ receive 5.5% and 23.8% front suffixes respectively and it is not clear how Kiparsky’s (2003) analysis alone could account for this variation.

Munro and Riggle (2004: 118-9) noted that in Pima (a Uto-Aztecan language), in which loanwords also exhibit an optional pseudo-compound analysis, stress pattern reanalysis occurs as words are nativized. It is possible that the Finnish words may undergo changes to their stress pattern and assimilate to the rhythmic pattern as they are nativized. This exposes the possibility that a given word may be treated differently by different speakers or that the stress pattern may change over time.
Duncan (2011), in an examination of BN loanwords suffixation on the internet using Query Google\textsuperscript{54}, found that words with higher token frequencies had more suffix variation than those with lower frequencies. While forms with lower frequencies tended to be suffixed primarily with back allomorphs, which suggests a single domain or rhythmic stress analysis, those with higher frequencies displayed fairly even front/back allomorph selection, which suggests a prosodic compound or lexical stress analysis. Interestingly the relevant frequency appeared to be that of the stem+inflectional suffix combination rather than that of the stem itself. For example, while the loanword *arkkitehti* ‘architect’ suffixed primarily with back allomorphs in the partitive singular, which had a lower frequency online, in the partitive plural, which had higher frequency, approximately even numbers of front and back allomorphs were selected\textsuperscript{55}. Not only do these results indicate that frequency is relevant to suffix selection but Duncan (2011: 123-4) also suggested these findings could argue for some form of full-form lexical storage. If this is the case, specific suffixes may demonstrate divergent behaviour with the same lexical item and a single stem may illustrate different behaviour with different suffixes, which may potentially explain some of the differences in behaviour among various studies.

While all the studies discussed above used written data to determine the suffix allomorph variation Välimaa-Blum (1999) provides an acoustic analysis of the suffix vowels. Her results for the three neutral-final word types are shown below in Table 2-1. The suffix vowels were auditorily classified as front, back, or central.

<table>
<thead>
<tr>
<th>Stem Vowels</th>
<th>N</th>
<th>% Front [æ]</th>
<th>% Back [ɑ]</th>
<th>% Central [a]</th>
<th>% Speech Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNNN</td>
<td>180</td>
<td>51</td>
<td>39</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>BBNN</td>
<td>181</td>
<td>47</td>
<td>40</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td>FBNN</td>
<td>135</td>
<td>19</td>
<td>60</td>
<td>19</td>
<td>2</td>
</tr>
</tbody>
</table>

54 Query Google is a Java applet programmed by Tim Ma of UCLA which was publicly available at http://www.linguistics.ucla.edu/people/hayes/querygoogle/.

55 As the internet is constantly being added to, these results may change over time and additional study could examine any emerging or changing preferences.
Both BNNN and BBNN words seemed to display very similar results with slightly more front allomorph selections while the FBNN class was affixed with a greater percentage of back suffixes. Interestingly, while Ringen and Heinämäki (1999: 316) posit that stressed vowels are preferred harmony triggers, the FBNN words, which would have stress on the front vowel, actually have quite high percentages of back allomorphs.

All word classes, especially the disharmonic class, displayed a noteworthy percentage of central [a] suffixes. The higher percentage of central suffixes cannot, however, be ascribed exclusively to some sort of linguistic uncertainty associated with the disharmony since the BF class, discussed above in section 2.3.2.2, exhibited very few such suffixes (5%).

Comparing the stem classes, there does not seem to be a significant difference between the percentage of front allomorphs between the BNNN and BBNN stems, which differ in the number of neutral vowels which precede the suffix vowel. If a count effect were operative, as has been suggested for Hungarian whereby an increase in the number of neutral vowels increases the likelihood of front allomorphs (Hayes and Londe 2006: 6), it is expected that BNNN stems would have more front suffixes than BBNN stems. As this is not the case, it seems no count effect has occurred. However, the addition of the five-syllable BBNNN word akateeminen ‘academic’ in the BBNN category may also have altered the percentages masking any count effect.

Välimaa-Blum (1999) does not discuss the degree of inter- or intra-speaker variation or lexical patterning for most words. However, she (1999: 252) reports that only a single word, omeletti ‘omelette’, displayed no variation. This word was exclusively suffixed with the back allomorph by all speakers. Other words with the same harmonic vowel pattern displayed quite different behaviour: arkkitehti ‘architect’ 73% F, ateisti ‘atheist’ 44.4% F (Välimaa-Blum 1999: 256).

As with the BF disharmonic words, a great deal of variation has been uncovered in previous work, though the precise amount of variation associated with specific lexical items or BN words in general has not been determined. In order to account for the occurrence of the front allomorphs some sort of domains-based analysis is generally acknowledged though the details remain in dispute. This suffix variation will be addressed in the two experiments discussed in Chapter 3-Chapter 6.
2.3.2.4 Summary of Suffixation Patterns

Overall, most researchers agree that certain word types are likely to evidence variation while others are expected to categorically select certain allomorphs. It is the precise degree of the variation as well as the phonological causes which are generally in dispute. The expected patterns are shown below in Table 2-2.

Table 2-2: Summary of Expected Suffix Allomorph Patterns

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Syllable Number</th>
<th>Expected Suffix Allomorph</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB</td>
<td>three</td>
<td>back</td>
</tr>
<tr>
<td></td>
<td>four or more</td>
<td>back</td>
</tr>
<tr>
<td>BF</td>
<td>three</td>
<td>variation depending on vowel height</td>
</tr>
<tr>
<td></td>
<td>four or more</td>
<td>variation depending on vowel height; more front allomorphs than BF trisyllabic words due to availability of pseudo-compound analysis</td>
</tr>
<tr>
<td>BN</td>
<td>three</td>
<td>back</td>
</tr>
<tr>
<td></td>
<td>four or more</td>
<td>variation due to the availability of the pseudo-compound analysis and possibly dependant on stress pattern of word</td>
</tr>
</tbody>
</table>

2.3.2.5 Lexical Item Comparison

As noted by Välimala-Blum (1999: 256), identical lexical items have widely different suffix allomorph selection values across different studies. Words for which front suffix values were provided in more than one study are presented below in Table 2-3. As Levomäki (1972) and Duncan (2011) were unable to ascertain intra-speaker variation, Ringen and Heinämäki’s (1999) results from tests 1 and/or 2 are presented for a closer comparison. Those lexical items for which data was also given for tests 3 and 4, in which the same group of participants underwent the experiment on two occasions, have those results listed in brackets. While Levomäki’s (1972), Ringen and Heinämäki’s (1999), and Duncan’s (2011) results refer to written affixes, Välimala-Blum’s (1999) were determined auditorily.
Table 2-3: Comparison of Front Allomorphs across Studies

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>adjektiivi</td>
<td>‘adjective’</td>
<td>--</td>
<td>4.0</td>
<td>--</td>
<td>17.9</td>
</tr>
<tr>
<td>afääri</td>
<td>‘affair’</td>
<td>83.1</td>
<td>80.0 (68.7)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>analyysi</td>
<td>‘analysis’</td>
<td>81.4</td>
<td>50.0 (40.0)</td>
<td>93.0</td>
<td>53.6</td>
</tr>
<tr>
<td>appelsiini</td>
<td>‘orange’</td>
<td>33.3</td>
<td>--</td>
<td>--</td>
<td>26.3</td>
</tr>
<tr>
<td>arkkitehti</td>
<td>‘architect’</td>
<td>73.0</td>
<td>48.0</td>
<td>73.0</td>
<td>33.3</td>
</tr>
<tr>
<td>artikkeli</td>
<td>‘article’</td>
<td>4.2</td>
<td>4.0</td>
<td>--</td>
<td>39.0</td>
</tr>
<tr>
<td>ateisti</td>
<td>‘atheist’</td>
<td>--</td>
<td>0.0</td>
<td>44.4</td>
<td>--</td>
</tr>
<tr>
<td>bolsevikki</td>
<td>‘Bolshevik’</td>
<td>42.6</td>
<td>26.0</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>dynamiitti</td>
<td>‘dynamite’</td>
<td>28.6</td>
<td>8.0</td>
<td>16.0</td>
<td>--</td>
</tr>
<tr>
<td>fakulteetti</td>
<td>‘faculty’</td>
<td>32.2</td>
<td>4.8</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>hieroglyfi</td>
<td>‘hieroglyph’</td>
<td>82.0</td>
<td>80.0 (68.0)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>jonglööri</td>
<td>‘juggler’</td>
<td>--</td>
<td>86.0 (72.0)</td>
<td>--</td>
<td>70.1</td>
</tr>
<tr>
<td>juveniili</td>
<td>‘juvenile’</td>
<td>46.8</td>
<td>--</td>
<td>--</td>
<td>33.9</td>
</tr>
<tr>
<td>karamelli</td>
<td>‘caramel, candy’</td>
<td>52.6</td>
<td>16.0</td>
<td>72.0</td>
<td>34.4</td>
</tr>
<tr>
<td>mannekiini</td>
<td>‘mannequin’</td>
<td>36.4</td>
<td>--</td>
<td>--</td>
<td>21.8</td>
</tr>
<tr>
<td>marttyyri</td>
<td>‘martyr’</td>
<td>52.0</td>
<td>42.0 (24.0)</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>partikkeli</td>
<td>‘particle’</td>
<td>--</td>
<td>0.0</td>
<td>--</td>
<td>11.5</td>
</tr>
<tr>
<td>reumatismi</td>
<td>‘rheumatism’</td>
<td>29.6</td>
<td>--</td>
<td>--</td>
<td>28.5</td>
</tr>
<tr>
<td>revolveri</td>
<td>‘revolver’</td>
<td>15.3</td>
<td>--</td>
<td>--</td>
<td>10.6</td>
</tr>
</tbody>
</table>

In some cases the same lexical item may be similar in two or more studies and then differ in another e.g. analyysi ‘analysis’ or artikkeli ‘article’. In others, the word shows consistent behaviour in all studies in which it was included or conflicting behaviour in all e.g. hieroglyfi ‘hieroglyph’ and karamelli ‘caramel, candy’ respectively. While approximately half the words display similar behaviour in more than one study, it is equally common that the lexical items have divergent behaviour, seemingly without pattern, and so the ultimate basis for the varying behaviour is unclear. As some of the studies have examined written behaviour and others phonetic, the second experiment herein, introduced in Chapter 4, compares the suffixation patterns in the two mediums. It is also possible that the variation is due to other phonological or sociolinguistic factors which will also be addressed.
2.3.2.6 Unexpected Suffixal Disharmony

While most of the harmonic BN loanwords which have been noted to display unusual suffixal harmony are four or more syllables and therefore clearly diverge from the expected length patterns of native words, some three syllable back harmonic words may also display unusual harmonic behaviour e.g. *ap.ri.li-a* ~ *ap.ri.li-ä* ‘April Fool (part.)’ (Levomäki 1972: 255; Kiparsky 2003: 140 note 22). As these words are less than four syllables and Finnish does not allow CV or CVC words outside of the closed class of function words, the pseudo-compound analysis is unavailable for these words.

Kiparsky (2003: 140 note 22) observes that some trisyllabic loanwords which were accented on the second syllable in the donor language but synchronically have Finnish stress patterns may behave as though they maintain the original accent underlyingly though it is not phonetically realized. These words, like polysyllabic loanwords with fixed lexical stress, vacillate in suffix allomorph selection in his database. For example, *konflikti*, which is borrowed from Swedish *konflikt* (NS8) is attested as both <kónfliktè-j-a> `conflicts (part.pl.)’ and unexpected <kónfliktè-j-ä>56. Such words demonstrate a crucial difference between the traditional pseudo-compound analysis and Kiparsky’s (2004) stress-based analysis. Trisyllabic words are too short for the pseudo-compound analysis to apply but, assuming they have an underlying, phonetically unrealized accent on the second neutral syllable, Kiparsky’s (2004) stress-based analysis may apply.

Ringen and Heinämäki (1999) and Levomäki (1972) each included several three syllable BN words in their studies. In Ringen and Heinämäki’s study (1999: 313) both of the three syllable BN words had very low rates of front suffixes: *katrilli* ‘quadrille’ 6.0% and *fakiiri* ‘fakir’ 0.0%. Conversely in Levomäki’s (1972) study all but one unexpectedly received a significant percentage of front allomorphs, as shown below in Table 2-4. In several cases trisyllabic BN words received greater percentages of front allomorphs than longer BN words.

56 Levomäki (1972: 257) notes that BN words in which [i] or [e] had primary stress in the donor language but are stress-less in Finnish typically are suffixed with back allomorphs e.g. *turisti* ‘tourist’ 0.0% F and *artikkeli* ‘article’ 4.2% F, which appears to conflict with Kiparsky’s (2003: 140 note 22) remarks.
Table 2-4: Three-Syllable BN Words from Levomäki (1972)

<table>
<thead>
<tr>
<th>Lexical Item</th>
<th>% F</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>turisti</td>
<td>0.0</td>
<td>‘tourist’</td>
</tr>
<tr>
<td>puustelli</td>
<td>16.7</td>
<td>‘official residence’</td>
</tr>
<tr>
<td>aprilli</td>
<td>21.5</td>
<td>‘April fool’</td>
</tr>
<tr>
<td>ateljee</td>
<td>22.2</td>
<td>‘atelier’</td>
</tr>
</tbody>
</table>

The stress patterns for these words in the donor language are shown below in (23). Though neither fakiiri ‘fakir’ nor ateljee ‘atelier’ were listed in the etymological dictionaries consulted, there are similar words in Swedish and it is possible that these were the source of the Finnish loanwords.

(23) Stress Patterns in Swedish

<table>
<thead>
<tr>
<th>Finnish</th>
<th>% F Suffix</th>
<th>Swedish</th>
<th>Etymological Dictionary</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. fakiiri</td>
<td>0.0</td>
<td>Swedish fakír</td>
<td></td>
</tr>
<tr>
<td>b. turisti</td>
<td>0.0</td>
<td>Swedish turíst</td>
<td>NS, SSA</td>
</tr>
<tr>
<td>c. katrilli</td>
<td>6.0</td>
<td>Swedish kadrílj</td>
<td>SSA</td>
</tr>
<tr>
<td>d. puustelli</td>
<td>16.7</td>
<td>Swedish bóstâlle</td>
<td>SKES, SSA</td>
</tr>
<tr>
<td>e. aprilli</td>
<td>21.5</td>
<td>Swedish apríl</td>
<td>SKES, SSA</td>
</tr>
<tr>
<td>f. ateljee</td>
<td>22.2</td>
<td>Swedish ateljé</td>
<td></td>
</tr>
</tbody>
</table>

The stress patterns in the donor language do not appear to be the source of the suffix variation in Finnish. For example, while both katrilli ‘quadrille’ and aprilli ‘April Fool’ display identical stress patterns in Swedish only aprilli ‘April Fool’ demonstrates any substantial degree of variation.

57 Stress patterns provided by Johan Gross (p.c. Nov. 9, 2014).

58 Kiparsky (2003: 116) states that -isti is a productive suffix which is marked with lexical stress but, like other such suffixes, does not initiate a new harmonic domain.
Levomäki (1972) also included four harmonic words, which would be expected to suffix categorically. Two, however, displayed significant variation.

Table 2-5: Unexpected Suffix Responses from Levomäki (1972)

<table>
<thead>
<tr>
<th>Lexical Item</th>
<th>% Front</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>timotei</td>
<td>63.4</td>
<td>‘timothy hay’</td>
</tr>
<tr>
<td>primääri</td>
<td>66.0</td>
<td>‘primary’</td>
</tr>
<tr>
<td>interiööri</td>
<td>91.0</td>
<td>‘interior’</td>
</tr>
<tr>
<td>geneettinen</td>
<td>97.3</td>
<td>‘genetic’</td>
</tr>
</tbody>
</table>

Very unexpectedly the back harmonic trisyllabic word *ti.mo.tei* ‘timothy hay’ was affixed 63.4% of the time with front allomorphs. It is possible the unstressed [o] is perceptually difficult (though note that the study was written) but other native or nativized words such as *kir.joi.te* ‘written text’ or *ki.hok.ki* ‘sundew’ or common loanwords such as *ki.os.ki* ‘kiosk’ have a similar vowel pattern and have not been reported to display variation.

The front harmonic word *primääri* ‘primary’ is affixed only 66.0% of the time with front allomorphs. In the *Kielitoimiston sanakirja*, both *primääri* and *primaari* are listed though it is noted that the back variant is more usual. Perhaps then the variation could be attributed to differing stem vowels which may vary from those represented orthographically.

Mahonen (2011) also uncovered some unexpected suffixation patterns in her written data. Though the suffixation was as expected and close to categorical for the native words and back harmonic loanwords, there were some anomalous, unexplained results. For example, in the categorical results, the mean percentage of back allomorphs was 9.1% for front harmonic nonce words, e.g. *väämi*, with a maximum percentage of back allomorphs of 30.8% (Mahonen 2011: 141). The mean percentage of ‘either’ responses (20.7%) was also especially high for this word type (Mahonen 2011: 144). Mahonen (2011: 145, 147) notes that the harmonic nonce words had greater suffix variability and lower quality-of-fit ratings than phonologically similar harmonic loans which she (2011: 165) attributes to “increased harmony choice difficulties that participants faced when learned lexical effects were removed.” Word knowledge is an unexpected factor in the suffixation of harmonic words as it is normally assumed Finnish orthography is shallow and speakers simply match the harmonic class of the suffix to that of the stem.
These word types, unlike either disharmonic words or the longer BN loanwords, have not yet been provided with a phonological account of the variation. In fact, there appears to be less consensus in the experimental findings concerning the degree of variation or even whether variation occurs. The written and phonetic suffixation of trisyllabic BN loanwords is examined and compared with that of longer BN loanwords in Experiment 2, introduced in Chapter 4.

2.4 Outstanding Issues

While Finnish vowel harmony has been widely studied, several issues remain unexplored or are as yet unresolved. Though suffixal harmony is based on the stem vowels and stem harmonization has been acknowledged and has occurred diachronically, no systematic examination of the stem vowel quality in disharmonic words has yet been undertaken, to my knowledge. Whether these loanwords are pronounced disharmonically, harmonically, or whether there is variation is still unknown. It is also possible that those which are pronounced disharmonically are largely unassimilated and as they fully enter the lexicon of the language they become harmonized. The apparent lack of current harmonization may also be (at least partially) a consequence of the standardized orthographic forms.

If these loanwords are truly disharmonic and remain as such, what consequences does this have concerning the status of the harmony system? There are conflicting views on the effect of loanwords which do not conform to native phonological processes. Hammarberg (1974: 173) connects the introduction of non-gradated loanwords into Finnish with the decline of qualitative gradation, a lenition process affecting stops in the onset of closed syllables. Conversely Binnick (1991), in his discussion of the deterioration of vowel harmony in certain Uralic and Altaic languages, argues that disharmonic loanwords are not responsible for the loss of harmony in these languages which is instead more likely to be the result of language internal factors such as vowel coalescence or deletion, vowel reduction, or umlaut. In fact Binnick (1991: 39) states that disharmonic loanwords have little, if any, effect on the system since they normally undergo regular suffixation. Loanwords alone are likely insufficient to cause the decline of harmony though they may be implicated in harmony loss alongside other language internal factors and language contact.
The Finnish loanwords discussed herein are largely learned and are subject to prescriptive rules. As well, many are of low frequency and form a very small segment of the language. All of these factors may limit their possible effect on the system as a whole. However, the long-term acceptance of stem disharmony within both loanwords and slang perhaps indicates a grammar-wide shift. Alongside the great number of non-compositional disharmonic etymological compounds there may then be a growing portion of the Finnish lexicon which does not obey stem harmony.

If loanwords do not harmonize even when they are integrated into the Finnish lexicon, two possible explanations are available. These words may be lexically marked as being exceptional to harmony though stem harmonization may remain a future possibility for some such words. Any effects of this exceptionality on the native harmony system would likely be related to the overall number and frequency of the exceptional loanwords. Alternatively, the failure of these loanwords to undergo stem harmony may signal that root harmony is no longer active in Finnish and harmony in stems is merely a historical artifact. Under this analysis, loanwords which have recently entered the language will not be subject to harmony at all.

Suffixal vowel harmony has been well-studied for BF disharmonic words and long words with only neutral vowels in the final disyllable. However, many studies have produced conflicting results which have not been explained. As well, FB disharmonic words, which are normally assumed to allow only back allomorphs, may not be as categorical in suffix selection as expected, as indicated by Mahonen’s (2011) written results. Similarly, some tri-syllabic BNN words also unpredictably display suffixal variation in Levomäki’s (1972) study which cannot be explained by any of the current phonological analyses.

Unexpectedly, within Mahonen’s (2011) study, loanwords and nonce words with harmonically identical vowel sequences displayed different behaviour. Harmonic nonce words did not display the categorical suffix allomorph selection expected and evidenced by the harmonic native words. This suggests a potential relationship between suffix allomorph selection and word knowledge or possibly frequency, which was seen to be relevant in Duncan (2011). Words which are known to the speaker may be treated in accordance with stored remembrances while those which are not,
should be subject only to the productive phonological rules available. That the nonce words do
not appear to display the expected harmonic alternations is puzzling and potentially problematic.

As most of the relevant studies have relied exclusively on the written form (Levomäki 1972,
Ringen and Heinämäki 1999, Kiparsky 2004, Kimper 2011) the question arises as to whether the
written forms correspond with spoken forms. Although Välimaa-Blum’s (1999) study was
phonetic, as it did not have a written component, it cannot directly address this question. An
additional complication is that Välimaa-Blum (1999) found a third suffix vowel, a centralized
variant. As Finnish orthography does not provide any such written lexeme, it is unclear how
speakers might choose to represent such a vowel. As it cannot be represented orthographically
writers would necessarily have to select one of the available low vowels, which would not
correspond phonetically. Though Mahonen (2011) did do both a written and phonetic study, the
results were not directly compared so it remains unclear what the relationship may be between
individual written and spoken forms. However, while her F2 results for the FB words, for
example, appeared to be consistent with back allomorphs, her written data displayed variation,
suggesting that there was some divergence between the data. As every experiment, including the
phonetic studies, relies on the written medium at least as a prompt, the influence of orthography
is an outstanding issue.

These loanwords have long been subject to prescriptive rules, which may be taught in the school
system. The effect, if any, of these rules has not been explicitly tested though many researchers
have relied on the idea that these types of words are subject to prescriptive and social pressures.

The behaviour of loanwords in terms of both stem and suffixal harmony is relevant to the
synchronic state of the harmony system. Though disharmonic stems may simply be in a semi-
permanent state of disharmony, perhaps exacerbated by the orthographic representation, the
long-term maintenance of such forms could suggest a weakening of the stem harmony constraint.
Are these lexical exceptions to an active stem harmony constraint or are they evidence that stem
harmony is no longer active in the grammar in which case any stem harmony that exists is
simply a remnant or an artifact of an earlier stage of the language?

The suffixal centralization seen in Välimaa-Blum’s (1999) work and the conflicting results of
many researchers may be indicative of a suffixal harmony breakdown, which also requires
further study. Also suggestive of such a breakdown is Mahonen’s (2011: 72-6) results concerning the phonetic overlap of phonologically front and back allomorph vowels with native front and back stems. The previous findings not only reveal the need for additional study of the loanwords but also suggest the possibility of a more general weakening of harmony in Finnish which requires examination. The experiment discussed in Chapter 3 will examine the phonetic realization of suffix vowels in compound words and loanwords and stem vowels in disharmonic words in an effort to determine how such vowels are typically pronounced.
Chapter 3
Experiment 1: Phonetic Realization by Age and Gender

While stem and suffixal harmony are unquestionably the norm in discussions of Finnish vowel harmony as most words, even loanwords, are both harmonic and less than four syllables, exceptionality and variation have been reported amongst certain loanwords, as discussed in Chapter 2. Some loanwords have been permitted to enter the language with unrepaird stem disharmony (e.g. analyysi ‘analysis’) and suffixes may not always correspond with the final harmonic vowel of the stem (e.g. arkkitehti-ä ‘architect (part.)’). This tolerance of disharmony leads to the question of whether or not the productivity of harmony is declining.

As well, though a significant amount of work has been done on these disharmonic forms, several issues have thus far been largely overlooked. Much previous work has concentrated on written data, assuming that the written stem vowels and suffix allomorphs are identical to the phonetic forms. Phonetic work on the disharmonic stems has examined the suffixes without establishing that the stem vowels are, in fact, pronounced as they are written. Though Finnish does have a fairly transparent orthography, it also has strong normative rules and high levels of literacy, which may prevent participants from writing forms which conflict with the expected written form. As well, any reduction or centralization, which has been suggested to be possible for both stem and suffix vowels, would simply be impossible to represent in writing.

Moreover the experimental methods utilized in much previous work may have been overly transparent, allowing participants to potentially recognize the experimental purpose. This is particularly problematic when there are long-standing prescriptive rules governing allomorph selection. When the speakers are potentially consciously aware both of the experimental purpose and the existence of normative rules, it is unclear what effect this may have on behaviour.

Finally, most previous work, with the notable exception of Levomäki (1972), has not examined lexical items for individual patterning but has assumed that all words which are phonologically identical behave alike. However, as previous work on language change has shown, not all lexical items will necessarily behave in a similar manner (Bybee 2002; Labov 1994). While the
nativization of loanwords is not language change per se, Sloos (2013) demonstrated that lexical diffusion was also apparent in Dutch loanword adaptation in Indonesian. Grouping all lexical items together without individual examination obscures any such patterning which may occur in the Finnish data.

The goal of this chapter is to phonetically examine harmony in BN and BF loanwords, concentrating not only on the suffixes but also on the stem vowels in the disharmonic words. This work is crucial as most other studies, though numerous, do not focus on the phonetics of harmony but rely instead on the written system. The experimental purpose is presented in section 3.1 and then the participants, materials, procedures, and analysis are discussed in section 3.2. The results for the overall vowel space, compound suffixation, and the loanword stem and suffix harmony are presented in section 3.3. The loanwords are discussed both by category and in terms of individual lexical items to determine if there is lexical patterning. The results are then discussed in detail in section 3.4 and the conclusions in section 3.5.

3.1 Experimental Purpose

Previous work, though extensive, has been unable to definitively establish the behaviour of the loanwords in terms of suffixation. The central issue with Levomäki’s (1972), Ringen and Heinämäki’s (1999), and Kimper’s (2011) experiments is the fact that the researchers cannot definitively establish the actual pronunciation of either the stems or the suffixes as the experiments rely solely on written responses. The experimental paradigm relies exclusively on the intuition of speakers, which is introspective and therefore has the potential to be somewhat unnatural. The transparent methodology may exacerbate this issue somewhat.

While Kiparsky (2003) avoids some of these methodological issues by basing his analysis primarily on an examination of actual usage within a corpus of approximately 1.3 million words, as the forms are written, the question still remains as to how closely the written forms correspond with phonetic behaviour. As well, as the corpus is derived primarily from a magazine (Suomen Kuvalehti), forms may have been subject to editorial considerations.
Välimaa-Blum’s (1999) and Mahonen’s (2011) phonetic studies do not explicitly examine stem vowels and so cannot ensure that the stems are, indeed disharmonic. As well, the words were not comprehensive in terms of vowels and surrounding phonological environment. In these phonetic studies lexical items were grouped phonologically, obscuring any potential lexical patterning.

The aims of this study were to determine whether BF disharmonic loanwords are pronounced as they are written and how BF disharmonic loans and BN loans are suffixed. As previous work has not examined stem vowels, it is unclear whether stem harmonization will occur in disharmonic stems though the assumption in previous research has been that the stems are written and pronounced in an identical manner. Assuming that the written suffix vowels are consistent with the spoken forms, variation in allomorph selection is expected in both the BF and BN loanwords.

Lexical items were examined both individually and in terms of their larger phonological category. As discussed in section 2.3.2 the experimental results for a particular word or a given stem type have not always been consistent across different studies. To illustrate, karamelli ‘caramel, candy’ received 52.6% F suffixes in Levomäki (1972), 16.0% F in Ringen and Heinämäki (1999), 72.0% F Välimaa-Blum (1999), and 34.4% F Duncan (2011). Phonologically similar stems from Levomäki (1972) also received different percentages of front allomorphs which cannot be based on their stem vowel sequences e.g. ekumeeni ‘?’ 11.8% F and beduiini ‘Bedouin’ 25.2% F. The source of such disparities is uncertain and so it is unclear whether there is any lexical patterning which will emerge or if the suffixal variation is based solely on the phonological shape of the word and any differences between experiments are related to differences in method or subject group.

This study also examined whether or not the loanwords were treated differently by older or younger speakers and/or by males and females. As participants in other experiments are generally not grouped into sub-classes or the participants were so unbalanced as to make comparisons impossible or unreliable, the impact of either age or gender in terms of allomorph
selection has been not yet been studied. As variation is known to occur and the allomorph selection of the loanwords is subject to prescriptive rules (see sections 2.3.2.2 and 2.3.2.3 for details), it is conceivable that these factors may be relevant. Men and women have been reported to respond differently to prescriptive rules with Labov (2001: 293) stating that “women conform more closely than men to sociolinguistic norms that are overtly prescribed”.

In a pilot study it was noted that the method whereby speakers merely inflected nouns into the partitive case to agree with the requirements of the given verb was overly transparent for many speakers in terms of experimental purpose. All pilot study speakers tested commented on the disharmonic nature of some of the loanwords and their uncertainty regarding the correct suffix allomorph. Many were also aware of the existence of a prescriptive rule though not necessarily able to correctly articulate it.

As a solution to the possibility that responses were overly considered and therefore unnatural, a language game was used to divert attention from the suffixation. The language game, in which speakers exchange the initial consonant and vowel of adjacent words and reharmonize vowels if necessary, is outlined in section 3.2.3 and discussed in detail in Chapter 6. The game has been previously examined by Campbell (1980, 1986), Harrikari (2000), and Vago (1988) and is widely known by Finnish speakers.

### 3.2 Methods

#### 3.2.1 Participants

Eight native speakers of Finnish, each paid 15 CAD, participated in the study. The speakers, who were members of two separate choirs visiting Canada for a short period, were divided into two age groups, younger and older speakers. The younger group consisted of one male and three females between the ages of 17 and 18. The older group consisted of two males and two females.

Note that the participants in this experiment are also not perfectly balanced so any gender-based results herein should be treated as preliminary. See section 3.2.1 for details.
between the ages of 56 and 80. Within this chapter, speakers are referred to using the following conventions. The first element indicates gender: F (female) or M (male). The second, age: Y (younger) or O (older). The final element is a number referring to the individual. For example, the three young females are referred to as FY1, FY2, and FY3.

### Table 3-1: Experiment 1 Participants by Age and Gender

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Older</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>3</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

All were currently residing in Finland and were in Canada for a period of two weeks or less. The four older speakers were current residents of Järvenpää, a town near Helsinki, though all had lived elsewhere in Finland as well. The four younger speakers had lived only in Mikkeli, a town in the Savo region (see dialect map in Appendix 1). Finnish spoken in Finland is traditionally divided into two major dialects, the Eastern and Western dialects (Hyvönen, Leino, and Salmenkivi 2007: 272; Viitso 1998: 99). Järvenpää is located in the Western dialect area and Mikkeli, in the Eastern dialect area. This presents a complication in terms of the examination of the behaviour of the participant groups as the groups differ not only in terms of age but also dialect. Should there be a difference in the behaviour of these groups, additional research should examine whether it is age or dialect related.

Though all participants were native speakers of Finnish, all but one also spoke at least one other language. One older female considered herself to be mono-lingual while the others spoke some combination of Swedish (the other official language of Finland), English, French, German, and/or Russian. There is some possibility that the knowledge of non-harmonic languages could have an effect on the harmonization, or lack thereof, of the disharmonic loans as speaker bilingualism has been implicated as a factor in the degree of nativization of loanwords.

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Note that previous research has not indicated the presence of dialectal differences in the instantiation of harmony.
Sankoff, and Miller 1988). However, with only a single monolingual speaker, this possibility remains for further study\(^6\).

In terms of education, the younger speakers were identical; all were students at the Finnish equivalent of an academic high school, preparing for either college or university. The older speakers were varied in their educational background. Two had completed the equivalent of high school, one, vocational college, and one, university.

For disharmonic loans, the speech of only a subset of speakers was examined due to the labour-intensive nature of this analysis. One participant from each category was selected for analysis: one young male; one young female; one older male; and one older female. In cases where there was more than one possible participant in a given group, one speaker was randomly selected. All eight speakers were examined for all other aspects of the analysis.

3.2.2 Materials

The materials used in this study consisted of the following three sets: control words to determine the overall vowel space of each speaker, presented in section 3.2.2.1; target BN loanwords and compound control words, discussed in section 3.2.2.2; and target BF loanwords and relevant compound controls, illustrated in section 3.2.2.3.

\(^6\) As Swedish and another foreign language are school requirements, truly monolingual speakers are likely near impossible to find.
3.2.2.1 Vowel Control Words

The eight control words, shown below in Table 3-2 and originally used by Wiik (1965: 40), were used to determine the overall vowel space for comparison with the loanwords.

Table 3-2: Vowel Control Words

<table>
<thead>
<tr>
<th>Target Vowel</th>
<th>Word</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[i]</td>
<td>tikin</td>
<td>‘stitch (gen.sg.)’</td>
</tr>
<tr>
<td>[e]</td>
<td>tekin</td>
<td>‘you, too’</td>
</tr>
<tr>
<td>[y]</td>
<td>tykin</td>
<td>‘cannon (gen.sg.)’</td>
</tr>
<tr>
<td>[ö]</td>
<td>tökin</td>
<td>‘I keep pushing’</td>
</tr>
<tr>
<td>[ä]</td>
<td>täkin</td>
<td>‘bedspread (gen.sg.)’</td>
</tr>
<tr>
<td>[u]</td>
<td>tukin</td>
<td>‘log (gen.sg.)’</td>
</tr>
<tr>
<td>[ø]</td>
<td>tokin</td>
<td>‘herd of reindeer (instr.)’</td>
</tr>
<tr>
<td>[a]</td>
<td>takin</td>
<td>‘coat (gen.sg.)’</td>
</tr>
</tbody>
</table>

Though the control words contained only short vowels in stressed position while the target and compound words contained long and short vowels in stressed and unstressed positions, previous work indicates that neither vowel length nor stress have a substantial effect on vowel quality (Eerola and Savela 2012; Iivonen and Harnud 2005; Iivonen and Laukkanen 1993; Palo et al 2012; Wiik 1965). Only the high back vowel pair is typically affected to a significant degree by length in these studies. Thus, the differences between the control vowels and target vowels were considered to be sufficiently minimal as to allow for reliable comparison.

3.2.2.2 Neutral-Final Loanwords and Compound Control Words

The first set of target words, shown below in Table 3-3, was comprised of BN loanwords and phonologically similar compound words. The six loans were four syllable nouns with a back vowel in the first disyllabic sequence and only neutral vowels in the final disyllabic sequence. As discussed below in section 3.2.3, each test word was inflected in the partitive case /-tA/[^1].

[^1]: In most cases the underlying stop in the partitive case does not surface.
the BN loanwords and the compound control words, the quality of the suffix vowel was the relevant feature.

Table 3-3: Back Neutral Loanwords and Native Compound Control Words

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Nominative Singular</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN Loanwords</td>
<td>adjektiivi</td>
<td>‘adjective’</td>
</tr>
<tr>
<td></td>
<td>arkkitethti</td>
<td>‘architect’</td>
</tr>
<tr>
<td></td>
<td>karamelli</td>
<td>‘caramel, candy’</td>
</tr>
<tr>
<td></td>
<td>karuselli</td>
<td>‘carousel’</td>
</tr>
<tr>
<td></td>
<td>konstaapeli</td>
<td>‘constable’</td>
</tr>
<tr>
<td></td>
<td>krokotiili</td>
<td>‘crocodile’</td>
</tr>
<tr>
<td>Neutral-Final Compounds</td>
<td>kure=liivi</td>
<td>‘corset’</td>
</tr>
<tr>
<td></td>
<td>lasten=lehti</td>
<td>‘children’s magazine’</td>
</tr>
<tr>
<td></td>
<td>kaura=veli</td>
<td>‘oatmeal gruel’</td>
</tr>
<tr>
<td></td>
<td>vanki=selli</td>
<td>‘prison cell’</td>
</tr>
<tr>
<td></td>
<td>noppa=peli</td>
<td>‘dice game’</td>
</tr>
<tr>
<td></td>
<td>katto=tiili</td>
<td>‘roof tile’</td>
</tr>
</tbody>
</table>

The six compound words were each composed of two independent disyllabic elements. Each compound was selected to be as phonologically similar to the loanwords as possible, within the confines of the Finnish lexicon. However, due to the constraints of the lexicon it was not possible to control fully for the preceding and following consonants and vowels. The compound words varied in their frequency and may also have varied in their degree of transparent compositionality. As well, some words are colloquial or slang.

Compound words were necessary as controls since native Finnish (underived) words are normally two to three syllables in length, as discussed in section 2.3.2.3. As compound words select the suffix allomorph which corresponds to the harmonic category of their final element, the above compounds with only neutral vowels in their final element are expected to select front allomorphs.

Only compound words with neutral vowels in the final element were used as controls for these words since additional compound words which had back or front vowels in the final element and would therefore be expected to suffix with back and front allomorphs respectively were used as
controls for the disharmonic words (discussed below in section 3.2.2.3)\textsuperscript{63}. Thus, clear tokens for comparison of back allomorphs and front allomorphs were otherwise available.

3.2.2.3 BF Disharmonic Loanwords and Compound Control Words

The purpose of the second set of target words, shown in Table 3-4, was to examine the stem and suffix vowel quality of the BF disharmonic loanwords. These nine loans were four syllable nouns with back vowels followed by front vowels. There were three loans with each of the front harmonic vowels /y, ö, ä/ as the final harmonic vowel. The eighteen compound words were selected in the same manner described above and again include some words which are colloquial or slang.

\textsuperscript{63} A limitation of having used only compounds with neutral vowels in the final element as controls for the back neutral words is that in the control stimuli the absolute number of native compounds which would be expected to select front suffixes (front-final compounds and neutral-final compounds) is higher than the number of native compounds which would be expected to select back suffixes (back-final compounds only). A result of this is a possible priming effect towards front suffixes. This possibility is further discussed in section 3.3.3.1.
Table 3-4: BF Disharmonic Loanwords and Compound Target and Control Words

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Word Type</th>
<th>Nominative Singular</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>/yy/</td>
<td>BF Loanwords</td>
<td>molekyyli</td>
<td>‘molecule’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>analyysi</td>
<td>‘analysis’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>manikyyri</td>
<td>‘manicure’</td>
</tr>
<tr>
<td></td>
<td>Front-Final Compounds</td>
<td>taksi=kyyti</td>
<td>‘taxi ride’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nyky=lyydi</td>
<td>‘modern Ludic Karelian (a language)’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>arki=tyyli</td>
<td>‘weekday style (of clothing)’</td>
</tr>
<tr>
<td></td>
<td>Back-Final Compounds</td>
<td>marja=kuusi</td>
<td>‘yew tree’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ala=huuli</td>
<td>‘lower lip’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pohja=tuuli</td>
<td>‘north wind’</td>
</tr>
<tr>
<td>/öö/</td>
<td>BF Loanwords</td>
<td>amatööri</td>
<td>‘amateur’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>konduktööri</td>
<td>‘conductor’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>kuvernööri</td>
<td>‘governor’</td>
</tr>
<tr>
<td></td>
<td>Front-Final Compounds</td>
<td>lasten=kööri</td>
<td>‘children’s choir’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ruoho=rööki</td>
<td>‘marijuana cigarette’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>savu=rööri</td>
<td>‘pipe’</td>
</tr>
<tr>
<td></td>
<td>Back-Final Compounds</td>
<td>lastu=kori</td>
<td>‘basket made of wooden chips’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nahka=rotsi</td>
<td>‘leather jacket’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>housu=rooli</td>
<td>‘type of men’s opera role’</td>
</tr>
<tr>
<td>/ää/</td>
<td>BF Loanwords</td>
<td>atmosfääri</td>
<td>‘atmosphere’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>miljonääri</td>
<td>‘millionaire’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>karriääri</td>
<td>‘career’</td>
</tr>
<tr>
<td></td>
<td>Front-Final Compounds</td>
<td>ranta=käärme</td>
<td>‘grass snake’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lenko=sääri</td>
<td>‘crooked leg’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pellon=ääri</td>
<td>‘field’s edge’</td>
</tr>
<tr>
<td></td>
<td>Back-Final Compounds</td>
<td>teräs=vaari</td>
<td>‘grandfather’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iso=saari</td>
<td>‘Big Island’</td>
</tr>
<tr>
<td></td>
<td></td>
<td>vilja=laari</td>
<td>‘grain bin’</td>
</tr>
</tbody>
</table>

64 The final consonants were alveolar in all of the disharmonic loans, all but one BN loan (adjektiivi), and all but three of the control compounds (ruohorööki, rantakäärme, and kureliivi). According to livonen and Laukkanen (1993: 49). /a:/ is fronted following alveolars, in a medial position following velars, and retracted following labials. It is unclear whether their results relate directly to this situation though since the consonants are not immediately adjacent to the suffix vowel but are, in all cases mediated by the vowel /i/. Even if the tendency towards fronting is present in this data, since the suffix vowels are (mostly) in similar alveolar environments, it is expected that the tendency should apply equally to all forms.

65 Note that sfääri ‘sphere’ is a free morpheme in Finnish which might encourage a compound analysis though atmö does not exist as a morpheme.

66 Note that karrieeri is listed in the Kielitoimiston sanakirja as an alternative spelling.
As with the neutral-final compounds four syllable compound words composed of two disyllabic elements were used as control words. As suffix vowels correspond to the harmonic class of the final element, the back- and front-final compounds provide expected back and front suffix allomorph exemplars for comparison with the loanword suffixes.

3.2.2.4  Loanword Frequency

Though the loanwords, for the most part, have been part of the Finnish lexicon for some time (see Appendix 2), the majority of the target loans are still of quite low frequency. According to the *Suomen kielen taajussanasto* (Frequency Dictionary of Finnish)\(^67\), only a very few of the loans used in this study are among the 12,663 most common words of Finnish. The following chart lists those target words (bolded) or related words which are of sufficient frequency to be included in the frequency dictionary.

**Table 3-5: Frequency of Loanwords**

<table>
<thead>
<tr>
<th>Frequency Ranking</th>
<th>Word</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>3740</td>
<td>analysoida</td>
<td>‘to analyze’</td>
</tr>
<tr>
<td>3740</td>
<td>arkkitehti</td>
<td>‘architect’</td>
</tr>
<tr>
<td>5842</td>
<td>adjektiivi</td>
<td>‘adjective’</td>
</tr>
<tr>
<td>6684</td>
<td>analysointi</td>
<td>‘the process of analyzing’</td>
</tr>
<tr>
<td>6684</td>
<td>molekyyli</td>
<td>‘molecule’</td>
</tr>
<tr>
<td>7844</td>
<td>analytiikka</td>
<td>‘analytics’</td>
</tr>
<tr>
<td>7844</td>
<td>analyyyttinen</td>
<td>‘analytic(al)’</td>
</tr>
<tr>
<td>9466</td>
<td>arkkitehtuuri</td>
<td>‘architecture’</td>
</tr>
<tr>
<td>9466</td>
<td>konstaapeli</td>
<td>‘constable’</td>
</tr>
<tr>
<td>11536</td>
<td>kuvernementti</td>
<td>‘government’</td>
</tr>
<tr>
<td>11536</td>
<td>regressionanalyysi</td>
<td>‘regression analysis’</td>
</tr>
</tbody>
</table>

Since the frequency dictionary is based primarily on written Finnish and some radio broadcasts, the frequency of the lexical items in everyday discourse may differ somewhat. For example, it might be expected that *karamelli* ‘caramel, candy’ would be more frequent for many speakers

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\(^{67}\) The *Suomen kielen taajussanasto* is a corpus of Finnish comprised of 408,301 word occurrences from fiction and non-fiction books, newspapers and periodicals, and radio broadcasts. Overall, there were 43,670 different words in the corpus.
than molekyyli ‘molecule’ though the former does not appear on the frequency list while the latter does. Regardless, low frequency did not seem to impair understanding in that none of the speakers asked for clarification of the meanings of any of the loanwords and so it is assumed that they were known and understood by speakers.68

3.2.3 Procedure

The recordings took place in a quiet room in either Toronto or Vancouver using an Audio-Technica AT831b lavaliere microphone and a Fostex FR-2 digital recorder with 16-bit quantification and 44.1 kHz sampling rate. Each participant was recorded individually.

Participants first completed a sociolinguistic questionnaire (see Appendix 3) and were then familiarized with the format of the experiment, which was composed of an initial component concerning the vowel controls and the second, main component concerning the loanwords. After the participant completed the first task, they were given a short break and then the second task was explained. When they indicated they were comfortable with the procedure, they completed the second component of the experiment.

In the first task, the vowel control words, shown previously in Table 3-2, were embedded in the carrier phrase Sano __ taas. “Say __ again.” The sentences were randomized and the set read five times resulting in five tokens of each word per speaker.

In the second task the words from Table 3-3 and Table 3-4 were randomized and presented in nominative case in parentheses following verbs which syntactically required the noun to be in the partitive case /-tA/.69 The speaker was required to inflect the word into the partitive to complete

68 In contrast a couple of the control words were unclear for some speakers e.g. nyky=lyydi ‘modern Ludic Karelian (a related Finnic language)’. Participants were encouraged to ask for clarification if they did not understand a given word.

69 Due to stop deletion, short intervocalic stops are deleted following an unstressed light syllable (Keyser and Kiparsky 1984: 14-5; Kiparsky 2003: 116). As a result, most of the partitive suffixes are realized as [a] or [ä] for the words in this experiment.
the sentence. Since Finnish orthography differentiates between the front <ä> and back <a> partitive allomorphs, it was essential that the words in question be written in the unsuffixed nominative case to avoid bias.

(24) Sample Inflection of Test Sentence

a. Given: Inhoaa __________ (kauravelli)

b. Inflected: Inhoaa kauravelliä ‘S/he hates oatmeal gruel.’

As discussed in section 3.1, participants in a pilot study found this method to be overly transparent so a well-known Finnish language game that consists of transposing the initial consonant and vowel of adjacent words was used as a distractor. It seemed that the language game sufficiently diverted the attention from the suffixation since, unlike in the pilot test, none of the speakers commented on the loanwords.

The full list of sentences was repeated four times by each speaker resulting in four tokens of each word per speaker. The speakers were instructed to read the sentences at a normal rate of speech, as they would usually pronounce them.

3.2.4 Analysis

Data was inputted into Praat (Boersma and Weenink 2009). For each relevant vowel F1 and F2 were measured based on LPC analysis at the vowel mid-point to minimize the co-articulatory effects of adjacent segments. F2 is particularly important as it represents the front-back

70 In Experiment 1 the language game was used merely as a distractor and the game reading output was not examined. The language game proved to be overly difficult for some speakers. As a result, three speakers only used the language game for a majority of the experiment and then, for the remainder, read the sentences only in the normal reading. The game proved to be more difficult for the older speakers with only one older speaker being able to complete the entire experiment using the game while all the younger speakers were able to.

71 Speaker MO1, the oldest speaker at 80 years old, was unable to complete the experiment due to fatigue. Since he had completed 65% of the sentences with no errors, his responses were retained in the analysis.
dimension of the vowel space with higher F2s associated with vowels that are further front. In the first word set for the determination of the vowel space (see Table 3-2), only the relevant control vowel was measured whereas in the compounds and loanwords (see Table 3-3 and Table 3-4), all vowels, with the exception of diphthongs, were measured. Diphthongs were excluded from analysis as there was not a sufficient number for comparison. Overall, 308 control vowels, 3,346 compound vowels, and 2,194 loan vowels were analyzed. Of the compound tokens, 708 were suffix vowels and 2,638 stem vowels. Of the loan tokens, 435 were suffix vowels and 2,203 stem vowels. In total, 5,848 vowels were measured and analyzed.

The suffix vowels appended to the compound words were examined to ensure that each speaker exhibited suffixal harmony displaying categorical front and back allomorphs. These results are discussed in section 3.3.2.

The suffix vowels associated with both the BN and BF loanwords were examined and compared to the control low vowels determined for each speaker. While in most cases the vowel category of the suffix was unambiguous, some vowels were clearly centralized. In these cases, the midpoint between the relevant front and back harmonic vowels for the given speaker was ascertained and the F2 value of the vowel in question was compared to this midpoint. When the vowel lay on the ‘front’ side of the midpoint, it was considered to be a front vowel and, when it lay on the ‘back’ side, it was considered a back vowel. While this procedure limits the full descriptiveness of the analysis as it does not distinguish between those tokens which were strongly front and those which were more centralized, it was necessary for the sake of clarity and mimics the phonological binary classification into front and back. Another possibility would be to divide the space between the means for /ä/ and /a/ into three sections instead of two. In this way, centralized vowels (those in the middle third) could be identified. For speakers who exhibited some degree of centralization of suffixal vowels an analysis based on three categories

72 While Wiik (1965) found [ä] was higher than [a], [ä] was lower than [a] in Iivonen and Laukkanen’s (1993) data and the two vowels were approximately the same height in Iivonen and Harnud (2005). If the vowels are differentiated by height as well as backness, the distinction between these vowels may require reference to both F1 and F2.
might be more appropriate as the front/back division obscures the observed centralization. Future work should examine these vowels based on the possibility of centralization.

Overall, the three category approach was not chosen since it would result in tokens which are clearly front in relation to other stem vowels being identified as central. For example, in Figure 3-1, the chart for *atmosfääri* ‘atmosphere’ for speaker MY1 demonstrates this difficulty. The stem vowel /ä:/ realizations, circled and marked as ‘ää’ in Figure 3-1, are clearly front in relation to the stem vowel /a/ realizations, circled and marked as ‘a’. However, if the vowel space were to be divided into thirds, some tokens of the stem vowel /ä:/ would be considered central. As the suffix vowels, circled and marked as ‘Suffix’, are in all four tokens clearly front, the ‘centralized’ /ä:/ tokens must be phonologically front. Future work though may wish to examine the suffix (and stem) vowels as either front, back, or central and to examine the possibility of some degree of phonetic assimilation.

![Figure 3-1: Mean F1 and F2 Values (in Hz) of Eight Finnish vowels and Vowels for BF Loan *atmosfääri* ‘atmosphere (part.)’ Produced by Speaker MY1](image)

Figure 3-1: Mean F1 and F2 Values (in Hz) of Eight Finnish vowels and Vowels for BF Loan *atmosfääri* ‘atmosphere (part.)’ Produced by Speaker MY1

73 Note that the suffix [ä] vowels are more front than the stem-internal [ää] vowels. This is likely due to coarticulation in that the suffix vowel occurs following [i].
As stem harmonization of disharmonic loanwords has been acknowledged as a possibility (see section 2.3.1 for discussion), the basic assumption cannot then be that a given stem is pronounced by the speaker in question as it is written. For each individual disharmonic word token, the harmonic vowels of the stem were compared with the speaker’s control vowels (see Table 3-2). In most cases it was clear from visual examination which vowel was being pronounced in the loanwords. However, in cases where it was unclear, control vowels from the native compounds were compared. These compound words had maximally similar phonological environments as the loanwords to eliminate, as much as possible, the effect of consonant interactions.
3.3 Results

3.3.1 Vowel Space

Figure 3-2 plots the Finnish vowel inventory in an acoustic F1 x F2 space from control tVkin words (see Table 3-2), as produced by all female (a) and male (b) speakers (see Table 3-1). Overall, 308 control vowels were analyzed. All vowels were statistically distinct based on F1 and/or F2; see Duncan (2008: 39-40) for details.

Figure 3-2: Mean F1 and F2 Values (in Hz) of Eight Finnish Vowels Produced by (a) Female and (b) Male Speakers by Age Group
Overall, the vowel space is highly similar to those found by other researchers including Wiik (1965), Iivonen and Laukkanen (1993), and Iivonen and Harnud (2005). Crucially the low vowels [ä] and [a] in the control words were distinct for all speakers. The relative positions of the low vowels are similar to those in Wiik’s study in that the low front vowel is slightly higher than the low back vowel. Since age is not a significant factor and these results closely approximate those of previous researchers, there does not appear to be any change in the vowel space reflected in the data.

3.3.2 Compounds

This section discusses the suffixation of the compound words used as controls for the loanwords (see Table 3-3 and Table 3-4 for lists of the relevant compound words). Since suffixes agree with the harmonic class of the final element of the compound, back-final compounds were expected to select back allomorphs, e.g. vilja-laari-a ‘grain bin (part.)’, while front-final and neutral-final compounds were expected to select front allomorphs, e.g. ranta-käärme-ttä ‘grass snake (part.)’ and kaura=velli-ä ‘oatmeal gruel (part.)’.

The position of each suffix vowel for each speaker was plotted in an acoustic F1 x F2 space. The suffix vowel realizations of FO2, shown in Figure 3-3, were representative of the behaviour of the older male and female speakers and the younger male (5 speakers in total), who all displayed clear front and back suffix categories corresponding to the harmonic class of the final element of the compound. As exemplified by speaker FO2, those suffixes appended to front- and neutral-final compounds (e.g. ranta=käärme-ttä ‘grass snake (part.)’ and kaura=velli-ä ‘oatmeal gruel (part.)’ respectively) were typically farther front than those appended to the back-final compounds (e.g. vilja=laari-a ‘grain bin (part.)’). There was a clear F2 boundary between the expected front and back allomorphs, approximately 1650 Hz for speaker FO2 in Figure 3-3. The

74 However, the relatively small size of the current study necessitates caution. Future work with a larger number of participants could examine the vowel space in greater detail.
very few suffix tokens which surfaced outside of the expected area are likely speech or measurement errors.

Figure 3-3: F1 and F2 Values (in Hz) of Suffix Vowels Associated with Compound Words as Produced by Speaker FO2

In contrast the younger female speakers did not display categorical realizations of front and back suffixes, as might be expected in a backness harmony language. These three speakers appear to have an unexpected degree of overlap between the front and back suffix categories, as exemplified by speaker FY1 in Figure 3-4 below. In the speech of this speaker, the F2 boundary between the front and back suffix categories cannot be as easily determined as it was in the speech of FO2 in Figure 3-3 above. Although most realizations of expected [ä] associated with front- and neutral-final compounds have F2 values greater than 1600 Hz, the realizations of expected [a] associated with back-final compounds are more variable. While many of the back allomorphs did have F2 values less than approximately 1600 Hz, many also had higher F2 values which situated them in the front allomorph phonetic space.
These speakers’ phonetic realizations of the low vowels in the compound stems were then examined to determine whether the overlap was specific to the suffix vowels or was a more general process affecting low vowels in all positions. Disregarding cases in which the low vowels appear to have raised to mid vowels, the stem low vowels [ä] and [a] appear distinct in the realizations from the compounds, which is expected as [ä] and [a] were found to be statistically distinct in the control words, discussed in section 3.3.1. This suggests that the overlap is a property specific to the suffix vowels.

To determine the degree of overlap more precisely, all speakers’ suffixes appended to back-final, front-final, and neutral-final compounds were also compared with the given speaker’s midpoint between the F2 means of the control vowels [a] and [ä]. The assumption is that suffixes

75 Note some [a] tokens produced by FY2 and FY3 appear somewhat fronted when following [j] e.g. marjakuusi ‘yew tree’. Though some other speakers also had fronting in this position or in the second vowel of rantakäärme ‘grass snake’, it was not as pronounced as for FY2 and FY3.
appended to back-final compounds would present with F2 values consistent with or closer to the control vowel [a] while those appended to the front- and neutral-final compounds would have F2 values closer to the control vowel [ä]. For the older speakers, the suffix allomorphs were correctly classified in this manner as back 94.3-100.0% of the time and as front 90.2-100.0% of the time. These classifications for the young male were 93.7% and 91.1% correct for the back and front allomorphs respectively. The correct classification rates for the three young females are presented below in Table 3-6.

**Table 3-6: Correct Suffix Classifications in Compound Words for Young Females**

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Back-Final Compounds</th>
<th>Front- and Neutral-Final Compounds</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY1</td>
<td>61.1</td>
<td>85.0</td>
<td>76.0</td>
</tr>
<tr>
<td>FY2</td>
<td>86.2</td>
<td>81.0</td>
<td>83.0</td>
</tr>
<tr>
<td>FY3</td>
<td>87.9</td>
<td>81.4</td>
<td>83.7</td>
</tr>
</tbody>
</table>

The error rate for FY1 is, at 24.0%, strikingly high. The very high error rate for back-final compound suffixes indicates that the overlap appears to be primarily a result of the disproportionate misclassification of the back vowels though the expected front vowels also exhibit a substantial amount of unexpected realizations.

While the overall percentages of misclassified suffixes for FY2 and FY3 are not as high as those of FY1, they still represent a departure from the behaviour of the older speakers and the young male indicating that the younger female speakers’ suffix vowels correlate less closely with the harmonic class of the stem as determined by the comparison of their F2 value with that of their control vowels. For these two speakers both expected front and back suffixes appear to be equally affected.

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76 ‘Correct’ classification here refers to an expected back suffix vowel being produced closer to the F2 mean for the control [a] vowel than to the F2 mean for the control [ä] vowel and an expected front suffix vowel being produced closer to the F2 mean for the control [ä] vowel.

77 Note that this experiment cannot comment on the perception of the harmonic class of the affixes.
3.3.3 Back Neutral Loanwords

This section presents the results for the BN loans both as a group (Section 3.3.3.1) and as individual lexical items (Section 3.3.3.2).

3.3.3.1 Back Neutral Loanwords as a Word Type

As the target of interest was the front vs. back nature of the suffix vowels and the data was balanced, an ANOVA was performed for F2 of the suffix vowel with the following factors: the between subjects factors of Age (Young and Old) and Gender (Female and Male); and the within subjects factor Word Type (Back-Final Compounds, Front-Final Compounds, Neutral-Final Compounds, and BN Loans)\(^78\). The ANOVA revealed a main effect of Age (F(1,877) = 54.534, p < .001). The mean F2 of the older speakers, at 1647 Hz, is slightly higher than that of the younger speakers, at 1616 Hz.

Gender also exerted a significant effect of F2 (F(1,877) = 545.803, p < .001). Female speakers had higher mean F2s, as is expected, based on anatomical differences. The mean F2 for females was 1700 Hz and for males, 1497 Hz.

Word Type was also significant: (F(3,877) = 236.851, p < .001). Bonferroni post hoc tests for Word Type revealed that the mean F2 of the suffix vowels of back-final compounds, e.g. *vilja=laari-a* ‘grain bin (part.)’, was significantly lower than the means of the other three word types (p < .001). The other word types, front-final compounds e.g. *ranta=käärmel-tä* ‘grass snake (part.)’, neutral-final compounds e.g. *kaura=velli-ä* ‘oatmeal gruel (part.)’, and BN loans e.g. *karamelli-A*\(^79\) ‘caramel, candy (part.)’, all had mean F2s which were not significantly different from each other, indicating that these word types all selected the same suffix allomorph.

---

\(^78\) See Table 3-3 and Table 3-4 for word lists. For closer comparison with Experiment 2, the data in Experiment 1 was re-examined using a linear mixed effects model to determine if there were any differences between it and the ANOVA reported in the body of Chapter 3. See Appendix 4 for details.

\(^79\) The suffix vowels for the loanwords are written with a capital indicating the uncertainty of the vowel quality.
F2 was the highest for the neutral-final compounds (1716 Hz) and lowest for the back-final compounds (1451 Hz). These results for all speakers combined are shown in the chart below in Figure 3-5.

![Mean Suffix F2 Values (in Hz) by Word Type](chart.png)

**Figure 3-5: Mean Suffix F2 Values (in Hz) by Word Type**

Note that there is some centralization of all the suffix vowel means as compared with the mean F2s for the primary stressed vowels in the control words tākin ‘bedspread (gen.sg.)’ and takin ‘coat (gen.sg.)’. This centralization appears to be more extensive in the back suffixes than in the front suffixes. In spite of this centralization, the means of the suffix vowels are still clearly distinct and there is a noticeable division between the front and back suffix means.

There was a significant interaction between Age and Gender ($F(1,877) = 31.532, p < .001$) and between Age, Gender, and Word Type ($F(3,877) = 10.511, p < .001$). As the charts below in Figure 3-6 show, there are some differences in the actual means of suffix vowels for the various word types, but no differences in the overall patterning in that the BN loans pattern with the front-selecting word types in all cases.
Figure 3-6: Mean Suffix F2 Values (in Hz) for Four Word Types Produced by (a) Female and (b) Male Speakers by Age Group
The notable difference seen in the charts is the variation in the front suffixes as produced by the female speakers. The means for the back suffixes for the younger and older speakers are near identical (1518 Hz and 1524 Hz respectively) but the means for the front suffixes are much lower, in all cases, for the younger speakers. The F2 means for the younger speakers are as follows: front-final compounds, 1726 Hz; back neutral compounds, 1719 Hz; and BN loans, 1697 Hz. The F2 means for the older speakers are as follows: front-final compounds, 1885 Hz; back neutral compounds, 1901 Hz; and BN loans, 1849 Hz. The younger females’ phonetic realization of the front suffix vowel -ä/ is less front and more centralized than that of the older female speakers. Male speakers do not demonstrate any such age-related patterning.

These differences in the suffix vowels of older and younger females are unexpected based on the results of the tVkin control words, presented in section 3.3.1. In these controls, there was no significant difference between the /ä/ vowels of the older and younger females. However, it must be noted that the /ä/ vowels in the controls were stressed vowels in the initial syllable of disyllabic words whereas the /ä/ vowels in the suffixes shown above in Figure 3-6 (a) are unstressed vowels in the final syllable of five syllable words. These differences may indicate a centralization of front suffix vowels by young female speakers.

In footnote 63, the possibility of priming was discussed. Because only compounds with neutral vowels in the final element were used as controls for the BN loans, the absolute number of compound control words which would be expected to select front suffixes (front-final compounds and neutral-final compounds) is higher than the number of native compounds which would be expected to select back suffixes (back-final compounds only). A possible result of this is priming towards front suffixes amongst the loanwords in which there may be uncertainty concerning the harmonic quality of the suffix vowel. An ANOVA was performed to determine whether this may, indeed, have been a significant concern. If there was a priming effect, it is likely that later repetitions of the same word would display an increased likelihood of being suffixed with front allomorphs. An ANOVA was performed for F2 of the suffix vowel with the following factors: Repetition (1-5) and Lexical Item (adjektiivi ‘adjective’, arkkitehti ‘architect’, karamelli ‘caramel, candy’, karuselli ‘carousel’, konstaapeli ‘constable’, and krokotiili ‘crocodile’). No significant effects were found for Repetition (F(1,169) = .944, p = .421), indicating that priming is not likely to be a significant issue.
3.3.3.2 Back Neutral Loanwords by Lexical Item

ANOVA and Bonferroni post hoc tests were performed to determine if all BN loanwords behaved identically in terms of suffix F2. The factors were: Gender (Female and Male); Age (Young and Old); and Lexical Item (adjektiivi ‘adjective’, arkkitehti ‘architect’, karamelli ‘caramel, candy’, karuselli ‘carousel’, konstaapeli ‘constable’, and krokotiili ‘crocodile’). There was a main effect of Gender (F(1, 169) = 117.370, p < .001). As expected, the mean F2 value for females, at 1754 Hz, was higher than that of the males, at 1544 Hz. There was a highly significant effect of Age (F(1, 169) = 24.918, p < .001). The mean F2 for older speakers was 1729 Hz and for younger speakers, 1652 Hz, which is in line with the results discussed previously in section 3.3.3.1.

There was some apparent lexical patterning in that Lexical Item (F(5, 169) = 5.047, p < .001) was also highly significant. A Bonferroni post hoc test revealed that, of the lexical items, only adjektiivi ‘adjective’ and karamelli ‘caramel, candy’ were statistically different from each other (p < .001). When the actual tokens are graphed, as shown below in Figure 3-7, most lexical items show considerable overlap and there is clearly great variability in the F2 values of the suffix vowels for all word types. It is also clear though that all the BN loans pattern with the other front selecting word types. There are no BN loans which consistently pattern with the back-final compounds.
For several lexical items the variation seen with the BN loans is greater than that of the phonologically similar BN compounds, indicating potential uncertainty or the treatment by different speakers as different classes (F vs. B suffixing). In particular, *karamelli* ‘caramel, candy’ and *karuselli* ‘carousel’, and to a lesser extent *adjektiivi* ‘adjective’, display extensive variation in suffix F2 values. It should be noted though that many of the back neutral and front-final compound words also demonstrated variation in suffix selection with some suffix tokens having F2s within the back vowel range. This indicates that some degree of suffix overlap is typical for this participant group.

The interaction between Age and Gender was significant (F(1, 169) = 5.381, p = .022). Males had similar mean F2s, regardless of age. The younger males had mean F2s of 1519 Hz whereas the older males had mean F2s of 1563 Hz. Females, however, displayed different behaviour dependant on age with younger females having a lower mean F2 of 1697 Hz and older females a mean F2 value of 1849 Hz. This interaction was shown in Figure 3-6 where the productions of
four word types (back-final compounds, front-final compounds, BN compounds, and BN loans) were presented.

The interaction between Gender and Lexical Item was found to be highly significant ($F(5, 169) = 3.975$, $p = .002$). As the chart below in Figure 3-8 indicates, females were more consistent in their treatment of the BN loanwords. For females all BN loan suffix vowels displayed mean F2s consistent with front vowels though *adjektiivi* ‘adjective’ and *krokotiili* ‘crocodile’ displayed somewhat lower means. Overall, across the different lexical items there was little difference in the mean F2 values, which varied between 1715 and 1793 Hz.

Conversely, in the male productions there were much greater disparities in the F2 means for the different lexical items, which varied between 1430 and 1662 Hz. While *karamelli* ‘caramel, candy’, *karuselli* ‘carousel’, and *krokotiili* ‘crocodile’ were all clearly affixed with allomorphs with F2 means consistent with front suffixes, the F2 mean for the suffix vowel of *adjektiivi* ‘adjective’ was closer to the mean for back-final compounds and *arkkitehti* ‘architect’, and, to a lesser extent, *konstaapeli* ‘constable’, had lower F2 means which were close to the midpoint between the means of the front-final and back-final compounds. Notably these three lexical items were the only ones to have sufficient frequency to have appeared on the frequency list and are also the words more likely to be used in formal contexts.
When the F2s of the suffix vowels are charted by participant, a fair amount of inter- and intra-speaker variation is revealed\(^80\). The individual behavior of each speaker is shown in Table 3-7 below. In this table, the numbers indicate the percentage of responses in which the F2 value of the loan suffix was above the midpoint line between the average F2 of back suffix selecting compounds and the front allomorph selecting compounds for the same speaker. Thus, for speaker FY1, a young female, 75% of her suffixes for *adjektiivi* ‘adjective’ had F2s which were closer to

\(^80\) Since there were only four repetitions of each word per speaker, any observations concerning individual lexical items should be treated as preliminary and require additional study.
the average F2 of her front allomorph selecting compounds than the average F2 of her back allomorph selecting compounds indicating that 75% of the time, this speaker suffixes *adjektiivi* ‘adjective’ with a front allomorph\(^{81}\). In the following table, those cells which represent front allomorph selection 50% or less of the time are shaded. Those cells which have no value indicate that the given speaker did not use a harmonic suffix for any of their pronunciations of the given word. In most cases this indicates that the speaker erroneously used the accusative suffix /-n/.

**Table 3-7: Summary of Suffixation of BN Loanwords by Participant**

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Back Neutral Loan % F</th>
<th>Mean % F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adjektiivi ‘adjective’</td>
<td></td>
</tr>
<tr>
<td>FY1</td>
<td>100</td>
<td>71</td>
</tr>
<tr>
<td>FY2</td>
<td>100</td>
<td>88</td>
</tr>
<tr>
<td>FY3</td>
<td>75</td>
<td>63</td>
</tr>
<tr>
<td>MY1</td>
<td>100</td>
<td>71</td>
</tr>
<tr>
<td>FO1</td>
<td>75</td>
<td>65</td>
</tr>
<tr>
<td>FO2</td>
<td>100</td>
<td>95</td>
</tr>
<tr>
<td>MO1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>MO2</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>Mean</td>
<td>56</td>
<td>82</td>
</tr>
</tbody>
</table>

Most speakers, while exhibiting a clear preference for front allomorphs, displayed variation in allomorph selection. Only speaker FO2, an older female with 95% front allomorphs, and speaker MO1, an older male with 100% front allomorphs, seemed to treat all BN loanwords identically patterning exclusively with the front allomorph selecting compounds. While the other six speakers all tended towards suffixing BN loans with front allomorphs, they allowed some words to vary and others to select predominantly back or front allomorphs. Although it was common for speakers to exclusively suffix a given word with front allomorphs, only very rarely did a speaker treat a word as exclusively selecting back suffixes. There was no particular clear pattern which could be discerned in relation to gender or age though younger speakers appeared less likely overall to exclusively select front allomorphs.

\(^{81}\) Note though that the single suffix token which is not categorized as front is clearly very central and not definitively back. Note also that the young female speakers did not display the expected categorical suffixation of compound words and so their results in this section should be viewed with reservations.
While there did not appear to be a great deal of consensus across speakers with regards to the treatment of specific lexical items, there did appear to be some individual lexical patterning. For example, MO2 exclusively suffixed *karamelli* ‘caramel, candy’, *karuselli* ‘carousel’, and *krokotiili* ‘crocodile’ with front allomorphs while clearly preferring back allomorphs for *adjektiivi* ‘adjective’ and *konstaapeli* ‘constable’. As seen with *konstaapeli* ‘constable’ while some speakers were largely uniform in their treatment of a particular loanword with categorical or near categorical selection of an allomorph, others vacillated. Even those speakers with a clear preference do not necessarily agree on which allomorph is appropriate. Though there did not appear to be complete consistency in which loanwords were permitted back allomorphs and all of the words display some degree of overall suffix allomorph variation, there did appear to be some lexical patterning in that some words, such as *adjektiivi* ‘adjective’, were more likely to be sometimes affixed with back allomorphs while others, such as *karamelli* ‘caramel, candy’, were more likely to receive only front allomorphs. Note that in no case was the overall mean for any lexical item 50% front or less, though that of *adjektiivi* ‘adjective’ was very close at only 56%.

Though superficially frequency appears to have some effect in that the three BN words which were of sufficient frequency to appear in the frequency dictionary – *adjektiivi* ‘adjective’, *arkkitehti* ‘architect’, and *konstaapeli* ‘constable’ – were the same three words which had the lowest percentages of front suffixes, the percentage of front suffixes for *arkkitehti* ‘architect’ (79%), the lexical item with highest frequency, was suffixed only marginally less often with front allomorphs than were the least frequent words (80-86%). Therefore it appears that, in this word set, frequency as determined by inclusion in the *Suomen kielen taajussanasto* is not likely a significant determining factor in relation to the affixal variation when the responses of males and females are considered together.
3.3.4 BF Disharmonic Loanwords

The stem and suffix vowels of the BF disharmonic loanwords were compared with the control vowels and the overall results are shown below in Table 3-8\textsuperscript{82}. Here, the stem harmony was indicated with D for a phonetically disharmonic stem pronounced as written, B for a stem in which the harmonic vowels were harmonized to back, and F for a stem in which the harmonic vowels were harmonized to front. When the tokens of a word differed in terms of stem harmony for a given speaker, the percentage of tokens which evidenced the stem harmony type was listed as well. The suffix vowel allomorph was listed as a percentage of front suffixes. Centralized vowels were treated as either front or back, depending on their position in relation to the means of the low vowels as determined in section 3.2.4. Those results which underwent stem harmonization or did not have exclusively front suffix allomorphs are shaded.

Table 3-8: Summary of Suffixation of BF Loanwords by Participant

<table>
<thead>
<tr>
<th>Speaker</th>
<th>analysis’</th>
<th>manicure’</th>
<th>molecule’</th>
<th>amateur’</th>
<th>conductor’</th>
<th>governor’</th>
<th>atmosphere’</th>
<th>career’</th>
<th>millionaire’</th>
<th>Mean % F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young Female FY2</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>50 D</td>
<td>D</td>
<td>F</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suffix % F</td>
<td>100</td>
<td>75</td>
<td>75</td>
<td>100</td>
<td>66</td>
<td>75</td>
<td>100</td>
<td>100</td>
<td>75</td>
</tr>
<tr>
<td>Young Male MY1</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suffix % F</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Older Female FO1</td>
<td>Stem Harmony</td>
<td>75 D 25 B</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suffix % F</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Older Male MO2</td>
<td>Stem Harmony</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suffix % F</td>
<td>75</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Mean % F</td>
<td>81.25</td>
<td>93.75</td>
<td>93.75</td>
<td>100</td>
<td>91.5</td>
<td>93.75</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>93.75</td>
</tr>
</tbody>
</table>

\textsuperscript{82} Again, as there were three to four repetitions of each word per speaker, any observations concerning individual lexical items should be treated as preliminary and further additional study.
Stem harmonization was rare and occurred in only 5% of the tokens. All but one of the seven instances of harmonization was observed in the young female. Only three loanwords – *analyysi* ‘analysis’, *atmosfääri* ‘atmosphere’, and *miljonääri* ‘millionaire’ – exhibited any harmonization. One token of *analyysi* ‘analysis’ was progressively harmonized to [analµ:si] by FO1 and two tokens of *atmosfääri* ‘atmosphere’ were harmonized progressively to [atmosfä:ri] by FY2. The four tokens of *miljonääri* ‘millionaire’ which were harmonized by FY2 evidenced regressive harmonization to [miljönä:ri] which was possibly strongly influenced by the preceding palatal glide [j]. The dearth of harmonized tokens prevent any claims about the direction of harmonization.

Interestingly when harmonization occurred, the suffix vowel quality did not necessarily accord with the class of the surface stem vowels. In all three tokens which harmonized to back stem vowels, the suffix vowels were front and in one of the four tokens which harmonized to front stem vowels, the suffix vowel was back. These forms may either represent slips-of-the-tongue or the relevant vowels may be centralized and then treated as the opposite harmonic category due to the two-way analysis chosen herein. As well, FY2 did not display the expected categorical production of front and back allomorphs appended to the compounds so it is perhaps expected that her suffixation of other word types would also show some lack of correspondence between the stem and suffix vowels (see section 3.3.2 for details).

When these forms with harmonized stems and mismatched suffixes were examined more closely, centralization appeared to be a factor. The suffix vowels for [atmosfä:ri] as produced by FY2 were clearly central, not strongly front. The low stem vowel in the fronted token of *miljonääri* ‘millionaire’ with the back suffix vowel produced by FY2 was perhaps more accurately transcribed with a central low vowel, which might explain the very central ‘back’ suffix. The high stem vowel in [analu:si-ä] produced by FO1 was also more central than back and so it perhaps is phonologically front, explaining the front suffix. Therefore it seems two of the seven stem harmonizations are not truly harmonized.

Suffix vowels were almost exclusively front for all speakers, regardless of the height of the final harmonic stem vowel. For example, *manikyyri* ‘manicure’ was suffixed in the same manner as *kuvernööri* ‘governor’ and *miljonääri* ‘millionaire’ though the quality of the harmonic stem
vowels differed. Only the younger female appeared to deviate in any way from the exclusive use of front suffixes though the caveat remains that the young females did not display the expected harmonic categories with the compounds. The sole lexical item which appeared to deviate from the front allomorph pattern was *analyysi* ‘analysis’. As its stem vowels were not markedly different from those of *manikyyri* ‘manicure’, the difference in allomorph selection may be determined by factors other than the stem vowels.

Each speaker’s suffixation of the BF loanwords was compared with their suffixation of the BN loanwords. The young female, who was the only speaker to produce any significant amount of suffix variation with the BF loanwords, had a higher than average percentage of front suffixes with the BN loanwords (88% front) than the other speakers who produced 65-71% front allomorphs with the BN loanwords. However, her overall percentage of front suffixes with the disharmonic words was very similar at 85.1% front, indicating that the BN loanwords and BF loanwords were treated very similarly by this speaker. The three other speakers who suffixed the BF loanwords almost exclusively with front allomorphs had lower levels of front suffixes with the BN loanwords ranging from 65-71% front. For these speakers, there is a clear difference in the patterning of the BN and BF loanwords. Though, overall, both word types are affixed with front allomorphs, there are subtle differences in the patterning due to the affixal variation of individual BN lexical items.

3.4 Discussion

In the following sections the significance of the results presented in section 3.3 is discussed first in relation to the compounds, then the neutral-final loanwords, and finally the disharmonic loanwords.

3.4.1 Compounds

While the affixation of the compounds by the older speakers and the younger male was generally unremarkable with suffixes corresponding in harmonic class with the final element of the
compound, the productions of the three younger females were unexpected. For all three speakers some overlap was observed in the suffixes associated with back-final, front-final, and neutral-final compounds reminiscent of Mahonen’s (2011: 72-5) findings, discussed in footnote 28.

Though the overlap between the expected front and back suffix vowel categories is not complete, for all three young female speakers there is a considerable amount of overlap which is specific to the suffix vowels and requires explanation. While it is possible that the suffix vowels are subject to some degree of coarticulation from the preceding stem-final [i] which may cause fronting, it is unclear why the fronting is sufficient to cause overlap for only these speakers; even in the identical phonetic environment other speakers produce distinct front and back suffix allomorphs. While final position may be a weak position in which neutralization is not unexpected (Barnes 2006), the anomaly here lies in that fact that it appears to be confined to the young females.

For all three young females, but especially for speaker FY1, the lack of categorical suffixation in the compounds calls into question the meaning of the findings concerning the loanwords. If suffixation even in compound words does not habitually follow the expected suffix harmony patterns then it is unclear what the expectations should be for loanwords. Additional research into the suffixation of native words is required especially concerning what degree of overlap is tolerated by listeners and when it will begin to cause perceptual issues.

3.4.2 Back Neutral Loanwords

A comparison with Hungarian, a related language which also displays backness harmony, is useful. Hungarian displays a count effect whereby BNN words are more likely to receive front allomorphs than are BN words (Hayes and Londe 2006: 6). This tendency is not evidenced in the Finnish data. The BN loanwords with the vowel sequence BNNN (adjektiivi ‘adjective’ and arkkitehti ‘architect’) do not appear to prefer front allomorphs to a greater extent than those

83 Note that [a] following [j] within the stem also displayed some fronting for these speakers.
loanwords with the vowel sequence BBNN and so a count effect also cannot be responsible for any differences in lexical behaviour.

Overall, BN loanwords as a group pattern not with the back-final compounds but rather with the front-final and back neutral compounds selecting front allomorphs. In terms of the overall treatment of BN loanwords as compared with other studies, the preference for front suffixes was much stronger in this experiment than has been observed in some other studies (Levomäki 1972; Ringen and Heinämäki 1999). That the percentages of front suffixes were much greater in this study may relate to the influence of orthography and prescriptive rules. As written language is more likely to conform to prescriptive norms than is spoken language and the normative rules stipulate these words should be affixed with back suffixes, this could account for the increased percentages of back allomorphs seen in the written studies.

The selection of front allomorphs is consistent with the prosodic compound analysis, discussed in section 2.3.2.3 and long held in the literature on Finnish, which presumes that Finnish speakers analyze words of four or more syllables as pseudo-compound words with the suffix allomorph agreeing with the final foot. Though the compound analysis is normally assumed to be optional, and perhaps the less likely treatment of such words (see Ringen and Heinämäki 1999: 313), instead for two older speakers in this study (FO2 and MO1) it appears to be the only means of phonological analysis for such words. Other speakers, however, do allow more significant affixal variation, though the dominant analysis for all speakers appears to be one which allows front allomorphs.

In Ringen and Heinämäki’s (1999) study, only those loanwords which could, phonotactically, be seen as compound words displayed variation leading Ringen and Heinämäki (1999: 313) to posit that speakers employed the compound analysis approximately 25% of the time when it was phonologically possible. In this experiment, of the six loanwords only adjektiivi ‘adjective’ was an implausible compound. While all words received substantially greater mean percentages of front allomorphs than the expected 25%, adjektiivi did receive markedly less front allomorphs than the other words, providing some support for Ringen and Heinämäki’s assertion that phonotactic compound plausibility may be relevant. However, compound implausibility does not appear to render the prosodic compound analysis unavailable.
Kiparsky (2003) modified the prosodic compound hypothesis somewhat basing the instantiation of a new harmonic domain on stress, rather than merely syllable count. Under his analysis rhythmic stress is not expected to initiate a new harmonic domain whereas lexical stress may. Of the lexical items discussed by Kiparsky (2003), three were tested in this work, *arkkitehti* ‘architect’, *karamelli* ‘caramel’, and *konstaapeli* ‘constable’. Kiparsky (2003: 114-5) states that *konstaapeli* ‘constable’ has rhythmic stress whereas *arkkitehti* ‘architect’ and *karamelli* ‘caramel, candy’ both have lexical stress. Thus, it is expected that *konstaapeli* should select back suffixes while *arkkitehti* ‘architect’ and *karamelli* ‘caramel, candy’ should display some variation in allomorph selection. However, these predictions are not borne out by the data. While *konstaapeli* ‘constable’ did display a greater percentage of back suffixes (71% F vs. 79% F and 86% F) this was not consistent across all speakers and the overall difference was small. It is possible that the difference between lexical and rhythmic stress may only be significant for some speakers. As well, as the rhythmic stress is the typical stress pattern for Finnish words perhaps those words with lexical stress are those which remain less assimilated into the lexicon. The degree of integration may vary for a given speaker.

In a study on the nativization of Dutch loanwords in Indonesian, phonological nativization and integration of loanwords into the lexicon as reflected in the application of a phonological rule (coalescence) was shown to be sensitive to frequency in Indonesian (Sloos 2013). As the rhythmic pattern appears to be the native Finnish stress pattern for non-compound words, it is possible that words may adjust their stress pattern as they assimilate and that frequency may play a role. According to the *Suomen kielen taajussanasto* (Frequency Dictionary of Finnish) *arkkitehti* ‘architect’, *adjektiivi* ‘adjective’, and *konstaapeli* ‘constable’ are the most frequent of the test stems. While these three had the lowest percentages of back allomorphs, the difference was slight. When the mean suffix F2 values were examined by gender though, as shown in Figure 3-8, these three words had much lower values for the male speakers only. These results

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84 Sloos (2013: 149) notes that obvious foreign structure may impede nativization. She states that “words with clear foreign structure…are more likely to be recognized as loanwords for a very long time.” As all the neutral-final loanwords discussed here violate the prototypical word length, possibly this feature marks them as being non-native and is sufficient to inhibit any stress shift.
suggest that if frequency does play a role in allomorph selection, it appears to be relevant only for the male speakers for whom higher frequency correlates with lower mean F2 values. Since rhythmic stress is expected to allow only back allomorphs, this may suggest that these words are more nativized and better integrated into the stress system of Finnish for these speakers.

These findings conflict with those of Duncan (2011), discussed in section 2.3.2.3, who studied the suffixation patterns of BN loanwords on the internet. Duncan’s (2011) findings indicated that frequency was central in allomorph selection, with lower frequency BN loanwords selecting mostly back allomorphs while higher frequency forms displayed almost equal selection of front and back suffixes. Notably though the relevant frequency was that of the stem and suffix together, not simply the stem alone, which may make the frequency rankings of the Suomen kielen taajussanasto, where all forms were combined, difficult to compare. Moreover, Duncan (2011) examined written representations while this experiment examined phonetic tokens.

The findings in Duncan (2011) may be recast as a competition between the prescriptive written norms, which require back suffixes, and the spoken forms, which prefer front suffixes. While lower frequency forms may be more subject to the written prescriptive rules, resulting in the high percentages of written back allomorphs, the higher frequency forms are increasingly influenced by their spoken forms. Similarly Leskinen (1981: 318-9) notes that recent loanwords from English which have orthographic stem vowel forms in conflict with their spoken forms are more likely to receive affixes which accord with their stem pronunciation when they are more frequent. That the written high frequency forms in Duncan (2011) never seem to reach the same percentages of front suffixes as the spoken forms demonstrates that the written norms continue to affect written behaviour.

In contrast to Levomäki’s (1972) study, which revealed a great deal of lexical variation (5.5-73.0% F), here, apart from adjektiivi ‘adjective’, the BN loans demonstrated greater consistency within the category. The present study shared only two BN loanwords with Levomäki’s (1972) study, arkkitehti ‘architect’ and karamelli ‘caramel, candy’. In Levomäki’s study, arkkitehti ‘architect’ was suffixed with front allomorphs 73.0% of the time and, karamelli, ‘caramel, candy’ 52.6%. These loans both demonstrate majority suffixation with front allomorphs in Levomäki’s work, as in the present study, though the difference in behavior of the two loans seen
in Levomäki’s study was not mirrored in the present work. In fact, these loans displayed highly similar behaviour in this study. Levomäki’s (1972) study has two major differences which may account for any discrepancies. The difference in time between the two studies is over three decades and any differences may be a result of changes in the treatment of such words over time. Also, Levomäki’s (1972) results were based on written responses which may also be subject to different pressures than the oral responses examined in this experiment.

Speakers in this study varied in their treatment of given lexical items and none of the words were treated identically by all speakers, as shown in Table 3-7. For example while FO2 suffixed konstaapeli ‘constable’ exclusively with front allomorphs, FY3 allowed variation and MO2 used primarily back allomorphs. While some of this apparent variation may have been an artifact of the method of analysis whereby the suffix vowels divided into front and back though some tokens were phonetically quite central, it is still noticeable that there was some degree of inter-speaker variation. Therefore a different subject pool could display markedly different results.

Notably the younger females appeared to have an unexpected degree of centralization of the front suffixes as compared to the older females. The suffix centralization, as shown in Figure 3-6, occurred not only with the BN loanwords but included also the front-final and neutral-final compounds. As there was no similar difference in the positioning of the low vowels in the tVkin tokens, this appears to be a difference in suffixation rather than general vowel placement. While Välimaa-Blum (1999: 253-4) also noted centralization, in her data it occurred only in the loanword suffixes and was distinct enough to be auditorily classified as a separate vowel. As well, Välimaa-Blum (1999: 266) notes that there was no apparent age-grading; the central vowel was present in the productions of all three speakers. However, there was no indication in this study that there were distinct front, back, and central suffix vowels and there was also no indication that the loanwords patterned differently than the front-final and neutral-final compounds in the speech of the young females.

Skousen (1975: 104-5) notes that some low suffix vowels exhibit centralization though he states that it is the back vowels which centralize resulting in the suffix alternation [ä] ~ [ə]. There is no
evidence in this data that the centralized suffix vowels are typically schwa-like as there does not appear to be any general tendency towards raising\textsuperscript{85}. Mahonen (2011: 72-85) also noted some centralization in the suffixes appended to both native and loanwords resulting, for some speakers, in a lack of delineation between the front and back suffix categories. The overlap, attributed to unstressed vowel reduction, was so extensive Mahonen (2011: 162) states that “most speakers had considerable F2 overlap between suffix vowels of front and back words.” The overlap observed in the young females in this study is consistent with that in Mahonen (2011).

That the centralization of front allomorphs is apparent only in the young females in this study may indicate a change in progress though the caveat remains that the observations are preliminary given the small sample size. If the centralization were exclusively a property of dialectal differences, it would also be expected in the speech of the young male, but this is not the case. If it were a long-standing static gender-based difference, then it would be expected in the speech of the older females, but here again it is absent. The difference either appears to be related to a stable gender and age-based difference or incipient language change, which has often been reported to originate in the speech of young females (see for instance Kang and Han 2013 for discussion of language change and age-grading). Future research may examine these possibilities.

Overall, the acoustic results of this study do not support the analyses of Ringen and Heinämäki (1999), Kiparsky (2003), or Duncan (2011). Instead, as in Välimaa-Blum (1999), they indicate that BN loanwords normally select front allomorphs, providing possible support for the prosodic compound analysis. However, there may be some difference in the treatment of a particular loan by different speakers. Given speakers are often fairly consistent in their suffixation of a specific loan though there is not necessarily suffix allomorph agreement across speakers. Though there were indications that external factors might be relevant to the suffixation patterns (e.g. frequency relevant for males, potential lexical patterning in the anomalous treatment of \textit{adjektiivi}

\textsuperscript{85} Only a single speaker, FY2, produced a single token of a [ə]-like vowel.
‘adjective’, suffix centralization by young females) the effects of frequency, age, and gender are not fully apparent in this study and require further examination.

3.4.3 BF Disharmonic Loanwords

The disharmonic pronunciation of orthographically BF stems is unexpected if stem harmony is a productive phonological rule, but what we see in this experiment is instead the absence of robust harmony in such stems. However, the analysis, because it does not indicate partial harmonization, e.g. FY2’s pronunciation of konduktööri as [kondyktööri-ə], may underestimate the degree of harmonization occurring. As well, a number of pronunciations exhibited stem vowel centralization, as was first noted by Wiik (1995 as reported in Välimaa-Blum 1999: 253), which could be indicative of some harmonization tendencies. However, some instances of native compounds also demonstrated centralized vowels, so it is not clear whether centralization is more likely in disharmonic words or a more general phonetic property occasionally occurring also in harmonic native words. Though stem vowels in disharmonic stems did occasionally evidence some centralization, these central vowels were not common enough to indicate that this was a typical, regular repair. Overall, the disharmonic loans are typically pronounced as they are written. Without additional study, it is unclear whether the centralization is more frequent in disharmonic loanwords and, if so, if it represents uncertainty or difficulty in pronunciation. Additional work could also examine listener perception of such vowels.

An additional factor which may bear on the lack of harmonization is that, as actual words, these forms may be subject to normative pronunciations and may be influenced by their orthographic stem vowels. The lack of stem harmonization may be related to these factors and may still be expected to occur with nonce forms, for example.

It is clear that the BF disharmonic stems in this experiment are overwhelmingly suffixed with front allomorphs. These results are very similar to those of Välimaa-Blum (1999) who found that, for BF disharmonic loans, 84% of the time, they were suffixed with front vowels and 5% of the time, with the unknown vowel.
Of the four speakers examined only the young female displayed any degree of variation. It is possible that the lower percentage of front suffixes with the disharmonic stems seen with the young female may relate to the overall centralization of all front suffixes seen amongst the younger females. When the suffix vowels were examined individually, many of the ‘back’ suffixes were, in fact, very central and one was actually more schwa-like than low. Without further study, it is unclear whether her pronunciations are idiosyncratic or if they are typical of young female speakers.

Centralization of the suffix vowels was not exclusive to young females or loanwords. In Figure 3-9, three of the four suffix vowels for the native compound *lenkosäärö* ‘crooked leg’ as produced by the young male would be characterized as front and one would be characterized as back, by the criteria used in herein (those vowels on the side of the midpoint closer to the /ä/ control means are considered front whereas those on the side closer to the /a/ control means are considered back). If the vowel space were to be divided into thirds, allowing for central vowels, then two of the four suffix vowels would be front, and two would be central. Either way, as shown for the compound in Figure 3-9, the suffix vowels for this native compound are not categorically strongly phonetically front.

![Figure 3-9: Mean F1 and F2 Values (in Hz) of Eight Finnish vowels and Suffix Vowels for Native Compound *lenkosäärö* ‘crooked leg (part.)’ as Produced by Speaker MY1.](image-url)
In terms of lexical patterning, only *analyysi* ‘analysis’ appeared to have any atypical behaviour. While most suffixes appended to *analyysi* ‘analysis’ were front (81.25%), it was the only lexical item which displayed any substantial variation. Notably, along with *kuvernööri* ‘governor’, it was also one of only two disharmonic test words to appear in the frequency dictionary. *Analyysi* ‘analysis’ though also had several related words which also appeared in the frequency dictionary, three of which contained back derivational suffixes, e.g. *analysoida* ‘to analyze’. It is possible that the existence of these common forms may have influenced the tendency for *analyysi* ‘analysis’ to suffix with back allomorphs.\(^86\)

The differences in vowel height seen in Ringen and Heinämäki’s (1999) and Kimper’s (2011) studies are not apparent here. Instead, all vowels front vowels, regardless of height, pattern alike. The harmony rule for disharmonic BF loans therefore appears to be the same as that for native roots; suffixes are dependent on the final harmonic vowel in the stem. Only the young female speaker demonstrates any strong evidence of suffix vowels that are not dependent on the final harmonic vowel.

It is possible that the variation seen in the written studies was, at least partly, based on the orthographic representation of the vowels. Most of the nominal inflectional suffixes contain low vowels which are orthographically realized as `<ä> ~ <a>`. When the stem final vowel is either of the vowels which are distinguished by the presence or lack thereof of umlauts and the suffix is also marked by the presence of umlauts, the suffix vowel seems more likely to be orthographically rendered as corresponding to the stem vowel. When the final stem vowel is `<y>`, the only front harmonic vowel which, like the back vowels, is not marked with umlauts, the suffix varies orthographically between front and back. The height difference, which appears to be strong in the orthographic representations but perhaps is absent from the phonetic forms, may then relate to orthographic factors. There may be some subtle orthographic influence here in that writers may be less likely to follow an umlauted vowel with the un-umlauted variety. This tendency may be especially strong when the following vowel is identical to the closest stem

\(^86\) Note also that in many normative discussions of disharmonic words, *analyysi* ‘analysis’ is presented as an illustration and so as a result speakers may be more sensitive to its pronunciation.
harmonic vowel. As orthography has been shown to have some effect on phonology and/or phonetic realization, its influence should not be ignored (Perre, Pattamadilok, Montant, and Zeigler 2009; Warner, Jongman, Sereno, and Kemps 2004; Warner, Good, Jongman, and Sereno 2006).

3.5 Conclusions

The main purpose of this phonetic study was to examine the phonetic realization of stem vowels in orthographically disharmonic BF loanwords and the suffix vowels in BF and BN loanwords. While previous work has taken the orthographic forms of the stems to be identical to their phonetic forms, if stem harmony is productive, significant harmonization is in fact expected. In written studies suffix selection has been linked to a number of phonological factors including stem vowel height, stress patterns, and frequency. These factors were examined in relation to the phonetic realizations of the suffix allomorphs.

With regard to the BF disharmonic loanwords, it was found that, overwhelmingly, they are pronounced as they are written i.e. disharmonically. While disharmonic pronunciations corresponding to the orthographic forms might be expected to be the norm, that almost no harmony repair at all occurred might be indicative of a weakening of the harmony constraint in the language. Though stem and suffix harmony are reported to be robust and pervasive in the native lexicon, it seems that disharmonic words appear to be freely incorporated into Finnish with little repair. As these words are typically learned vocabulary and Finnish is a highly standardized language, there remains the possibility that the lack of harmonization is not necessarily indicative of a lack of productive harmony in the language but is instead a consequence of the normative expectations of these lexical items.

In terms of phonetic suffixation, the BF loans typically harmonize with the closest available harmonic vowel, in spite of prescriptive rules allowing either suffix allomorph when the final harmonic vowel is /y/. However, as participants were not explicitly asked about their knowledge of this rule, it is not possible to determine whether they were aware of its existence.
These results deviate from the expected variation based on height of the final harmonic vowel and the vowel with primary stress, both of which were suggested to be factors in previous studies (Ringen and Heinämäki 1999; Kimper 2011). Instead, harmony was almost invariably based on the final harmonic vowel of the stem. This pattern is common in other harmony languages, e.g. Turkish and Kazakh (Kabak and Weber 2013: 60-1; Bowman and Lokshin 2014: 2).

Suffix harmony, though, may vary for some speakers (e.g. young female). While the behaviour of the older speakers and the young male was comparable, the young speaker displayed some suffixal variation, which may have been related to the suffixal centralization and overlap seen amongst the young females (see section 3.3.2 and Figure 3-6). Due to the small number of speakers analyzed for this word type, further research is necessary to determine if this is an idiosyncratic finding particular to this speaker or if it may be common across young females.

BN loanwords, though phonotactically well-formed in terms of harmony, display seemingly aberrant behaviour. Here, suffixation also seems to be overwhelmingly front; these words pattern with the front-final and back neutral compounds, in spite of the absence of front harmonic vowels in the root available to condition the front suffix allomorph. While different speakers may be fairly consistent in their allomorph selection for some lexical items, there appears to be both inter- and intra-speaker variation.

The overall results of this study are summarized in Table 3-9 and compared with previous research. As shown, the variation seen in previous studies was largely absent from Experiment 1.

Table 3-9: Allomorph Comparison between Previous Research and Experiment 1

<table>
<thead>
<tr>
<th>Stem Type</th>
<th>Expected Suffix Allomorph Based on Previous Research</th>
<th>Experiment 1 Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>F ~ B</td>
<td>some variation; mostly F</td>
</tr>
<tr>
<td>BF</td>
<td>F ~ B (degree of variation dependant on height of front vowel)</td>
<td>mostly F (no height effect)</td>
</tr>
</tbody>
</table>

In spite of the expectation of categorical front and back suffix allomorphs, many partitive suffix tokens evidenced centralization or overlap with both native words and loanwords. Again, the lack of categorical front and back variants is detrimental to the instantiation of suffixal harmony. As young females tend to be the forerunners of linguistic change (Labov 2001), these divergences from the expected harmonic behaviour, which appears to be restricted to the young
females in this study, may be indicative of an incipient change or may indicate age-graded variation (e.g. Kang and Han 2013). If found to be a general pattern common to young females, it may indicate that suffixal harmony is deteriorating. Centralization and overlap would obscure the front and back categories and without discrete suffix allomorphs, suffixal harmony is greatly weakened.
Chapter 4
Experiment 2-A: Orthographic Responses

This chapter and the two that follow discuss a second production experiment investigating the written and phonetic stem and suffix harmony of BN and disharmonic loanwords. In this chapter the written results are presented, in Chapter 5, the phonetic results, which include a comparison of the written and phonetic responses, and in Chapter 6, the results of the language game. As all are components of the same experiment the general experimental details – the purpose, participants, materials, and procedure – will be presented herein in sections 4.1 and 4.2 and only additional details relevant to a given chapter will be discussed elsewhere. The results for the written component of the experiment will be presented in section 4.3 and discussed in section 4.4. Conclusions are presented in presented in section 4.5.

4.1 Experimental Purpose

The experiment discussed in this chapter and the following two chapters has three main objectives: to orthographically and phonetically examine stem and suffix harmony in disharmonic and long BN loanwords, to examine the effect of prescriptive rules on allomorph selection, and to examine the application of stem and suffix harmony in nonce forms created by a language game. Each of these aims will be discussed in detail below.

Previous research discussed in section 2.3.2 has indicated that suffix allomorph selection in disharmonic and long back neutral loanwords is not necessarily simply based on the last harmonic stem vowel, as is expected on the basis of native harmony. Loanwords with back vowels in the non-final disyllable and only neutral vowels in the stem-final disyllable may vary in suffix allomorph selection e.g. arkkitehti-a ~ arkkitehti-ä ‘architect (part.).’ Disharmonic loanwords with back vowels as the final harmonic vowel are reported to always suffix with back allomorphs e.g. tyranni-a, *tyranni-ä ‘tyrant (part.).’ When the final harmonic vowel is front, however, vowel height, which has been interpreted as a sonority effect, has been argued to be
relevant (Ringen and Heinämäki 1999). As vowel height increases, the suffix vowel is less likely to surface as front. Thus, *brosyyri* ‘brochure’, with a final high front vowel, is less likely to be suffixed with a front allomorph than *blobääri* ‘blueberry’, with a final low front vowel.

Most of the studies which have examined these effects have relied on written behaviour (Kimper 2011; Kiparsky 2003; Levomäki 1972; Ringen and Heinämäki 1999). In an acoustic experiment with three speakers Välimaa-Blum (1999) found that suffix allomorphs did vary with long back neutral words but the expected extensive variation was not evidenced with BF words. As well, she found some evidence of a central suffix vowel.

In the acoustic experiment discussed in Chapter 3 long BN words were typically suffixed with front allomorphs. For some speakers this was the only possible pattern while, for others, some variation occurred. The height effects in BF loanwords seen in the written studies were not found to be present and were speculated to be potentially an artifact of the orthography. However, since no written responses were obtained in Experiment 1, it is unknown how these speakers would have suffixed these words in writing. This experiment explicitly compares the written and spoken responses to determine their correlation and factors which may impact one or both mediums.

Standard Finnish is a heavily standardized language and the long loanwords discussed in this thesis are subject to specific prescriptive rules concerning their usage. The prescriptive rule concerning BN lexical items is that they are to be treated as back vowel words and suffixed with back allomorphs accordingly (Eronen 2000). Thus, the prescriptive rule does not treat the BN loans as exceptional with regard to harmony but expects that they should follow the usual rule of selecting the allomorph on the basis of the last non-neutral vowel in the stem. The rule for disharmonic loans stipulates that the suffix should agree with the harmonic class of the final harmonic vowel unless the final harmonic vowel is the high front rounded vowel, in which case either allomorph is considered acceptable (Eronen 2000). In these cases the status of *[y/yy]* differs based on the type of word in which it occurs; harmonic when occurring in a front harmonic word but potentially neutral and transparent when occurring as the final harmonic vowel in a disharmonic word. Levomäki (1972) found that although *[y/yy]* does not behave as strictly front harmonic, neither does it pattern identically to the neutral vowels.
While Campbell (1980: 250-1) claims that the variation is sociolinguistic with back allomorphs considered to be more prestigious and front responses more colloquial, Ringen and Heinämäki (1999: 309-10) dispute this claim noting that their participants, when asked to provide ‘correct’ suffix responses for BF words, actually provided more front responses.

Though the loanwords are subject to prescriptive rules, which have been utilized in some analyses of Finnish vowel harmony to partially justify the allomorph selection, the influence of these normative rules and perceived ‘correctness’ on actual behaviour is unclear. These prescriptive rules may be taught as part of the school curriculum at the discretion of the teacher at the equivalent of the high school level. This experiment attempts to test the behaviour of two groups of students: those who have and those who have not yet learnt the prescriptive rule. This allows the effect of the prescriptive rule on both oral and written production to be analyzed. The group which has not yet been formally exposed to the prescriptive rules must rely on other factors, both phonological and sociolinguistic, in their suffix selection while the group which has been exposed to the prescriptive rules may also utilize the prescriptive determination of ‘correct’ suffix selection.

Finally, this experiment endeavours to examine the application of stem and suffix harmony to nonce forms generated by a language game, which also serves as a distractor. As existent lexical items may be unduly influenced by such factors as frequency, orthography, and overt prescriptive rules, the language game creates nonce forms which are without a history and are therefore less subject to such factors, allowing for an examination of the phonology alone.

4.2 Methods

4.2.1 Participants

24 native speakers of Finnish participated in the study, which was conducted in Joensuu, Finland. Though some of the participants had been born outside of the region, all but two participants reported having lived with native Finnish speaking parents only in Joensuu or surrounding areas, which are part of the Eastern Savo/North Karelian dialect area (see the dialect map in Appendix 1). Though one participant lived for 7 years and another for 10 years in
Järvenpää, which is part of the South Häme dialect region, both participants used the Savo dialect of Finnish.

All participants had normal or corrected-to-normal vision. One participant, a younger male, had a cochlear implant; others were without hearing or language impairments. This younger male’s oral portion of the experiment was excluded from the acoustic analysis though his written responses were kept.

In an effort to determine any possible effects of the prescriptive rules the participants selected included two groups of students, those who had not yet been taught the rules and those who had been. The participants were evenly divided into two groups: 12 younger students (14-15 years old) who had not yet been taught the prescriptive rules concerning loanwords and 12 older students (17-18 years old) who had already been taught the rules, as presented above in section 4.1, in school\(^{87}\). The school was paid the equivalent of approximately 132 CAD for the participation of the younger students while the older students were paid directly the equivalent of approximately 11 CAD each for their participation. As shown in Table 4-1 below, the 24 participants are evenly distributed in terms of age and gender.

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Exposed to Prescriptive Rules</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Exposed to Prescriptive Rules</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>12</td>
<td>24</td>
</tr>
</tbody>
</table>

A confounding factor is that the two age groups differ in two ways. The participants in the group which was exposed to the prescriptive rules were also older by two to four years than those participants in the younger group, which had not yet been exposed to the rules. There may be some difference in terms of increased facility with the language which may occur in these years.

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\(^{87}\) Note that even though the younger group had not been taught the rules formally, some may have inferred the rules already through reading.
irrespective of teaching\textsuperscript{88}. In the experimental results it is thus impossible to tease apart the effects of age and teaching. An alternative approach would have been to test the same group of participants before and after having learnt the rules. However, this approach would also not be without issue since the participants would have had experience with the test methodology and any differences in behavior could, in theory, be tied to this familiarity. Future work may wish to examine separate groups of students in the same classroom immediately prior to and following the prescriptive instruction.

Within this dissertation, participants from Experiment 2 are referred to using the following conventions. The first element is a number referring to the individual. The second element indicates gender with F representing female and M, male and the final element indicates the experiment group with Y indicating younger group, not yet exposed to prescriptive rules and O indicating older group, exposed to prescriptive rules. For example, a female who has been exposed to the prescriptive rules may be referred to as 11FO.

4.2.2 Materials

Three and four syllable disharmonic nouns and four syllable BN nouns were the object of study for this experiment with three syllable back neutral words being included as a comparison with the four syllable back neutral words. The loanwords were extracted from Nykysuomen sanakirja: Vierassanojen etymologinen sanakirja (Modern Finnish Dictionary: Etymological Dictionary of Loanwords), Nykysuomen sivistyssanakirja: Vierasperaiset sanat (Contemporary Finnish Education Dictionary: Loanwords), an online list of loanwords located at http://www.cs.tut.fi/~jkorpela/siv/sanata.html, and relevant linguistic articles. Since the participants were not adults, certain loanwords which were considered highly technical or specialized were omitted. To increase the number of disharmonic words, disharmonic slang

\textsuperscript{88} This possibility should be examined in future research. The results of the written portion of this experiment indicated that there were in fact fewer spelling and case errors in the written responses of the older females. No such difference was observed amongst the males.
words were extracted from Karttunen (1979) and Paunonen and Paunonen (2000). Both recent and outdated words were included. Though efforts were made to include an equal representation of each word length and vowel sequence, it proved impossible due to the phonological shape of existing loanwords in the language.

The disharmonic loanwords are presented and discussed in section 4.2.2.1 and the harmonic loanwords in section 4.2.2.2.

4.2.2.1 Disharmonic Loanwords

For three syllable disharmonic words, an attempt was made to include two lexical items with every possible relevant vowel pattern. Diphthongs were excluded in part due to the possibility of dialectal vowel changes (see section 5.2 for discussion). The words selected are listed in Table 4-2 and those words which are considered primarily slang are underlined.

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89 The use of both loanwords, which are often part of the learned vocabulary of Finnish, and slang words, introduces the possibility that the distinction is phonologically or psychologically relevant. Prescriptive rules are likely to apply differently to more and less formal lexical items. However, as there were not sufficient numbers of phonologically similar words of each type it was impossible to examine this possibility in the context of this experiment.

90 Note that long and short vowels were considered equivalent. Due to the dearth of lexical items available for study, this was a necessary concession. The possibility remains open that length is a significant factor (see Kimper 2011 and Ringen and Heinämäki 1999 for discussion).

91 For the purposes of this experiment, inclusion in the Kielitoimiston sanakirja with a label indicating the word is considered slang (“slg.”) resulted in a word being treated as slang as did inclusion in either slang dictionary.
Table 4-2: Three-Syllable Disharmonic Loanwords

<table>
<thead>
<tr>
<th>Vowel Pattern BF</th>
<th>Finnish</th>
<th>Gloss</th>
<th>Vowel Pattern FB</th>
<th>Finnish</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>u-y-N</td>
<td>kutyyymi turnyyri</td>
<td>‘custom’ ‘bustle’</td>
<td>y-u-N</td>
<td>styrrpuuri</td>
<td>‘starboard’</td>
</tr>
<tr>
<td>u-ö-N</td>
<td>kulööri humööri</td>
<td>‘hue, shade’ ‘humour’</td>
<td>y-o-N</td>
<td>kyklooppi symboli</td>
<td>‘cyclops’ ‘symbol’</td>
</tr>
<tr>
<td>u-ä-N</td>
<td>vulgäärí</td>
<td>‘vulgar’(^{92})</td>
<td>y-a-N</td>
<td>syntaksi tyranni</td>
<td>‘syntax’ ‘tyrant’</td>
</tr>
<tr>
<td>o-y-N</td>
<td>brosyyri volyymi</td>
<td>‘brochure’ ‘volume’</td>
<td>ö-u-N</td>
<td>Lönnrot(^{93})</td>
<td>proper name</td>
</tr>
<tr>
<td>o-ö-N</td>
<td>jonglööri monttööri</td>
<td>‘juggler’ ‘mechanic’</td>
<td>ö-o-N</td>
<td>fürskotti</td>
<td>‘an advance’</td>
</tr>
<tr>
<td>o-ä-N</td>
<td>blobäärí</td>
<td>‘blueberry’</td>
<td>ö-a-N</td>
<td>Grönlanti fönari</td>
<td>‘Greenland’ ‘window’</td>
</tr>
<tr>
<td>a-y-N</td>
<td>parfyymi vampyyri</td>
<td>‘perfume’ ‘vampire’</td>
<td>ä-u-N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a-ö-N</td>
<td>šarmööri valööri</td>
<td>‘charmer’ ‘value (of a colour’</td>
<td>ä-o-N</td>
<td>äsmolli</td>
<td>‘eider duck’</td>
</tr>
<tr>
<td>a-ä-N</td>
<td>afääri kambäkki</td>
<td>‘affair’ ‘comeback’</td>
<td>ä-a-N</td>
<td>bänarit</td>
<td>‘end of relationship’</td>
</tr>
</tbody>
</table>

It was not possible to fill all theoretically possible cells with existing loanwords. Of the three syllable disharmonic loanwords, one cell, ä-u-N remained empty and seven of the eighteen cells had only a single representative item. Most of the absent forms were FB lexical items\(^{95}\). This

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\(^{92}\) Note that Wiktionary (March 15, 2013) lists vulgaari as the main spelling of this word and the disharmonic (original) vulgäärí as an alternative form.

\(^{93}\) Though <Lönnrot> is disyllabic in its nominative form, in inflected forms an epenthetic [i] is appended as shown in the partitive singular <Lönnroti-A>. This word, the last name of a famous Finnish folklorist, is also unusual in that it is not pronounced exactly as it is written but as [lönnrut]. There was variation in the pronunciation of this word with some study participants using a spelling pronunciation while others pronounced his name correctly.

\(^{94}\) The grapheme <š> is meant to represent IPA [ʃ] though in practice many speakers pronounce it as [s].

\(^{95}\) It is unclear whether the scarcity of this word type and the resultant FB-BF asymmetry is a result of internal factors in Finnish or if it is simply an accidental result of the words borrowed or an artifact of the donor language(s). It is also possible that FB words may be more apt to harmonize therefore appearing less often. While BF loanwords were more common and FB words loanwords very uncommon in the standard lexicon, in two and three syllable disharmonic slang words (four syllable disharmonic slang words were exceedingly rare) the opposite pattern emerged where the FB pattern appeared to actually be more common. Future research is necessary.
leaves open the possibility that the behaviour of one of these cells represents lexical item specific behaviour, rather than a more general phonological pattern.

Overall there were 27 three syllable disharmonic words. Of these, 16 were BF and 11 FB. Nine three syllable disharmonic words were considered slang and two were proper names. There were clear frequency differences among the lexical items with some, such as vampyyri ‘vampire’, being widely known while others, such as turnyyri ‘bustle’, being infrequent. Due to the nature of the lexicon the items could not be matched in terms of frequency.

It proved especially difficult to obtain phonologically representative examples of four syllable disharmonic loanword nouns. In the ideal situation, for each vowel quality, three words would be found. Each would have the relevant vowel in the first disyllable and a vowel of the opposite harmonic class would occur in the third syllable. Each of the three words would have different harmonic vowels in the third syllable, representing all three possible heights. In an effort to ensure vowel height was as constant as possible, in the first disyllable only a single harmonic vowel quality was allowed; neutral vowels were allowed in the second, unstressed syllable but only the relevant harmonic vowel may appear in the first, primary stressed syllable. As shown in Table 4-3 the reality of existing loanwords fell quite short of the ideal. Appropriate FB four syllable words were virtually non-existent. Disharmonic loanwords with either [y] or [ä] as the initial vowel were not found and only a single, low frequency lexical item with stressed [ö] was found. As well, samples of BF four syllable disharmonic loanwords with all possible harmonic vowels in the third syllable were also not found and so additional examples with alternate vowels were included. Unfortunately slang words were not available to increase the number of disharmonic words as they were for the three syllable words since the slang words were typically two or three syllables.

The result of these issues is that the list of four syllable disharmonic loanwords is extremely unbalanced, as shown in Table 4-3. Overall only 10 acceptable four syllable disharmonic words were found. Of these, nine were BF and one FB.
Table 4-3: Four-Syllable Disharmonic Loanwords

<table>
<thead>
<tr>
<th>Vowel Pattern</th>
<th>Finnish</th>
<th>Gloss</th>
<th>Vowel Pattern</th>
<th>Finnish</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>[B][F][F]</td>
<td>uvertyyri</td>
<td>‘overture’</td>
<td>[F][F][F]</td>
<td>y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>kuvernööri</td>
<td>‘governor’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sutenööri</td>
<td>‘pimp’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[B][F][F]</td>
<td>molekyyli</td>
<td>‘molecule’</td>
<td>[F][F][F]</td>
<td>ö</td>
<td>följetongi</td>
</tr>
<tr>
<td></td>
<td>konduktööri</td>
<td>‘conductor’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>volontääri</td>
<td>‘volunteer’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[B][F][F]</td>
<td>manikyyri</td>
<td>‘manicure’</td>
<td>[F][F][F]</td>
<td>ä</td>
<td></td>
</tr>
<tr>
<td></td>
<td>amatööri</td>
<td>‘amateur’</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sanitääri</td>
<td>‘medic’</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2.2.2 Harmonic Loanwords

Three and four syllable BN harmonic loanwords were also included in the experiment and are shown below in Table 4-4 and Table 4-5 respectively. The seven three syllable BN words were all comprised of words with back harmonic vowels in the initial syllable followed by neutral vowels in the final two syllables and were all expected to suffix exclusively with back vowels.\(^{96}\)

Table 4-4: Three-Syllable Harmonic Loanwords

<table>
<thead>
<tr>
<th>Vowel Pattern</th>
<th>Finnish</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>u-N-N</td>
<td>muffinssi</td>
<td>‘muffin’</td>
</tr>
<tr>
<td>u-N-N</td>
<td>puustelli</td>
<td>‘type of official residence’</td>
</tr>
<tr>
<td>o-N-N</td>
<td>hobitti</td>
<td>‘hobbit’</td>
</tr>
<tr>
<td>o-N-N</td>
<td>hostelli</td>
<td>‘hostel’</td>
</tr>
<tr>
<td>a-N-N</td>
<td>aprilli</td>
<td>‘April fool’</td>
</tr>
<tr>
<td>a-N-N</td>
<td>ateljee</td>
<td>‘atelier’</td>
</tr>
<tr>
<td>a-N-N</td>
<td>graffiti</td>
<td>‘graffiti’</td>
</tr>
</tbody>
</table>

Only four four syllable BN loanwords were included as test items. While previous work suggested that these words may display suffix variability, since the harmony of disharmonic words in normal readings and as part of the language game were the central questions in this experiment and these words could not bear on these issues, few were included. In the selection of

\(^{96}\) Note that some such words have exhibited suffix variation (e.g. Levomäki 1972), as discussed in section 2.3.2.6.
the four syllable BN words, those words which could be plausibly analyzed as compounds or non-monomorphemic on the basis of the lexicon were excluded. For example, *kilometri* ‘kilometre’, though commonly discussed as a long BN loanword, was excluded since there are many other words in Finnish which contain the element *-metri* and a free morpheme *metri* ‘metre’ also occurs. As well, words such as *ateisti* ‘atheist’ which contain a final element which could be analyzed as a suffix or pseudo-suffix on the basis of many similar forms were excluded. Finally, all words which also had a related truncated form, such as *diskoteekki-disko* ‘discotheque’ and *reumatismi-reuma* ‘reumatism’ were excluded.

**Table 4.5: Four-Syllable Harmonic Loanwords**

<table>
<thead>
<tr>
<th>Vowel Pattern</th>
<th>Finnish</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>o-o-N-N</td>
<td>kompromissi</td>
<td>‘compromise’</td>
</tr>
<tr>
<td>o-N-N-N</td>
<td>orkesteri</td>
<td>‘orchestra’</td>
</tr>
<tr>
<td>N-o-N-N</td>
<td>nikotiini</td>
<td>‘nicotine’</td>
</tr>
<tr>
<td>a-a-N-N</td>
<td>paratiisi</td>
<td>‘paradise’</td>
</tr>
</tbody>
</table>

**4.2.3 Procedure**

Participants were tested individually in a quiet room at their school. Each participant first filled out a sociolinguistic questionnaire to enable the results to be assessed by factors such as gender and exposure to other languages (see Appendix 3).

Participants were informed that they would have four tasks: reading a series of words in a carrier phrase; orally completing a sentence using a word provided; playing a language game with the resultant sentence; and then, following the oral component, completing a written fill-in-the-blank questionnaire.

Participants were seated in front of a laptop computer screen and an Audio-Technica AT831b Lavaliere microphone was clipped onto their collar or shirt front. A Fostex FR-2 digital recorder with 16 bit quantification and 44.1 kHz sampling rate was used to record the acoustic output. The carrier phrase task was identical to that discussed in Chapter 3 (see section 3.2.3 for details). After they completed the control vowel sentences, the remainder of the experiment was explained.
Participants were told that in the next oral task they would be presented with a series of sentences, each consisting of a third person singular present tense verb followed by a noun in the nominative case, to read aloud and play a language game with. They were advised that, although some of the words might be unfamiliar to them, all were either current or former Finnish words. Model sentences, shown below in (25), were provided.

(25) Sample Test Sentences

a. Given: Ajattelee __________ (sinä)
   Inflected: [ajattelee sinua] ‘S/he thinks about you.’

b. Given: Odottaa __________ (bussi)
   Inflected: [odottaa bussia] ‘S/he waits for the bus.’

All nouns were placed in a sentential context to ensure suffixation without requiring either written suffixes or explicit instruction to utilize certain suffixes97. To allow for the use of the language game, discussed in Chapter 6, each sentence had exactly two words. Test items were randomized and distracters were included. The verbs used, which are presented in Appendix 5, belong to the class of atelic verbs, which require partitive case on the object noun, which in this case is always the test word. To obtain a grammatical reading, which is referred to herein as the ‘normal reading’, the verb required that a partitive suffix /-tA/ be appended to the noun. In most cases the /t/ of the partitive case was deleted through the phonological process of stop deletion though two lexical items did require maintainance of the [t].

Participants were instructed to say each sentence presented in a natural, grammatical manner while maintaining the verb in its original state and preserving the singular in the noun. After the normal reading of the given sentence, the participant then played the language game with the

97 As the grammatical requirements of the verbs necessitated partitive case on the noun, no instruction was necessary concerning inflection. All participants easily inflected the nouns without any hesitation or questions.
same sentence, switching the initial consonant(s) and vowel. Once done, they pressed the space bar and the next sentence appeared. Each participant was provided with two practice sentences on the laptop to familiarize themselves with the experimental procedure. When the participant was comfortable with the process and ready to begin, they pressed the space bar and the first test sentence appeared on the screen. See Appendix 9 for a complete list of sentences.

Following the oral portion of the experiment, each participant recorded their written responses to the normal readings. Participants were instructed that, should they feel more than one possibility was acceptable for a given word, they should write all with the most acceptable written first. Additionally, participants were asked to rate each word in terms of word knowledge and use based on the following categories: words known to the speaker and potentially used (known, used); words known to the speaker but unlikely to be used (known, not used); and words unknown to the speaker (unknown). To facilitate the ranking, participants were instructed to write “X” adjacent to words which were known but would not be used and “?” adjacent to unknown words. All written data was collected for analysis and overall 1,146 written tokens were collected.

4.2.4 Analysis

The written responses were examined not only on the basis of the suffix allomorph selected but also in terms of errors, both in case selection and spelling. The suffix allomorph choices were considered in relation to word type, length, word knowledge, gender, and exposure to the prescriptive rules.

98 Throughout this dissertation the original reading is termed the ‘normal reading’ and the switched reading, the ‘game reading’.

99 For six speakers a non-atelic verb was accidentally used with one lexical item. As a result, the noun did not receive a partitive suffix for these speakers.
4.3 Results

The written results of this experiment are discussed in this section while the oral and game results are presented in Chapter 5 and Chapter 6 respectively. Due to the nature of most previous studies on Finnish loanwords, the written responses in this section are perhaps more directly comparable to other work than are the spoken responses. Levomäki (1972), Ringen and Heinämäki (1999), Kiparsky (2003), and Kimper (2011) all utilized the written medium as the basis for their conclusions. Levomäki’s (1972), Ringen and Heinämäki’s (1999) and Kimper’s (2011) experimental studies included disharmonic stems but examined only the suffixal harmony, presumably because there were no responses which were relevant to stem harmony\(^{100}\). However, in this experiment, there were a number of written responses which are relevant to stem harmony. Though there were not sufficient numbers of such responses to allow for statistical analysis, they will be discussed informally in section 4.3.1. In section 4.3.2 the written suffixes will be discussed in relation to word type as well as gender, knowledge of prescriptive rules, and word knowledge.

4.3.1 Written Stem Harmony

While participants were simply expected to re-write the stem and appropriately suffix the word to conform to the syntactic requirements of the sentence, some instances of written stem harmonization occurred, whereby the expected disharmonic vowels of a word were regularized in the respondent’s written form. In the first, more common, type of written harmonization, all stem vowels were harmonized while in the second type, the word was only partially harmonized. There were also some instances of corrected harmonization where a respondent originally harmonized the stem and then subsequently corrected the form to conform to the expected spelling. Note that while some types of corrected forms were clearly apparent as participants crossed out and re-wrote vowels, other vowel changes would be undetectable. Changes between

\(^{100}\) Kimper’s (2011) study involved a forced choice between suffix allomorphs and so stem harmonization was not possible.
<u> and <y> were normally noticeable as was the removal of umlauts on vowels. The addition of umlauts on <o> and <a>, however, would not have been apparent, which means that any items which were originally harmonized to back and then corrected to front and did not involve the high harmonic vowels would not have been visible.

In the following tables, for each lexical item which was orthographically harmonized, the written form, the direction of harmonization, and the stem harmony changes are shown. As well, the participant’s knowledge of the word and the participant who provided the harmonized form are listed. The affected vowels are underlined in the written form. For the partially harmonized and corrected forms the stem harmony changes are not listed.
Table 4-6: Examples of Written Stem Harmonization Errors

Complete Stem Harmonization

<table>
<thead>
<tr>
<th>Original Word</th>
<th>Written Form</th>
<th>Direction of Harmony</th>
<th>Stem Harmony Changes</th>
<th>Word Knowledge</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>afääri</td>
<td>äfääre-j-ä, afääri-t</td>
<td>R → L</td>
<td>BF → F</td>
<td>known, used</td>
<td>19MO</td>
</tr>
<tr>
<td>bänarit</td>
<td>bänäre-i-tä</td>
<td>L → R</td>
<td>FB → F</td>
<td>known, used</td>
<td>10MY, 17MY, 19MO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>known, not used</td>
<td>3MY, 13MO, 23MO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>unknown</td>
<td>20MO</td>
</tr>
<tr>
<td>blobääri</td>
<td>blobaari-ä</td>
<td>L → R</td>
<td>BF → B</td>
<td>known, used</td>
<td>15FY</td>
</tr>
<tr>
<td>fönari</td>
<td>fönari-a</td>
<td>R → L</td>
<td>FB → B</td>
<td>unknown</td>
<td>24MO</td>
</tr>
<tr>
<td></td>
<td>fönäri-a</td>
<td>L → R</td>
<td>FB → F</td>
<td>unknown</td>
<td>19MO</td>
</tr>
<tr>
<td></td>
<td>fönäri-a</td>
<td>L → R</td>
<td>FB → F</td>
<td>known, used</td>
<td>15FY</td>
</tr>
<tr>
<td>jonglööri</td>
<td>jönglööri-a</td>
<td>R → L</td>
<td>BF → F</td>
<td>known, used</td>
<td>15FY, 23MO</td>
</tr>
<tr>
<td>kambäkki</td>
<td>kämbäkki-ä</td>
<td>R → L</td>
<td>BF → F</td>
<td>known, used</td>
<td>17MY</td>
</tr>
<tr>
<td></td>
<td>kombacki-a</td>
<td>L → R</td>
<td>BF → B</td>
<td>known, used</td>
<td>17MY</td>
</tr>
<tr>
<td></td>
<td>comebacki-a</td>
<td>L → R</td>
<td>BF → B</td>
<td>known, used</td>
<td>17MY</td>
</tr>
<tr>
<td>kulööri</td>
<td>kylööri-a</td>
<td>R → L</td>
<td>BF → F</td>
<td>known, not used</td>
<td>4FY</td>
</tr>
<tr>
<td>kuvernööri</td>
<td>kuvernoori-ä</td>
<td>L → R</td>
<td>BF → B</td>
<td>known, used</td>
<td>24MO</td>
</tr>
<tr>
<td>Lönnrot</td>
<td>Lonnrotti-a</td>
<td>R → L</td>
<td>BF → B</td>
<td>known, used</td>
<td>24MO</td>
</tr>
<tr>
<td>syntaksi</td>
<td>syntaksi-ä</td>
<td>L → R</td>
<td>FB → F</td>
<td>known, used</td>
<td>1MY</td>
</tr>
<tr>
<td>voluntääri</td>
<td>völöntääri-a</td>
<td>R → L</td>
<td>BF → F</td>
<td>known, not used</td>
<td>13MO</td>
</tr>
<tr>
<td>vulgääri</td>
<td>vulgari-a, vulgari-in</td>
<td>L → R</td>
<td>BF → B</td>
<td>unknown</td>
<td>14FY</td>
</tr>
</tbody>
</table>

Partial Stem Harmonization

<table>
<thead>
<tr>
<th>Original Word</th>
<th>Written Form</th>
<th>Direction of Harmony</th>
<th>Word Knowledge</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>konduktööri</td>
<td>kondyktööri-ä</td>
<td>R → L</td>
<td>known, used</td>
<td>5FY, 3MY</td>
</tr>
</tbody>
</table>

101 Morphological breakdown provided.
Corrected Harmonization

<table>
<thead>
<tr>
<th>Original Word</th>
<th>Written Form</th>
<th>Direction of Harmony</th>
<th>Word Knowledge</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>kambäkki</td>
<td>kämbäkki → kambäkki</td>
<td>R → L</td>
<td>known, used</td>
<td>3MY</td>
</tr>
<tr>
<td>konduktoöri</td>
<td>kondyktööri-ä → konduktoöri-ä</td>
<td>R → L</td>
<td>known, used</td>
<td>16MY, 13MO, 24MO</td>
</tr>
<tr>
<td>kutyymi</td>
<td>kutu → kutyymi-a</td>
<td>L → R</td>
<td>unknown</td>
<td>23MO</td>
</tr>
<tr>
<td>monttööri</td>
<td>mönttööri-a → montööri-a</td>
<td>R → L</td>
<td>unknown</td>
<td>23MO</td>
</tr>
<tr>
<td>nikotiini</td>
<td>nikötiini-a → nikotiini-a</td>
<td>n/a</td>
<td>known, used</td>
<td>13MO</td>
</tr>
<tr>
<td>turnyyri</td>
<td>turnu → turnyyri-ä</td>
<td>L → R</td>
<td>unknown</td>
<td>16MY</td>
</tr>
</tbody>
</table>

Of 888 possible instances of written stem harmonization (37 disharmonic test words x 24 participants), a mere 31 instances\(^\text{102}\) of partial or total orthographic harmonization (including corrected forms) were recorded though the above caveat concerning umlauts remains. Clearly participants were more likely to write the words as they are typically written which is perhaps unsurprising since the words were provided in their standard disharmonic written forms and the participants were only required to re-write the words and add the suffix. As well, the orthographic forms are standardized in their disharmonic form and so any words which were known to the speaker would be expected to be written in their sanctioned form. Under these circumstances it may be more surprising that there were any stem harmonizations at all. Within this dissertation, the written stem harmonizations are termed errors, akin to other sorts of spelling errors which were also seen, albeit errors which might reveal the writer’s phonological treatment of loanwords\(^\text{103}\).

Within the data there were 22 instances of total harmonization, two of partial harmonization, and seven instances of harmonization which were subject to self-correction by the participants. As occurred also with spelling errors, only a very few lexical items accounted for the majority of the errors. In the case of harmonization, 52% (16/31) of the instances of orthographic harmonization

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\(^{102}\) The vowel change in nikotiini ‘nicotine’ was not considered a true harmonization since its expected form was also harmonic.

\(^{103}\) Many of the spelling errors concerned length and often occurred when there was a mismatch between the written form and the spoken form.
were associated with only three lexical items: bändarit ‘end of relationship’ (eight harmonizations); konduktööri ‘conductor’ (two partial and three corrected harmonizations); and fönari ‘window’ (three harmonizations). Though both known and unknown words were subject to harmonization, a majority of the words harmonized were known to the participant.

Males were much more likely to harmonize than were females. While 5/12 or 42% of females made at least one harmony error, 10/12 or 83% of males did, though few respondents made more than one or two such errors. While younger females and males of either age category were equally likely to make harmony errors, harmony errors were uncommon amongst older females with only a single older female making any harmony errors. In terms of the absolute numbers of errors, males made over three times as many errors as did females. This cannot be simply seen as an overall pattern of males making more errors since the same pattern is not seen in the other types of spelling errors in which both genders were approximately equally represented (males were responsible for 20 errors and females, 23). This appears to be a pattern unique to the orthographic harmonization.

There appears to be little that can be said of the direction of harmonization. In Table 4-7 below, the direction of complete harmonization and the number of occurrences for each word type is shown. Although identical occurrences are not included, in cases where the same lexical item is harmonized both progressively and regressively by different speakers, as with fönari ‘window’, both are included. Cells in which back vowels are triggers are shaded.

**Table 4-7: Direction of Written Harmonization**

<table>
<thead>
<tr>
<th>Word Length</th>
<th>BF Disharmonic Loanwords</th>
<th>FB Disharmonic Loanwords</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Direction of Harmonization</td>
<td>Number of Occurrences</td>
</tr>
<tr>
<td>Three syllables</td>
<td>L → R</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>R → L</td>
<td>5</td>
</tr>
<tr>
<td>Four syllables</td>
<td>L → R</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>R → L</td>
<td>1</td>
</tr>
</tbody>
</table>

The older females were also least likely to make other errors in their written responses.
As was shown in Table 4-3 the test items are extremely skewed for four syllable disharmonic words. As there was only a single FB four syllable disharmonic word compared with nine BF disharmonic words it is unsurprising that no harmonization was found for the FB four syllable disharmonic word type. All other word types evidenced both progressive and regressive orthographic harmonization to a similar degree and no directionality preference can be detected nor does it appear that either back or front vowels are more likely to spread. However, as previously mentioned, some types of harmonization would be invisible if subject to self-correction so any items which were originally harmonized to back and then corrected to front and did not involve the high harmonic vowels would not have been apparent.

In an examination of the vowels to determine if some are more likely than others to trigger or undergo harmony, it seemed that all vowel qualities could act as both triggers and as targets. Though the low number of instances preclude any conclusions, the observation may be made that the only vowel combination which never resulted in harmonization was <o> and <y>.

While written stem harmonization was unanticipated due to the normative pressures of the standardized spellings of known words and the likelihood of accepting the written forms of unknown words, some harmonizations did occur. Though their small number precluded any definitive statements concerning the direction of harmony or likely triggers it seemed that trisyllabic stems were more likely to be subject to harmonization and harmonization was more common amongst males. The correspondences between the written and spoken stem realizations are explored in Chapter 5, which examines the phonetic output of the experiment. Although the written harmonizations will be shown to have a relationship with the spoken forms, it will be revealed that harmonization in the spoken forms is more extensive than in the written medium.

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105 As there were not sufficient examples with long and short quantities, long and short vowels of the same quality are treated together.
4.3.2 Written Suffix Harmony

In this section the nature of the written suffixes will be discussed. First, the degree of intra-subject variation will be examined. The suffixation of BN words will then be considered in section 4.3.2.1 and subsequently, the suffixation of disharmonic words in sections 4.3.2.2 and 4.3.2.3. Finally, the suffixation of harmonized words will be discussed in section 4.3.2.4.

Table 4-8 below lists the overall number of written suffix allomorphs for each stem type. Shaded cells represent the expected suffix category assuming that harmonic suffixes correspond with the final stem harmonic vowel. Harmonized stems have been removed and thus the total number of stems is 1,124106.

<table>
<thead>
<tr>
<th>Stem Harmony</th>
<th>Written Suffix</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Harmonic</td>
<td>Front</td>
<td>Back</td>
<td>Both</td>
</tr>
<tr>
<td></td>
<td>Suffix</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Harmonic BN</td>
<td>1.1</td>
<td>3</td>
<td>2.3</td>
<td>96.6</td>
</tr>
<tr>
<td>Disharmonic FB</td>
<td>2.2</td>
<td>6</td>
<td>0.7</td>
<td>97.0</td>
</tr>
<tr>
<td>Disharmonic BF</td>
<td>2.5</td>
<td>15</td>
<td>67.5</td>
<td>29.3</td>
</tr>
</tbody>
</table>

BN loanwords and disharmonic FB loanwords were near categorically suffixed with allomorphs which agreed with the final harmonic vowel of the stem. Only the disharmonic BF loanwords had a substantial number of suffixes which did not correspond to the final harmonic vowel of the stem.

Though participants were instructed to write more than one form if they felt more than one was possible, with the most acceptable variant listed first, unexpectedly few participants actually demonstrated harmonic variation of the suffix. Of the 1,124 written suffixes, only four tokens, all produced by a single young male, were suffixed with both front and back suffixes.

106 The six Grönlanti tokens were excluded since they were affixed with non-harmonic suffixes. See footnote 99 for details.
4.3.2.1 Orthographic Suffix Selection with BN Stems

There were seven three syllable and four four syllable BN words presented to each speaker, resulting in a total of 168 three syllable and 96 four syllable written BN words. Of these 264 words, three were not suffixed with the partitive case at all, six were suffixed with the front partitive allomorph, and the remaining 255 were suffixed with back partitive allomorphs. As shown in the table below, BN words, both three and four syllable, were overwhelmingly suffixed with back allomorphs.

Table 4-9: Written Suffixes of BN Stems

<table>
<thead>
<tr>
<th>Syllable Number</th>
<th>Written Suffix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Harmonic Suffix</td>
</tr>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td>3</td>
<td>1.8</td>
</tr>
<tr>
<td>4</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Word knowledge, phonotactic plausibility as a compound, and number of neutral vowels were not relevant to the suffixation. Suffixal variation was not observed.

There was no difference due to the prescriptive rule; both those students who had been taught the rule and those who had not suffixed this word type near categorically with back allomorphs.

4.3.2.2 Orthographic Suffix Selection with FB Stems

FB disharmonic words were expected to be suffixed with back harmonic vowels and, as shown in the table below, FB stems, like BN stems, were also overwhelmingly suffixed with back allomorphs. Note that all harmonized stem tokens (the harmonized stems discussed in section 4.3.1 above) have been excluded from the table and will be discussed in section 4.3.2.4.
### Table 4-10: Written Suffixes of FB Disharmonic Stems

<table>
<thead>
<tr>
<th>Syllable Number</th>
<th>Written Suffix</th>
<th>No Harmonic Suffix</th>
<th>Front</th>
<th>Back</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2.4</td>
<td>6</td>
<td>0.8</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2.2</td>
<td>6</td>
<td>0.7</td>
<td>2</td>
</tr>
</tbody>
</table>

A mere two of 269 of tokens, both of which were three syllable words, received front suffixes. However there was only a single four syllable front back word, följetongi ‘a serial’, so this lack of front suffixes with this word type may not be significant as it may be due to the particular lexical item or it may simply be due to the fact that there were many more opportunities to suffix three syllable front back words.

With the harmonized stems removed from consideration, only one instance of Fönari ‘window’ and one of bünarit ‘end of relationship’ remain as examples of disharmonic front back stems suffixed with front allomorphs. These words are also among those more likely to undergo written stem harmonization. It seems very clear from the data that, in writing, FB words near exclusively select back suffix allomorphs.

### 4.3.2.3 Orthographic Suffix Selection with BF Stems

As a group, the disharmonic BF words were more likely than other stem types to be suffixed with allomorphs not corresponding to their final harmonic vowel. Again, all harmonized stem tokens (the stems discussed in section 4.3.1 above) have been excluded from the table and will be discussed in section 4.3.2.4.

### Table 4-11: Written Suffixes of BF Disharmonic Stems

<table>
<thead>
<tr>
<th>Syllable Number</th>
<th>Written Suffix</th>
<th>No Harmonic Suffix</th>
<th>Front</th>
<th>Back</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>3.4</td>
<td>13</td>
<td>61.3</td>
<td>231</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0.9</td>
<td>2</td>
<td>78.5</td>
<td>168</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2.5</td>
<td>15</td>
<td>67.5</td>
<td>399</td>
</tr>
</tbody>
</table>
Though a majority of three and four syllable BF words which were suffixed with partitive suffixes were suffixed with the front allomorph, there was clear inter-speaker suffix harmony variation, though very little intra-speaker variation for any given lexical item. The percentage of front suffixes was somewhat higher with four syllable words.

In Table 4-12 below, the percentages of suffix allomorphs are given for each stem combination of vowels in three syllable BF loanwords. The tokens which were not suffixed with a harmonic suffix were excluded from the table as were those tokens in which the stem vowels were harmonized.

<table>
<thead>
<tr>
<th>Primary Stressed Vowel</th>
<th>Final Harmonic Vowel</th>
<th>Written Suffix Vowel</th>
<th>% Front</th>
<th>% Back</th>
<th>% Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>u/uu</td>
<td>y/yy</td>
<td>54.2</td>
<td>45.8</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö/öö</td>
<td>68.1</td>
<td>31.9</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä/ää</td>
<td>69.6</td>
<td>30.4</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>o/oo</td>
<td>y/yy</td>
<td>35.4</td>
<td>64.6</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö/öö</td>
<td>72.7</td>
<td>27.3</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä/ää</td>
<td>81.8</td>
<td>13.6</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>a/aa</td>
<td>y/yy</td>
<td>42.6</td>
<td>55.3</td>
<td>2.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö/öö</td>
<td>76.6</td>
<td>23.4</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä/ää</td>
<td>89.5</td>
<td>7.9</td>
<td>2.6</td>
<td></td>
</tr>
</tbody>
</table>

In the written data, as the initial back vowel lowers in height, stems are typically affixed with a higher percentage of front suffixes though note that this tendency does not appear to hold in the stems with an initial <u/uu> and final <y/yy>. As the front vowel lowers in height, the percentage of front suffixes also rises. Excepting the vowel sequences <o-y> and <a-y> most sequences tended to receive front allomorphs.

In Table 4-13 below, the percentages of suffix allomorphs are given for each four syllable BF stem type. The tokens which were not suffixed with a harmonic suffix were excluded from the table as were harmonized stems. As in the trisyllabic words the first harmonic vowel is assigned primary stress. Unlike in the trisyllabic words the final harmonic vowel carries secondary stress, which has previously been found to be relevant for allomorph selection (see section 2.3.2 for
discussion). For details on the specific lexical items, see Table 4-3. It should be remembered that in most cases each vowel sequence is represented by a single lexical item.

### Table 4-13: Written Suffix Vowels of Four Syllable BF Stems by Vowel Quality

<table>
<thead>
<tr>
<th>First Harmonic Vowel</th>
<th>Final Harmonic Vowel</th>
<th>Written Suffix Vowel</th>
<th>% Front</th>
<th>% Back</th>
<th>% Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>u/uu</td>
<td>y/yy</td>
<td>70.8</td>
<td>29.2</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö/öö</td>
<td>87.0</td>
<td>13.0</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä/ää</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>o/oo</td>
<td>y/yy</td>
<td>66.7</td>
<td>33.3</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö/öö</td>
<td>87.5</td>
<td>12.5</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä/ää</td>
<td>90.9</td>
<td>9.1</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td>a/aa</td>
<td>y/yy</td>
<td>67.7</td>
<td>33.3</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö/öö</td>
<td>83.3</td>
<td>16.7</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä/ää</td>
<td>75.0</td>
<td>20.8</td>
<td>4.2</td>
<td></td>
</tr>
</tbody>
</table>

In all cases the four syllable BF disharmonic stems are suffixed with front allomorphs a majority of the time. In fact, four syllable BF words which were suffixed with harmonic suffixes are somewhat more likely than three syllable BF words to be suffixed with front suffixes (79.0% vs. 63.5% respectively). This is even the case for those words such as *konduktööri* ‘conductor’ (87.5% F) and *uvertyyri* ‘overture’ (70.8% F) which are unlikely compounds due to the final consonant which would end the initial two syllable sequence.

Though the height pattern for the final harmonic vowel appears to be similar to that of the trisyllabic words with the percentage of front suffixes normally increasing as the vowel lowers, the pattern diverges for the primary stressed vowel. While the percentage of front suffixes typically increased in the trisyllabic words as the back vowel lowered, the percentage of front suffixes does not appear to have a pattern under the same circumstances in the four syllable words.

Especially amongst the trisyllabic words there appeared to be some lexical patterning. Some words with identical vowel sequences, such as *brosyyri* ‘brochure’ and *volyymi* ‘volume’, did not

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107 Note though that [r] is possible though rare word-finally.
necessarily exhibit the same behaviour, while other word pairs were similar. For example, while *brosyyri* ‘brochure’ is suffixed equally with front and back allomorphs (50% F), *volyymi* ‘volume’ was suffixed with a vast majority of back allomorphs (20.8% F). Conversely the word pair *valööri* ‘value (of a colour)’ and *šarmööri* ‘charmer’ were very similar in behaviour with 75.0% F and 78.3% F respectively.

While there was no consistent effect for word knowledge there appeared to be a tendency whereby if a speaker knew a given word, they were typically more likely to select front allomorphs. However, some of the most well-known words had some of the lowest overall percentages of front allomorphs e.g. *jonglööri* ‘juggler’ 66.7% F, *parfyymi* ‘perfume’ 33.3% F, *vampyyri* ‘vampire’ 52.3% F, *volyymi* ‘volume’ 20.8% F. Further research into word knowledge and frequency is necessary.

There appeared to be a relationship between gender and whether the students received instruction concerning the prescriptive rules. While the suffixation patterns of younger males and females who had not received instruction were largely similar (with the exception of <ö/öö>-final words), the patterns of the males and females who had received instruction differed, as seen in Table 4-14 below. In this table the responses for both three and four syllable words are included but all tokens which included harmonized stems were excluded.

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108 The prescriptive rules stipulate that BN stems are always to be treated as back stems and disharmonic stems with final <y> may receive either front or back suffix allomorphs.

109 Though the percentages of front suffixes differed somewhat for the three and four syllable stems, the overall patterns were the same. In most cases four syllable stems received higher percentages of front allomorphs.
Table 4.14: Percentage Written Front Suffixes by Participant Group and Stem Final Vowel

<table>
<thead>
<tr>
<th>Taught Prescriptive Rules</th>
<th>Gender</th>
<th>Final Harmonic Vowel</th>
<th>&lt;y/yy&gt;</th>
<th>&lt;ö/öö&gt;</th>
<th>&lt;ä/ää&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Male</td>
<td>63.0</td>
<td>78.0</td>
<td>84.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>62.3</td>
<td>87.5</td>
<td>81.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>62.6</td>
<td>82.6</td>
<td>83.1</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>Male</td>
<td>59.3</td>
<td>64.9</td>
<td>80.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>24.1</td>
<td>81.7</td>
<td>81.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>All</td>
<td>41.7</td>
<td>73.5</td>
<td>81.3</td>
<td></td>
</tr>
</tbody>
</table>

Stems with the final harmonic vowel <yy> were less likely in all groups to receive front suffixes. Amongst males, participants who had been taught the prescriptive rules used somewhat fewer front allomorphs for all stem types but especially those with final <ö/öö>, which does not accord with the prescriptive rule as taught. Females who had received prescriptive instruction as compared with females who had not displayed minimal differences with <ä/ää> final stems and showed some decrease in front allomorphs with <ö/öö> final stems but greatly differed in their treatment of the <y/yy> final stems. The older females clearly treat the <yy>-final stems in a different manner from the other stem types. The suffixation of these stems is only 24.1% front, far fewer front suffixes than stems with other final vowels and fewer front suffixes than used by the younger female group.

4.3.2.4 Orthographic Suffix Selection with Harmonized Stems

As discussed in section 4.3.1, complete orthographic stem harmonization was observed in 22 suffixed tokens only 14 of which were affixed with suffixes of the same harmonic class\textsuperscript{110}. In the remaining eight the suffix unexpectedly did not always conform to the harmonic class of the word. Both front stems with back suffixes (e.g. kylööri-a ‘hue, shade (part.)’) and back stems with front suffixes (e.g. blobaari-ää ‘blueberry (part.)’) were observed though the former was more common. As well this phenomenon occurred with both three syllable and four syllable stems.

\textsuperscript{110} The three forms of kambäkki ‘comback’ provided by 17MY are all treated as a single case.
words and in the responses of older and younger males and females. It is unclear how to explain these occurrences other than as apparent spelling errors with no relation to the phonology.

4.4 Discussion

In this section the written results are discussed first in terms of stem harmony (section 4.4.1) and subsequently suffix harmony (section 4.4.2). Overall, much of the written data concerning the disharmonic words accords well with the results of previous studies though the BN loanwords do not display the variation predicted.

4.4.1 Written Stem Harmony

Even though the disharmonic written forms are standardized and were provided to participants, some responses (31 tokens) unexpectedly displayed either complete or partial stem harmonization, which was not reported in other written studies. Three words were especially likely to be harmonized in writing: bänarit ‘end of relationship’, konduktööri ‘conductor’, and fönari ‘window’, potentially suggesting some degree of lexicalization and possibly interference from the phonology. In fact, these three words were often harmonized also in speech, indicating that there is some influence of the spoken form on the written representation. However, the phonetic stem harmonization, discussed in section 5.3.2, was much more extensive than the written harmonization and most words which underwent phonetic harmonization were rendered disharmonically orthographically, likely due to the pressure of the standardized written form provided for the participant to re-write. If the orthographic stem harmonization is, in fact, related to the phonetic harmonization by speakers, it is possible that in a more natural setting where participants were writing these words without a written prompt, harmonized phonological forms might interfere to a greater extent but this is a topic for future research.

While many of the harmonized forms were words known and used by the participant who produced the harmonized tokens, there did not appear to be any tendency for those lexical items which were well known overall to be subject to greater harmonization. That the majority of the
harmonized tokens were known to the given participant may be partly due to the fact that speakers might have had to look more closely at the written form of an unknown word to copy it and were thus less likely to alter the form, regardless of pronunciation or spelling norms.

Though there is insufficient data to make definitive phonological statements concerning stem harmonization (triggering vowels, direction, etc.), some anecdotal comments may be made. In discussions of stem harmonization, it is often presumed that harmonization is more likely to occur within a foot than across a foot boundary (Wiik 1965: 50-52). Since the majority of harmonizations are seen in the three syllable words, most are indeed foot internal. However, the relatively high number of instances of partial and corrected harmonization in *konduktööri* ‘conductor’ (5 instances) indicate that this is, at most, a tendency. As well, the percentage of four syllable words which underwent harmony (2.9%) is almost the same as that of three syllable words which underwent harmony (3.7%).

Participant 17MY provided an interesting response for *kambäkki* ‘comeback’ providing three possibilities for this word: <kämbäkkiä>, <kombackia>, and <comebackia>. These three spellings evidence varying degrees of nativization with the first being most nativized, containing only the illicit consonant <b>, and the final form being least nativized with the non-native graphemes <c>, silent <e>, <b>, and the digraph <ck>. The suffix harmony is dependent on the orthographic representation chosen. For the most orthographically nativized form *kämbäkki* ‘comeback’, with front stem harmony, the suffix selected is front. When either of the less nativized forms, *kombacki* or *comebacki*, are selected, the suffix is back, agreeing with the orthographic harmonic class dictated by the orthographic forms from English. Presumably while these would all be pronounced in the same manner the orthographic stem and suffix harmony differs according to the degree of nativization chosen.

In a pilot study Leskinen (1981) examined the phonological patterning in Finnish of recent English loanwords which had a mismatch between their orthographic and phonetic stem forms. His results suggested that both the orthographic and phonetic forms play a role in orthographic suffix choice. For example, though the partitive form of *<Sprite>* was pronounced [spraittia] 94% of the time, when written, it received front written suffix allomorphs 43% of the time, which accords with the written representation but is in conflict with the spoken form. While
phonetically harmonic words which were orthographically disharmonic also displayed suffix variation, those which were orthographically harmonic but realized with a different vowel class phonetically were overall less likely to receive the phonetically correct allomorph. Less common words appeared to be more affected by the mismatch (Leskinen 1981: 318-9). Some words have ultimately received nativized spellings in accordance with their pronunciations thereby eliminating the mismatch e.g. <blazer> has become <bleiseri> and <grape>, <greippi>. These results indicate that the orthographic form may influence the harmonic class of the written suffix vowels, as seen in the varying written forms provided by 17MY for kambäkki ‘comback’.

Written re-harmonization errors are interesting in that they may indicate that participants are sensitive to the written conventions that disallow back and front vowels in a non-compound word irrespective of the spoken form or that a participant may pronounce the word in harmonic manner and the pronunciation is interfering with the written form of the word\textsuperscript{111}. An examination of the correlation between written and oral stem harmony, which is discussed in section 5.3.2, suggests that for many speakers the orthographic form is influenced by the spoken form but written harmonization is less frequent than spoken and there is not an exact correlation between the two.

Overall, the written stem harmonization was unexpected but the number of occurrences was not sufficient as to provide much insight. In the vast majority of tokens, no harmonization was observed. While some harmonization is expected if stem harmony is a productive constraint, it may be that harmonization does occur in the phonetic form but is largely unrepresented in the orthographic form due to the standardized spellings and the prescriptive pressures of the written language.

\textsuperscript{111} This type of error would then be very similar to a number of spelling mistakes seen in this study concerning length where the phonetic form overrides the written standard form.
4.4.2 Written Suffixal Harmony

The most striking feature in the examination of the suffixal harmony is that there is so little variation. While Levomäki (1972) did not explicitly discuss whether any subjects wrote multiple allomorphs which may suggest that intra-subject variation either was not observed or was not common, Ringen and Heinämäki’s (1999) study includes many more participants who wrote both allomorphs, dependant on the stem type. However, even for Ringen and Heinämäki (1999), the percentage of both responses was fairly low and reached over 10% of the subjects for only two words. Only when Ringen and Heinämäki (1999) presented the test to the same group of students on two separate occasions did the amount of intra-subject allomorph variation increase substantially for the BF forms. This suggests that the low intra-speaker variation in this experiment may have been due to the respondents undertaking the written component only a single time and more variation may have been uncovered had the participants written the test on more than one occasion.

The suffixation of the BN stems diverged appreciably from the findings of other written studies, which found front-back variation in BN loanwords (Levomäki 1972; Ringen and Heinämäki 1999; Duncan 2011; Kiparsky 2003). Almost exclusively the participants in this study selected the back allomorph for this word type (96.6% B). Though the back suffixes are those which are expected based on the orthographic form, the almost total lack of front suffixes is difficult to reconcile with the results of other studies.

While the results for the FB loanwords are in keeping with those of Ringen and Heinämäki (1999) with near categorical selection of back allomorphs (97.0% B), the results for the BF loanwords differed somewhat from those of some researchers. As in Levomäki (1972), Ringen and Heinämäki (1999), and Kimper (2011) BF loanwords exhibited suffix variation. The height effect whereby the likelihood of affixes surfacing as front increases as the front vowel lowers was also apparent in the experimental data, especially for the trisyllabic BF loanwords. However, the effect of the primary stressed vowel in BF loanwords was somewhat different than the patterning seen for example in Kimper (2011) where, as the height of the back vowel lowers, the percentage of front suffixes lowers. In the results presented herein, the results are not consistent.
The suffixation of the BF disharmonic stems revealed some influence of the prescriptive rule, which states that in disharmonic stems \(<y>\) may be treated as neutral, which had not previously been experimentally studied. As only the behaviour of \(<y>\) is stipulated in the most recent prescriptive rule, discussed in section 2.3.2.2, for those speakers who abided by the normative rule the percentage of back suffixes would be expected to increase for the By words and to remain essentially constant for the other word types, Bä and Bö. The comparison between females who had not been taught the rule and those who had indicated that while all females demonstrated similar behaviour with Bö and Bä stems those who had been taught the prescriptive rules demonstrated a substantial increase in back allomorphs with the By stems, suggesting that their written behaviour had indeed been impacted by the rule. There did not appear to be a similar divergence in the behaviour of the males who had been taught the prescriptive rule though there was a small difference for these participants. Both the females and males who had been taught the prescriptive rule also displayed a slight difference in behaviour with the Bö stems. The overall suffixation patterns for the speakers taught the prescriptive rules correspond to Ringen and Heinämäki’s (1999) and Kimper’s (2011) findings where the percentage of front allomorphs increased as the final vowel lowered.

That the females seemed to follow the prescriptive rule more closely accords with the findings that the older group of females also made greater improvements in both spelling and grammar, as evidenced by their lower numbers of both types of errors. The asymmetry between the effect of the prescriptive rule on females and males may be related to the observation that women are more likely to use the prestigious variant of a stable sociolinguistic variable (Labov 2001: 266).

The apparent influence of the prescriptive rule conflicts with Ringen and Heinämäki’s (1999: 309-10) results where the percentage of front allomorphs increased for six of the nine BF lexical items when participants were instructed to provide the “correct forms, the ones they would use in a formal text”\(^{112}\). It is not clear whether the By loanwords were among those which demonstrated an increase in front suffixes. The increase in Ringen and Heinämäki’s (1999) data

\(^{112}\) As Ringen and Heinämäki (1999) do not specify which six of the nine BF lexical items exhibited the increase in front allomorphs, it is possible that the three By words did not actually demonstrate any increase.
though suggests that, if anything, participants considered the BF-B pattern to be more colloquial and the BF-F pattern more formal, which conflicts with the prescriptive rule that suggests that, at least for By forms, the By-B pattern should be more formal. It is unclear how to resolve these findings.

4.5 Conclusions

In the written portion of this experiment four syllable BN loanwords exhibited unexpectedly little suffixal variation; almost exclusively these were suffixed with back allomorphs in contrast to the results of previous written studies, especially Levomäki (1972), Ringen and Heinämäki (1999), and Duncan (2011), which indicated front allomorphs were possible for many of these lexical items. The explanation for the lack of variation in this experiment as compared with other studies is unclear.

While disharmonic FB stems also displayed a marked preference for back suffixes, as was expected, BF stems were the only stem type to evidence variation. As with previous work, the height of the final front vowel appeared to be relevant in the determination of suffix allomorph. This was especially true for the older females whose allomorph choice appeared to be influenced by the prescriptive rule. Older females were least likely to harmonize stems, exhibited fewer spelling and case errors, and were more likely to conform to the prescriptive suffix rule concerning disharmonic stems indicating that they more closely followed the normative expectations.
The overall results of this study are summarized in Table 4-15 and compared with Experiment 1 and previous research.

**Table 4-15: Allomorph Comparison between Previous Research and Experiment 2-A**

<table>
<thead>
<tr>
<th>Stem Type</th>
<th>Expected Suffix Allomorph Based on Previous Research</th>
<th>Experiment 1 Findings</th>
<th>Experiment 2-A Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>F ~ B</td>
<td>some variation, mostly F</td>
<td>B</td>
</tr>
<tr>
<td>BF</td>
<td>F ~ B (degree of variation dependant on height of front vowel)</td>
<td>mostly F (no height effect)</td>
<td>F ~ B (degree of variation dependant on height of front vowel)</td>
</tr>
<tr>
<td>FB</td>
<td>B</td>
<td>n/a</td>
<td>B</td>
</tr>
</tbody>
</table>

Overall the results indicate a great deal of inter-speaker consistency in the written treatment of loanwords. However, it is as yet unclear whether the written forms accurately represent the spoken forms of the participants. This question will be addressed in Chapter 5.
Chapter 5
Experiment 2-B: Phonetic Responses

While Experiment 1, reported in Chapter 3, examined complete stem harmonization only in BF disharmonic loanwords, stem harmony has not yet been experimentally tested in FB disharmonic loanwords nor has partial harmony been addressed. If harmony is a synchronically productive phonological process, which it clearly has been in the past as it actively eliminated stem harmony violations in older loanwords, it is expected that it should apply regularly to any disharmonic forms. If stem harmonization is not a regular occurrence, then the lack of productivity must be addressed. As the suffixal allomorph selection is crucially dependant on the stem vowels, it is necessary to determine what these vowels are to determine the basis of the suffix allomorph selection.

As discussed in section 2.3.2 previous work has centred mostly on the written suffix selection but also in some cases on the mean F2 values for various types of loanwords. Both written and phonetic studies have indicated that a wide variation in suffix allomorph selection occurs with some polysyllabic BN loanwords (4.2-73.0% F in Levomäki 1972; 0.0-48.0% F in Ringen and Heinämäki 1999; 47-51% F in Välimaa-Blum 1999) though this variation was unexpectedly absent in the written portion of this experiment, discussed in Chapter 4. Written studies by Ringen and Heinämäki (1999) and Kimper (2011) and the written portion of this experiment reveal that FB words in which the final harmonic vowel is back are expected to categorically select back affixes while the suffix allomorph selected for BF loanwords depends partially on the height of the final vowel. A phonetic study though by Mahonen (2011) indicates that suffix allomorphs are most likely to correspond to the final harmonic vowel of the stem in any disharmonic word though By loanwords evidence the greatest amount of variation. The correlation between the written and phonetic forms is not clear though. Are the varying results the consequence of different experimental paradigms, differences in behaviour across different subject pools, or differences in suffixation of written and spoken lexical items?
This chapter discusses the phonetic results of Experiment 2, of which the written results were presented in Chapter 4. Any differences in terms of the participants, materials, and procedures are discussed in section 5.2. The results are then presented and discussed first in terms stem harmony followed by suffix harmony, which includes a comparison of the orthographic and phonetic forms.

5.1 Experimental Purpose

This phonetic experiment examines long BN words and disharmonic FB and BF loanwords with different vowel combinations in an effort to further examine suffix allomorph selection and any effect of vowel height. As this experiment provides both acoustic and orthographic data, the uniformity of the two modes may be examined. Since most of the studies on disharmonic words rely on written output, the assumption is that the words are pronounced exactly as they are written, which is an oft repeated dictum in the literature on Finnish though possible phonetic stem harmonization is sometimes acknowledged (Skousen 1975: 50-2; Välimaa-Blum 1999: 248) and would be expected if stem harmony were a fully productive rule. To my knowledge, this assumption of exact correspondence between the written and phonetic stem vowels has not yet been tested concerning the disharmonic loanwords.

Since the class of the suffix vowel is crucially related to that of the stem vowels, it is important to determine exactly what those vowels are and whether they do, in fact, conform to the orthographic representation. This experiment attempts to examine the correlation between the written and spoken forms of stem vowels in loanwords. Once the stem vowels have been ascertained, then suffix vowels and their relation to the stem vowels can be examined. As well, the correlation between the written and oral suffix vowels may be assessed.
5.2 Methods

5.2.1 Participants

The participants for the analysis of the spoken responses were a subset of those discussed in section 4.2. While the responses of all participants were included in the written portion of the experiment only a subset was included in the acoustic portion to reduce the labour-intensive nature of the experiment. Eight participants, evenly distributed in terms of gender and age, were randomly selected for acoustic analysis for the normal output.

As discussed in section 4.2, the participants all lived in the Savo dialect area (see Appendix 1). During the course of the experiment, it was noted that the participants’ speech exhibited several phonological processes characteristic of the Savo dialects. High vowel lowering in diphthongs (as in käyttää → käöttää and kokeilee → kokeelee) was especially common in both the normal and game readings and resulted in an increase in mid vowel tokens. Another dialectal feature which occurred with somewhat less regularity was the rounding of the stem final [ee] on the verb. This rounding is common to Savo dialects and results in the third person singular present verb forms being realized as tulloo ‘s/he comes’ and käsköö ‘s/he commands’ instead of standard tulee and käskee respectively\(^{113}\) (Skousen 1975: 52). Though there were several dialectal elements present, the speech was clearly not casual dialectal speech. It is perhaps best seen as a local variety of the standard speech. See Suomi et al. (2008: 7) for discussion of local varieties of Standard Spoken Finnish.

5.2.2 Materials

The materials were identical to those presented in Chapter 4. Overall 320 control vowels (see Table 3-2) and 5,523 normal reading vowels (see section 4.2.2) were measured.

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\(^{113}\) Note that the rounding in some cases was also accompanied by backing to conform to harmony requirements. This process is a well-established marker of the Savo dialect.
5.2.3 Procedure

The general experimental procedures were as described in section 4.2.3.

5.2.4 Analysis

The phonetic data was transferred to computer and analyzed using the phonetic software Praat (Boersma and Weenink 2009) and the statistical software programs R (R Development Core Team 2011) and SPSS (IBM Corp. 2011).

For each participant text grids were created with the relevant vowels in the minimal set (see Table 3-2) and all vowel segments in the normal and game readings (see section 4.2.2). Vowels were delineated and transcribed auditorily with some reference to formant structure. In the normal reading participants used some dialectal rather than standard pronunciations and so the orthographic form, which is often assumed to be very close to actual pronunciation, could not be used in lieu of a transcription. See section 5.2 for discussion of the dialectal phonological changes.

For adults the maximum formant ceilings of 5000 Hz for males and 5500 Hz for females are normally assumed while those for children may be much higher. However, as the differences in the formant ceilings for males and females are based on the average differences in vocal tract size and the participants in this experiment were teenagers, some as young as 14, the maximum formant ceilings were determined on an individual basis. In practice they did not differ much from the adult values\textsuperscript{114}.

\textsuperscript{114} In some recent work on vowels (Escudero, Boersma, Rauber, and Bion 2009) formant ceilings are determined individually for each vowel quality which results in less intra-vowel F1 and F2 variation. For example, multiple formant ceilings are used to determine formant values for each vowel quality. When the formant value variation for each vowel is compared, the most appropriate formant ceiling, that which allows for the least amount of formant variation, is chosen for each individual vowel quality for each given speaker. In this way the formant ceilings are ‘emergent’, rather than applied solely on the basis of gender. Though this method is intriguing, in particular for its ability to tighten the vowel spaces, it is not compatible with the experiment’s methodology. The issue is that, if the individual formant ceilings are determined for each vowel quality, difficulty arises when the unknown vowels are to be measured and categorized (see discussion of discriminant analysis to follow). All the unknown vowels would have to be measured using the customary formant ceilings and then the results compared with the known verb
Praat scripts using the Burg algorithm and a window length of 0.025s were run to extract the F1 and F2 values, which represent the height and front-back dimension respectively, at the midpoint of the relevant vowels in the minimal set and all vowels in the normal reading. Those vowels with formant values more than two standard deviations from the formant mean for the given vowel for that speaker based on the control and normal reading verb vowels were re-examined manually to ensure the correct formant values were recorded. As each speaker repeated the set of sentences twice, in total 320 control vowels and 5,523 normal reading vowels were analyzed (2,777 from the females and 2,746 from the males).

To determine the quality of the noun stem and suffix vowels in the normal reading, the control and verb vowels, which were all native or fully nativized, were used as the model with which to compare and classify the noun vowels and the game reading vowels as shown in (26). The control and verb vowels were first analyzed using ANOVAs to ensure that all vowels were statistically distinct on the basis of F1 and/or F2. In SPSS all normal loanword and all game vowels were then categorized (on the basis of F1 and F2) into their optimal native vowel group using discriminant analysis. Discriminant analysis is a statistical technique which is able to classify individual cases into categories based on the values of all members of each class. Essentially the F1 and F2 values of the vowels in the loanwords (and game reading) were compared with the F1 and F2 values of vowels pronounced in the verbs and control words. On the basis of this comparison, the discriminant analysis then classified the noun vowels in terms of vowel quality, allowing for an examination of stem and suffix harmony.

(26) Example of Vowel Classification

<table>
<thead>
<tr>
<th>vowels analyzed for base line values</th>
<th>vowels categorized by discriminant analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>[sano tekin taas...]</td>
<td>[tutkii molekyyliA]</td>
</tr>
<tr>
<td>control vowels</td>
<td>normal reading</td>
</tr>
<tr>
<td>‘Say tekin again’</td>
<td>‘S/he examines the molecule’</td>
</tr>
</tbody>
</table>

vowels which were measured at, likely, very different formant ceilings. Thus it was determined that all vowels would be measured in the same way to increase categorization accuracy.
The verb vowels were also subject to discriminant analysis and this classification of the verb vowels was compared with the author’s auditory classification to evaluate the accuracy of the discriminant analysis. The accuracy of the discriminant analysis is discussed in section 5.3.1.

On the basis of the discriminant analysis classification, orthographically disharmonic loanwords were then examined to determine whether they were phonetically harmonized and, if so, in which direction. All loanwords were examined to determine their phonetic suffix vowel quality. The orthographic and phonetic vowel qualities were then compared.

5.3 Results

The normal reading phonetic responses were examined in relation to both stem harmonization and suffixal harmony. The stem harmonization, discussed in section 5.3.2, is based on the vowel categorization as determined by the discriminant analysis (augmented by the author’s auditory categorization, see section 5.3.1 for details). The suffix harmony, discussed in section 5.3.3, is discussed both in terms of suffix F2 measurements and the discriminant analysis classifications of the suffixal vowels. The suffix vowels are examined assuming both the orthographic stem vowels and the discriminant analysis stem vowels. The discriminant analysis stem vowel classifications allow the suffixes to be compared with the actual phonetic vowels, which may differ from the orthographic representations in cases in which harmonization has occurred. In section 5.3.3.3 the written and oral suffixes are compared. As the discriminant analysis vowel classifications are crucial to several of the analyses, the accuracy of the discriminant analysis is addressed first in section 5.3.1.

5.3.1 Discriminant Analysis

As discussed in section 5.2.4, the discriminant analysis used the control and verb vowels as models for the classification of the loanword vowels. Much of the analysis of the loanwords depends on the accuracy of the discriminant analysis classifications, and the classifications themselves depend upon the distinctiveness of the eight Finnish vowels in the speech of the
participants. This section discusses first the Finnish vowel space and subsequently the accuracy of the discriminant analysis.

The ANOVAs indicated that, for most speakers, all vowels extracted from the control words and verbs were statistically distinct based on F1 and/or F2. Figure 5-1 plots the Finnish vowel inventory in an acoustic F1 x F2 space from the 320 control tVkin vowels and 2,225 normal reading verb vowels, as produced by female (a) and male (b) speakers. Note that in some cases the long and short vowels means overlap.

115 The short front mid vowels [e, ő] of three female speakers were not statistically distinct though they were auditorily distinguishable. Possibly the addition of F3 would have served to distinguish [e] and [ő] more reliably for these speakers. As a result, all mid vowels for these speakers were classified auditorily by the author.
Figure 5-1: Mean F1 and F2 Values (in Hz) of Eight Finnish Vowels Produced by (a) Female and (b) Male Speakers

In terms of relative vowel positions, the male and female charts are very similar. As well, most vowels are in similar relative positions to those seen in other studies (Eerola and Savela 2012;
Iivonen and Harnud 2005; Iivonen and Laukkanen 1993; Palo et al 2012; Wiik 1965) and in Experiment 1.

In Experiment 2-B the formant measurements of all control and verb vowels, many of which were in different prosodic and syllabic environments and adjacent to different consonants, were combined. Without the separate examination of vowels in different positions (stressed, unstressed, medial, final, open, closed syllable), it is impossible to speculate as to what acoustic effect these positions might have had on the vowel formant measurements. As well, there was no control over the consonantal environment which would be expected to exert some co-articulatory influence. The rationale for using all the vowels in the analysis was that the vowels to be classified, those in the nouns and the game reading, also appeared in very disparate positions and so though ideal, it would be impossible to compare vowels only with other vowels in identical environments.

To determine the accuracy of the discriminant analysis, classifications of the verb vowels by the discriminant analysis were compared with the author’s auditory transcriptions. The following three types of unexpected classifications were examined: harmonic vowels classified as the opposite harmonic class; low vowels classified as 
\[e/ee\]; and neutral vowels classified as harmonic vowels. It is important to note that unexpected classifications could result from several different sources. Some coding errors and formant measurement errors are expected. Also, some vowel tokens may be phonologically a certain vowel but, due to coarticulation, may be phonetically within the vowel space of a different vowel resulting in mis-classification. Differences in height were not considered relevant since the significant feature for the purpose of this experiment was backness. Though the vowels were classified into long and short variants by the discriminant analysis, this was also not considered relevant and was taken only as an indication of a more or less peripheral pronunciation of the vowel quality\footnote{While the long vowels are typically somewhat more peripheral, the difference between the long and short variants is only substantial in the high back pair (Iivonen and Laukkanen 1993: 38; Wiik 1965: 37). O’Dell (2003: 73) found that both phonetically shorter vowels and phonologically shorter vowels display centralization in comparison to longer vowels.}.
The rate of misclassifications in the verbs was fairly low. Only 5.8% harmonic vowels were misclassified as the opposite harmonic class, suggesting that the discriminant analysis was quite successful at correctly classifying vowels as front or back harmonic vowels. Overall 2.2% of expected low vowels were misclassified as [e/ee]. Though neutral vowels in diphthongs exhibited less successful classification rates and were frequently misclassified as harmonic vowels, e.g. expected [eu] classified as [öu], monophthongal neutral vowels were well-classified overall. In general these results suggest that the suffix classifications as front or back have an acceptable degree of accuracy and may be accepted as generally valid.

As the suffix vowels follow [i] in most of the test words and the front-back dimension was the most significant factor in their analysis, the degree of coarticulation in this environment was relevant. An examination of the classification of the low vowels in the single verb with a low vowel adjacent to [j], ajatelee ‘s/he thinks’, suggested that while some fronting did occur in the speech of the males, a more substantial amount of fronting occurred with the female speakers. While some coarticulation is expected in this environment it is unclear why females exhibited a greater degree of fronting. Additional work could determine whether females display more coarticulation overall or if the coarticulation was specific to this type of environment or this lexical item.

5.3.2 Phonetic Stem Harmony

There are several questions addressed in this section, which centres on the pronunciation of the stem vowels. The first issue is how the stem vowels are actually pronounced. Are they pronounced as expected based on their orthographic representation or are they altered in some way? A second issue examined is how closely the orthographic representation of the stem provided by the participant matches the acoustic output. This is particularly relevant for the examination of studies which rely solely on orthographic output. As shown in Chapter 4 concerning the orthographic representations associated with this experiment, some participants did harmonize some test words though the vast majority remained orthographically disharmonic. As will be discussed below, the acoustic stem harmonization was more extensive and did not typically correspond to the orthographic forms provided.
To determine whether or not any stems were harmonized the vowel classifications established by the discriminant analysis were examined for each word. As shown in the examples below in (27a) and (27b), progressive and regressive harmonization occurred with both front and back vowels functioning as triggers. As shown in (27c) harmonization was not always complete in the four syllable words; in some cases it extended only to one adjacent vowel.

(27) Examples of Stem Harmonization: Change from Harmonic Vowel to Harmonic Vowel

a. Complete Harmonization - Progressive

bänarit ‘end of relationship’ [bänärei-tä] 5FY
jonglööri ‘juggler’ [jongloori-ä] 7FO

b. Complete Harmonization - Regressive

förskotti ‘an advance’ [forskotti-ä] 6MO
kambäkki ‘a comeback’ [kämbäkki-ä] 23MO

c. Partial Harmonization

konduktööri ‘conductor’ [kondyktööri-ä] 14FY

While harmonization often resulted in a change from one harmonic vowel to another harmonic vowel, in other words it resulted in a change from a harmonic vowel to a neutral vowel, as shown below in (28).

(28) Examples of Stem Harmonization: Change from Harmonic Vowel to Neutral Vowel

a. Lönnrot Finnish folklorist [lennrotti-a] 3MY

b. šarmööri ‘charmer’ [ʃarmeeri-ä] 16MY

The following table examines harmonization by stem type and direction of harmonization. An asterisk indicates complete harmonization in the case of four syllable words. For the four syllable BF words, the BNFN and BBFN words were combined except that their totals are listed
separately under the absolute numbers column with the first number relating to the BNFN words and the second to the BBFN words.

Table 5-1: Stem Type and Direction of Harmonization Based on Discriminant Analysis

<table>
<thead>
<tr>
<th>Stem Type</th>
<th>Total Number of Tokens</th>
<th>Direction of Harmonization</th>
<th>Trigger Vowel</th>
<th>Stem Harmony Changes</th>
<th>Harmonized Tokens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Absolute Number</td>
<td>Percentage</td>
</tr>
<tr>
<td>3 σ BF</td>
<td>256</td>
<td>L → R</td>
<td>B</td>
<td>BF → B</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R → L</td>
<td>F</td>
<td>BF → F</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>BF → BN</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Harmonization</td>
<td></td>
<td></td>
<td>64</td>
</tr>
<tr>
<td>3 σ FB</td>
<td>178</td>
<td>L → R</td>
<td>F</td>
<td>FB → F</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R → L</td>
<td>B</td>
<td>FB → B</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F</td>
<td>FB → FN</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>B</td>
<td>FB → NB</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F</td>
<td>FB → NF</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Harmonization</td>
<td></td>
<td></td>
<td>52</td>
</tr>
<tr>
<td>4 σ BBNF / BBFN</td>
<td>146</td>
<td>L → R *</td>
<td>B</td>
<td>→ BBNB</td>
<td>1 / 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L → R *</td>
<td>B</td>
<td>→ BNNN</td>
<td>9 / 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L → R *</td>
<td>B</td>
<td>→ BBNN</td>
<td>0 / 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R → L *</td>
<td>F</td>
<td>→ FNFN</td>
<td>3 / 0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>R → L</td>
<td>F</td>
<td>→ BFFN</td>
<td>19 / 13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>→ BFNN</td>
<td>0 / 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>→ BFBN</td>
<td>0 / 1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>→ BBNF</td>
<td>1 / n.a.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Harmonization</td>
<td></td>
<td></td>
<td>51</td>
</tr>
<tr>
<td>4 σ FNBN</td>
<td>16</td>
<td>R → L *</td>
<td>B</td>
<td>FNBN → BBNB</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>FNBN → NNBN</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>F</td>
<td>FNBN → FFBN</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Harmonization</td>
<td></td>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

Most cases of harmonization involved harmonic vowels shifting to the opposite harmonic class or front vowels shifting to neutral vowels. That front vowels are disproportionately more likely to become neutral vowels than are back vowels is expected due to the phonetic proximity of the front and neutral vowels as compared with the back and neutral vowels. In all cases the harmonic class of the resultant word was front or back; no repaired words became exclusively neutral and no originally harmonic words became disharmonic.

Overall 29% (174/596) of the orthographically disharmonic tokens were harmonized in speech. All lexical items other than three – blobääri ‘blueberry’, brosyyri ‘brochure’, and styyrpuuri ‘starboard’ – underwent at least one instance of harmonization and for seven lexical items – humööri ‘humour’, jonglööri ‘juggler’, fönari ‘window’, bänarit ‘end of relationship’,...
kuvernööri ‘governor’, sutenööri ‘pimp’, and konduktööri ‘conductor’—the number of harmonized forms was actually equal to or exceeded the number of disharmonic tokens. While there did appear to be some lexicalization, not all the harmonization (or lack thereof) could be tied to word knowledge or use suggesting that harmonization is also related to the phonological properties of the word.

As there is greater symmetry in the number of three syllable words, these will be discussed first and in greater detail. The three syllable words were examined to determine the direction of harmony and the harmonic trigger.

In Table 5-2 below, the percentage of harmonization for BF and FB three syllable disharmonic loanwords is provided, divided into the resultant harmonic class. For both BF and FB words the percentage of harmonization out of the total number of BF or FB words is provided to indicate the frequency of harmonization within the word type. The percentage of harmonization of the total number of BF or FB harmonized words is provided to illustrate the relative incidence of the spread of the front feature vs. the back feature. Those cells which represent progressive harmony are shaded.

**Table 5-2: Stem Harmonization in Tri-Syllabic Words**

<table>
<thead>
<tr>
<th>Resultant Harmonic Class</th>
<th>BF Disharmonic Loanwords</th>
<th>FB Disharmonic Loanwords</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage of Harmonization (of total three-syllable BF words)</td>
<td>Percentage of Harmonization (of total three-syllable FB words)</td>
</tr>
<tr>
<td>Back</td>
<td>18.4</td>
<td>73.4</td>
</tr>
<tr>
<td>Front</td>
<td>6.6</td>
<td>26.6</td>
</tr>
<tr>
<td>Total</td>
<td>25.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

---

<sup>117</sup> Words in which the harmonic vowels changed harmonic class are combined with words in which the harmonic vowels became neutral. Note that the latter may not, strictly speaking, be seen as an example of a particular direction of harmony.

<sup>118</sup> Note that the FB words which harmonized to NF were included here.
Both the direction of spread and the trigger feature value appear to be relevant to stem harmonization. While the BF disharmonic words appear to favour progressive harmonization, there is no such preference amongst the FB words; progressive and regressive harmonization appear to be equally likely. Resultant back words are more frequent amongst the harmonized tokens though only marginally so with the FB loanwords. These findings suggest that [+back] is a stronger harmony trigger.

In an effort to determine if some vowels are more likely to be harmony triggers or targets, the percentages of harmonization for each vowel sequence was examined in three syllable words. In Table 5-3 and Table 5-4 below the first stem vowel is listed in the rows and the second stem vowel in the columns. In some cases the vowel sequence occurs in only a single lexical item whereas in other cases, it appears in two lexical items. For the vowel sequence [ä.u], there are no test words. In each cell, the overall percentage of harmonization for tokens with that vowel sequence is given. In brackets the percentage of harmonized tokens which were back is also provided. Those cells in which 25% or more of the tokens were harmonized are shaded.

**Table 5-3: Harmonization of Three-Syllable BF Disharmonic Words by Vowel Sequence**

<table>
<thead>
<tr>
<th></th>
<th>V2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[y/yy]</td>
<td>[ö/öö]</td>
<td>[ä/ää]</td>
</tr>
<tr>
<td>V1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[u/uu]</td>
<td>12.5% (B 25%)</td>
<td>48.4% (B 100%)</td>
<td>35.3% (B 100%)</td>
</tr>
<tr>
<td>[o/oo]</td>
<td>12.5% (B 75%)</td>
<td>35.5% (B 46%)</td>
<td>0.0%</td>
</tr>
<tr>
<td>[a/aa]</td>
<td>25.0% (B 25%)</td>
<td>31.3% (B 100%)</td>
<td>18.8% (B 83%)</td>
</tr>
</tbody>
</table>

**Table 5-4: Harmonization of Three-Syllable FB Disharmonic Words by Vowel Sequence**

<table>
<thead>
<tr>
<th></th>
<th>V2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[y/yy]</td>
<td>[o/oo]</td>
<td>[a/aa]</td>
</tr>
<tr>
<td>V1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[u/uu]</td>
<td>0.0%</td>
<td>6.3% (B 100%)</td>
<td>24.2% (B 25%)</td>
</tr>
<tr>
<td>[ö/öö]</td>
<td>43.8% (B 86%)</td>
<td>50.0% (B 88%)</td>
<td>43.8% (B 50%)</td>
</tr>
<tr>
<td>[ä/ää]</td>
<td>---</td>
<td>12.5% (B 100%)</td>
<td>64.7% (B 9%)</td>
</tr>
</tbody>
</table>

Certain vowels appeared more susceptible to harmonization. In particular, the mid front rounded vowel [ö/öö] in any position was very likely to harmonize. In most cases where harmonization
occurred this unstable vowel [ö/öö] harmonized to back though the combinations [o-ö] and [ö-a] demonstrated that [ö] could function also as a trigger. Unexpectedly the vowel [a/aa] also appeared somewhat more likely to harmonize when in final position.

As previously discussed, back vowels overall appeared to be stronger triggers than front vowels and most cases of harmonization were to back. Of the back vowels, the vowel [u], when in initial position, appeared to be a strong trigger.

Speaker harmonization rates varied widely with some speakers harmonizing quite extensively and others only very rarely. The harmonization rates by speaker for three syllable words are presented in Table 5-5 below. Those cells in which 25% or more of the tokens were harmonized are shaded.

**Table 5-5: Stem Harmonization of Three-Syllable Words by Speaker**

<table>
<thead>
<tr>
<th>Speaker</th>
<th>3 σ BF</th>
<th>3 σ FB</th>
<th>Total 3 Syllable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentage Harmonized</td>
<td>Percentage Harmonized</td>
<td>Percentage Harmonized</td>
</tr>
<tr>
<td>3MY</td>
<td>12.5</td>
<td>22.7</td>
<td>16.7</td>
</tr>
<tr>
<td>16MY</td>
<td>18.8</td>
<td>45.5</td>
<td>29.6</td>
</tr>
<tr>
<td>6MO</td>
<td>35.5</td>
<td>57.1</td>
<td>44.2</td>
</tr>
<tr>
<td>23MO</td>
<td>12.5</td>
<td>31.8</td>
<td>20.4</td>
</tr>
<tr>
<td>5FY</td>
<td>15.6</td>
<td>18.2</td>
<td>16.7</td>
</tr>
<tr>
<td>14FY</td>
<td>54.5</td>
<td>41.7</td>
<td>41.1</td>
</tr>
<tr>
<td>7FO</td>
<td>46.9</td>
<td>13.6</td>
<td>33.3</td>
</tr>
<tr>
<td>11FO</td>
<td>0.0</td>
<td>4.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Total</td>
<td>25.0</td>
<td>29.2</td>
<td>26.7</td>
</tr>
</tbody>
</table>

Overall, speakers harmonized between 1.8-44.2% of the three syllable disharmonic words. Two speakers, 6MO and 14FY, harmonized almost half of their orthographically disharmonic three syllable tokens while one speaker, 11FO, harmonized only a single token. Neither prescriptive knowledge nor gender appeared to influence overall harmonization rates though the

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119 Only three syllable words were examined to eliminate the issue of partial vs. complete harmonization.

120 11F0 appeared to be a very careful speaker. She used fewer than average dialectal processes in her speech, was one of the few speakers who did not make a single spelling or case error (but neither did 6MO), and her written suffixes were quite closely aligned with the prescriptive rule.
harmonization of BF vs. FB lexical items seemed to be somewhat affected by gender. Males were more likely to harmonize FB words while tolerating disharmony in BF words. No similar pattern was evident for the females.

In Table 5-6 below, extracted from Table 4-6, the disharmonic written forms produced by those participants whose oral output was analyzed acoustically is reproduced below and compared with their oral output. Interestingly, the orthographically harmonized forms are close to at least one spoken token in all cases. The corrected tokens, where participants originally produced harmonized written forms which were subsequently re-written, do not demonstrate the same correspondence with the spoken forms though.

Table 5-6: Examples of Written Stem Harmonization Errors

Complete Stem Harmonization

<table>
<thead>
<tr>
<th>Original Word</th>
<th>Written Form</th>
<th>Written Stem Harmony Changes</th>
<th>Spoken Form</th>
<th>Word Knowledge</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>bänarit</td>
<td>bänärei-tä</td>
<td>FB → F</td>
<td>[bänärei-tä]</td>
<td>known, not used</td>
<td>3MY</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[bänäre-tä]</td>
<td>known, not used</td>
<td>23MO</td>
</tr>
<tr>
<td>jonglööri</td>
<td>jönglööri-a</td>
<td>BF → F</td>
<td>[jönglööri-a]</td>
<td>known, used</td>
<td>23MO</td>
</tr>
<tr>
<td>vulgääri</td>
<td>vulgaari-a,</td>
<td>BF → B</td>
<td>[vulgaare-ä]</td>
<td>unknown</td>
<td>14FY</td>
</tr>
<tr>
<td></td>
<td>vulgaari-in</td>
<td></td>
<td>[vulgeeri-ä]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Partial Stem Harmonization

<table>
<thead>
<tr>
<th>Original Word</th>
<th>Written Form</th>
<th>Spoken Form</th>
<th>Word Knowledge</th>
<th>Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>konduktööri</td>
<td>kondyktööri-ä</td>
<td>[kandyktööri-ä]</td>
<td>known, used</td>
<td>5FY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[konduktööri-ä]</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[kondyktööri-ä]</td>
<td></td>
<td>3MY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[kondyktööre-ä]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Though the orthographic harmonizations are close to some of the actual pronunciations, it must be emphasized that the percentage of oral harmonization is far greater than that of the orthographic harmonization and so written and spoken correspondences are not high when phonetic stem harmonization occurred. That all of these orthographically harmonized tokens have some parallel in the speaker’s phonetic form does seem to indicate that the orthographic form is somewhat influenced by the phonetic form and that the spelling errors are meaningful results rather than simply random errors.

Harmonization in the four syllable words was more complex in that it could either be partial or complete. As well, the words differed in that for some the harmonic vowels were in adjacent syllables while for others a neutral vowel intervening between the harmonic vowels. Depending on the theoretical approach ascribed to though, the vowel \([±\text{back}]\) specifications may be adjacent if neutral vowels are left unspecified.

With the four syllable BF words, of the harmonizations 31.4% (16/51) were complete and 68.6% (35/51) were partial. Of the complete harmonizations, all but three were progressive, triggered by the back vowel. Of the incomplete harmonizations, the opposite pattern occurred; almost all partial harmonizations were regressive, triggered by the front vowel.

With the four syllable FB tokens, all of which were pronunciations of a single lexical item, *följetongi* ‘a serial’, partial harmonizations were much more common and were always progressive, triggered by the front vowel (e.g. *följytongi*). Conversely all complete
harmonizations were triggered by the back vowel though it must be noted there were only two such tokens.

The tendencies are difficult to examine in the four syllable words since the number of four syllable FB tokens is so low. The four syllable BF words though seem to exhibit the same tendency towards progressive harmony seen amongst the three syllable BF words.

While the amount of written stem harmony was insufficient to determine any trends, even though phonetic stem harmonization was overall less common than phonetic stem disharmony, several tendencies could be observed. In general, progressive harmony seems to be the predominant pattern for BF words of both three and four syllables when the resultant harmonization is complete. In these cases the resultant word is back harmonic. For four syllable BF words partial harmonization typically arises from leftwards spreading of the front vowel. Three syllable FB words display both progressive and regressive harmony and the resultant vowel class is approximately equally likely to be either front or back. This may be due to the fact that there are competing pressures for these stems: the spread of the back feature and the preference for progressive harmony.

5.3.3 Phonetic Suffix Harmony

The phonetic realization of the suffixes is examined in two ways, first in terms of F2 and then in terms of the discriminant analysis categorizations. For both F2 and discriminant analysis categorizations the suffixes are examined by stem type first assuming the orthographic representation of the stems and then assuming the phonetic representation of the stem as determined by the discriminant analysis. The former is termed the ‘orthographic stem’ throughout and the latter the ‘phonetic stem’.
5.3.3.1 F2 Values of Suffixes

Statistical analyses are based on mixed-effects modeling using the lmer function in the lme4 package for R (2011). The effects of orthographic stem harmony type, syllable number, and gender on suffix F2 were examined. The optimal model was chosen starting with the full fixed effect structure and reducing the model by dropping the interaction with the lowest coefficient, retaining a factor if p<0.25 by ANOVA test.

Suffix F2 (Hz) value (measured at the vowel midpoint) was the dependant variable and in the final model orthographic stem harmony type (BN, BF, FB), syllable number (3 or 4), gender (female or male), and the interaction between syllable number and gender are fixed effect predictors. By speaker adjustment to harmony type as well as by speaker intercept were random effects. The reference categories are BN for harmony, 3 syllables for syllable number, and female for gender. Table 5-7 below summarizes the model.

Table 5-7: Output for Suffix (F2)

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>St.Error</th>
<th>t-value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1630.213</td>
<td>30.092</td>
<td>54.17</td>
<td></td>
</tr>
<tr>
<td>Harmony FB</td>
<td>-8.057</td>
<td>12.406</td>
<td>-0.65</td>
<td>0.5158</td>
</tr>
<tr>
<td>Harmony BF</td>
<td>158.262</td>
<td>19.858</td>
<td>7.97</td>
<td>&lt;0.0001 ***</td>
</tr>
<tr>
<td>Syllable Number</td>
<td>17.601</td>
<td>12.961</td>
<td>1.36</td>
<td>0.1742</td>
</tr>
<tr>
<td>Gender</td>
<td>-293.559</td>
<td>40.047</td>
<td>-7.33</td>
<td>&lt;0.0001 ***</td>
</tr>
<tr>
<td>Syllable.4:Gender2</td>
<td>20.162</td>
<td>18.066</td>
<td>1.12</td>
<td>0.2630</td>
</tr>
</tbody>
</table>

Significance Code: *** p<0.0001

There is a significant main effect of gender (p<0.0001). As expected, suffix F2 is higher overall in females than in males.

---

121 ANOVAs were considered suitable for the data in Experiment 1 as the data was evenly balanced but see Appendix 4 for comparison with linear mixed effects model. Because the data was unbalanced and displayed some large gaps in this experiment, especially for the phonetic stems, mixed effects modeling was determined to be more suitable.

122 The interaction between gender and harmony was not significant and was not included in the final model.
The model shows a significant difference of BN vs. BF (p<0.0001) though no significant difference between BN and FB. F2 is higher in suffixes appended to BF stems than in suffixes appended to FB stems. The same model with FB as the reference category shows a significant difference between FB and BF (p<0.0001) but no significant difference between FB and BN. Therefore, suffixal F2 is higher in suffixes appended to BF stems than in suffixes appended to BN or FB stems.

The effect of syllable number though was not significant (p=0.1742) which means that, for all stem types, suffix F2 was not different between the three and four syllable stems.

The following chart graphs the mean suffix F2 values by orthographic stem type and gender.

Figure 5-2: Mean Suffix F2 Values (in Hz) by Orthographic Stem Type Produced by Female and Male Speakers
For both males and females, the overall pattern is clear. Those stems with a final orthographic front harmonic vowel are suffixed with vowels with higher F2 values while those with a final orthographic back harmonic vowel are suffixed with vowels with lower F2 values; vowels are more front when appended to BF stems than when attached to BN or FB loanwords. Though the mean F2 for the four syllable BN stems is somewhat higher for both females and males, this difference did not reach statistical significance, as discussed above. Overall, the mean F2 of this stem type indicates that speakers are more likely to suffix these stems with more back vowels.

To determine whether a statistical examination using phonetic stem type rather than orthographic stem type elicited any differences, a similar linear mixed-model regression analysis was performed with the suffix F2 (Hz) value again as the dependant variable and phonetic stem harmony type (BB, BN, BF, FB, FF, FN, N), syllable number (3 or 4), gender, and the interaction between syllable number and gender are fixed effect predictors. By speaker adjustment to intercept is a random effect. The overall picture is largely the same as when the suffixes were examined using the orthographic stems\(^{123}\). See Appendix 6 for the relevant chart. As seen with the orthographic stems, mean F2 values are higher for both males and females when the final stem-harmonic vowel is front and lower when the final stem harmonic vowel is back. For both genders the BN stems have slightly higher mean F2 values than the disharmonic stems with final back vowels. This is especially evident for the males’ suffixes associated with four syllable BN stems. The higher mean F2 value for the four syllable BN stems may denote

\(^{123}\) A significantly different result related to the males’ suffixation of the FN3 stems. The mean F2 for males’ suffix production with FN3 stems is unexpectedly low. Since these stems contain only front and neutral vowels, it would be expected that their suffixes should have a similar mean F2 to that of the BF stems, as is seen with the female FN3 suffixes. Approximately two thirds of these stems were harmonized FB stems. It is possible that some of these stems were misclassified or that the orthographic form of the word interfered with the pronunciation. It is notable though that the behaviour of the males and females are different in these cases, which warrants further examination.

Suffixes appended to trisyllabic FB stems had lower mean F2 values when the stems were examined phonetically. As shown in Table 5-1, 14.1% of the orthographically FB three-syllable stems were actually harmonized to front and would be expected to have suffixes with higher F2 values. When these stems were removed from the FB stem category as they would have been in Appendix 6, the lower mean F2 value may be accounted for.

A puzzling difference is seen with the BN stems. The mean F2 values for the suffixes appended to three-syllable BN stems (males and females) and four-syllable BN stems (males) are higher in the phonetic stem analysis than the orthographic stem analysis. This suggests that some of the orthographically BN stems might have been pronounced as back stems. However, this possibility was not examined and is left for future research.
either of two scenarios; this may be evidence of more centralized suffixes or of variation in suffix F2 values.

As there were seven levels for the harmony type, by changing the reference categories pairwise comparisons were obtained to determine significant differences between stem types. Stem types were compared in pairs to determine which exhibited a higher suffix F2 value allowing for a ranking of the mean suffix F2 values amongst the stem types. The results indicate the following F2 relationships in which a stem type on the left of a greater than symbol has a higher suffix F2 value than the one on the right.

(29) Suffix F2 Relationships Based on Pairwise Comparisons

\[
BF > FN > BN > FB \\
BF > BB \\
FF > FB
\]

The very small number of tokens in the BB, FF, and N categories likely resulted in these categories not reaching statistical significance in their comparison with other categories. The main difference between the analyses using the orthographic and phonetic stems is that the analysis with the phonetic stems did expose the difference in mean suffix F2 values for phonetic BN and FB stems, as shown above in (29). As discussed in section 5.3.2, a certain number of the orthographically FB stems were phonetically harmonized to front stems (14.1% of the three syllable FB loanwords and 0.0% of the four syllable FB loanwords), which may account for the raising of the mean F2 for the FB orthographic stems resulting in the similarity between the F2 means for the FB and BN orthographic stems.

Summarizing the results, both statistical analyses indicate that suffix F2 values are higher when the final harmonic vowel is front than when it is back. Additionally the analysis which utilized the phonetic stems found that the mean F2 value is higher for BN loan suffixes than for FB loan suffixes. These results, higher suffixal F2 values with front-final stems and lower suffixal F2 values with back-final stems, are consistent with the expected harmony assuming that the suffixal vowel corresponds to the final harmonic vowel of the stem.
However, when the mean F2 results for the low vowels as determined by the vowels in control words and verbs are compared with the mean F2 results for the suffixes, the picture becomes somewhat more complex. The chart in Figure 5-2 is reproduced below in Figure 5-3 with lines representing the mean F2 for [ä] and [a] for both males (long dashed lines) and females (short dashed lines).

![Graph showing mean F2 values for suffixes compared to low vowels](image)

**Figure 5-3: Mean Suffix F2 Values (in Hz) by Orthographic Stem Type Compared to Mean Low Vowel F2 Values (in Hz)**

When examined alongside the means for the phonologically front and back short low vowels, a different pattern emerges. For females, all the mean suffix vowels are clearly closer to the mean for [ä] than to the mean for [a]. Though those suffix vowels which are appended to front-final stems have higher mean F2 values and those which are appended to back final stems have lower
mean F2’s, both are approximately equidistant from the mean [ä] line as well as being quite removed from the mean [a] line.

For the males, the means for the suffix vowels appended to front harmonic vowel final stems are very close to the mean for [ä] while the means for the back harmonic vowel final stems are near the midpoint between the means for [ä] and [a]. These means are neither clearly front nor clearly back. Whether these central means are indicative of suffix vowels which are actually central vowels, neither front nor back, or if they are the result of the averaging of some front and some back vowels is not explained by this chart. To resolve these two competing possibilities, each individual token must be individually analyzed.

5.3.3.2 Discriminant Analysis Suffixes

The discriminant analysis was used to classify the suffix tokens which were then examined in relation to the orthographic stem types followed by the phonetic stem types. The following charts in Figure 5-4 graph the suffix discriminant analysis (DA) classification, front vs. back, by orthographic stem type. In the graphs the stem types based on the orthographic form and syllable number are listed above the columns. For each stem type, the proportion of back suffixes and front suffixes are illustrated.
Examining first the male patterns, for all categories there are more front allomorphs than expected. For the first two stem types, which are disharmonic BF stems, it was expected that there would be significant suffix variation based on the height of the final front vowel, especially for the trisyllabic words. However, a strong majority of the suffixes were front and the expected suffix variation based on height which was clear in many orthographic studies (e.g. Ringen and Heinämäki 1999; Kimper 2011) was not seen here. While the four syllable BN stems are expected to evidence some suffixal variation, the three syllable BN stems are not, considering this word type has no front harmonic vowels and is too short to undergo a pseudo-compound
analysis. The expected variation was somewhat greater than expected for the four syllable BN stems and was very unexpectedly higher for the three syllable BN stems. The occurrence of front suffixes is also unexpected with the FB stems, which have not previously been reported to exhibit variation and are expected to suffix exclusively with back allomorphs in agreement with the final back vowel.

Comparing the behaviour of the males and females, though the patterns are similar, females use even more front allomorphs for all stem types except the four syllable BF stems, which already had an extremely high proportion of front allomorphs in the speech of the males. In fact, the preponderance of front allomorphs is such that female speakers have an unexpected majority of front suffixes for all word types. Overall the main differences between the behaviour of the females and the males lay in their treatment of the three syllable BN words and the FB disharmonic words though these differences were more of quantity than quality.

A logistic mixed-effects model was performed to determine how categorical suffix selection as determined by the discriminant analysis is affected by orthographic stem category, syllable number, and gender. Suffix value (front vs. back, with back as the reference category) was the dependant variable and orthographic stem harmony type (BN, BF, and FB), syllable number (3 or 4), gender, and their interactions fixed effect predictors. By speaker adjustment to intercept is a random effect. Table 5-8 summarizes the output.

Table 5-8: Output for Suffix (DA)

|                  | Estimate | Std. Error | z value | Pr(>|z|) |
|------------------|----------|------------|---------|----------|
| (Intercept)      | 1.84620  | 0.89956    | 2.052   | 0.0401 * |
| harmFB           | -0.74424 | 0.51927    | -1.433  | 0.1518   |
| harmBF           | 2.64486  | 0.62737    | 4.216   | <0.0001 *** |
| Syllable.4       | -0.24066 | 0.65988    | -0.365  | 0.7153   |
| Gender2          | -2.02816 | 1.22314    | -1.658  | 0.0973 ° |
| harmFB:Syllable.4| 2.32824  | 1.46574    | 1.588   | 0.1122   |
| harmBF:Syllable.4| 0.04046  | 0.96941    | 0.042   | 0.9667   |
| harmFB:Gender2   | 0.19836  | 0.64595    | 0.307   | 0.7588   |
| harmBF:Gender2   | 0.02456  | 0.76255    | 0.032   | 0.9743   |
| Syllable.4:Gender2| 0.88671  | 0.81659    | 1.086   | 0.2775   |
| harmFB:Syllable.4:Gender2| -2.81563 | 1.74869    | -1.610  | 0.1074   |
| harmBF:Syllable.4:Gender2| 1.37071  | 1.52402    | 0.899   | 0.3684   |

Significance codes: *** 0.001 ** 0.01 * 0.05 ° 0.1
The model shows a significant main effect of Harmony BF (<0.0001) and marginal significance of gender (p=0.0973). While BN and FB stems appear to pattern similarly in allomorph selection tending to choose more back suffixes, BF stems tend to select front allomorphs. As was seen in Figure 5-4 above, males are more likely to select back suffixes than are females though this effect is marginal statistically. Again, no significant effect of syllable was found.

The discriminant analysis suffixes were also examined on the basis of the phonetic stem types, as shown in Appendix 7. For the females the results are near identical to those for the orthographic stems. While the percentage of back suffixes in the three syllable FB stems has risen slightly as has the percentage of front suffixes in the three syllable BN stems, the differences are minimal.

The males’ results differ somewhat from their results with the orthographic stems though again the differences are minimal. The percentage of front allomorphs has increased slightly for the BN stems, the three syllable BF stems, and the four syllable FB stems while the percentage of back allomorphs has increased slightly for the four syllable BF stems and the three syllable FB stems. Unexpectedly the three syllable FN stems, which were phonetically harmonized orthographically disharmonic stems, evidenced an unusually high percentage of back suffixes. Like the three syllable BN stems, these stems are expected to suffix exclusively with the suffix corresponding to the harmonic vowel of the stem. Unlike the three syllable BN words, the three syllable FN words are orthographically disharmonic and it is possible that the orthography is influencing the suffix production.

To determine whether the categorical suffix selection statistical results are different when examined using the phonetic stem category instead, a logistic mixed-effects model fit by the Laplace approximation was performed. Suffix value (front vs. back as determined by the discriminant analysis) is the dependant variable and phonetic stem harmony type (BB, BN, BF, FB, FF, FN, N), syllable number (3 or 4), and gender are fixed effect predictors. By speaker adjustment to intercept is a random effect.

Gender was not found to be significant though syllable count was found to be significant (p=0.0065) with more front suffixes occurring with four syllable stems.
As there were seven levels for the harmony type, pairwise comparisons were obtained to determine significant differences. The results indicate that BF stems have more front responses than FN stems, which in turn have more front responses than both BN and BB stems. BN stems have more front responses than do FB stems. The relationships are summarized as follows:

(30) Suffix Discriminant Analysis Relationships Based on Pairwise Comparisons

\[ BF > FN > BN > FB \]

\[ BF > FN > BB \]

The very small number of tokens in the FF and N categories likely resulted in these categories not reaching statistically significance in their comparison with other categories. Again, these results are both similar to those with F2 as the dependant variable and are in the expected directions.

5.3.3.3 Comparison of Written and Spoken (Discriminant Analysis) Suffixes

The correspondence between a given speaker’s written and spoken outputs are of interest in that many studies rely exclusively on the written form, assuming that Finnish has a close correspondence between the written and phonetic forms. This section examines the degree of correlation between these two mediums in this experiment.

In Table 5-9 below the correspondences between participants’ written and spoken suffixes are examined. As discussed in section 4.2.3 each participant affixed each lexical item once in the written task and typically twice in the spoken task. The oral suffixes in the table below are based on the discriminant analysis categorizations and are compared with the written forms provided by each participant. For a given lexical item, if the associated suffixes were pronounced

\[ \text{As some participants repeated certain lexical items, a given participant may have more than two oral productions of any given lexical item.} \]
consistently in terms of the suffix’s harmonic category, they were treated as F (front) or B (back). Stems which varied in terms of their suffix realization were classified as ~ and those for which no harmonic oral suffix was produced were classified as Ø. For example, while male participants near categorically suffixed three syllable BN loanwords with back allomorphs in the written task, the discriminant analysis classified many of the spoken suffixes as front resulting in a mismatch between the written and oral forms. Of the total three syllable BN loanwords 21.4% exclusively received front oral suffixes, 32.1% received back oral suffixes, and an additional 42.9% varied in the allomorph category, according to the discriminant analysis. Note that none of the participants selected for acoustic analysis provided any examples of written variation. Shaded cells indicate cases in which the written and phonetic suffix forms are equivalent.

Table 5-9: Correspondences between Written and Spoken Suffixes by Gender (%)

<table>
<thead>
<tr>
<th></th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Written Suffix</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F        B        Ø</td>
<td>F        B        Ø</td>
</tr>
<tr>
<td>BN Stems</td>
<td>3 Syllables</td>
<td>DA Suffix</td>
</tr>
<tr>
<td></td>
<td>F        21.4</td>
<td>60.7</td>
</tr>
<tr>
<td></td>
<td>B        32.1</td>
<td>21.4</td>
</tr>
<tr>
<td></td>
<td>~        42.9</td>
<td>14.3</td>
</tr>
<tr>
<td></td>
<td>Ø        3.6</td>
<td>3.6</td>
</tr>
<tr>
<td></td>
<td>4 Syllables</td>
<td>DA Suffix</td>
</tr>
<tr>
<td></td>
<td>F        6.3</td>
<td>37.5</td>
</tr>
<tr>
<td></td>
<td>B        6.3</td>
<td>18.3</td>
</tr>
<tr>
<td></td>
<td>~        31.3</td>
<td>6.3</td>
</tr>
<tr>
<td></td>
<td>Ø        3.6</td>
<td>3.6</td>
</tr>
<tr>
<td>BF Stems</td>
<td>3 Syllables</td>
<td>DA Suffix</td>
</tr>
<tr>
<td></td>
<td>F        60.9</td>
<td>17.2</td>
</tr>
<tr>
<td></td>
<td>B        1.6</td>
<td>1.6</td>
</tr>
<tr>
<td></td>
<td>~        4.7</td>
<td>7.8</td>
</tr>
<tr>
<td></td>
<td>Ø        1.6</td>
<td>3.1</td>
</tr>
<tr>
<td></td>
<td>4 Syllables</td>
<td>DA Suffix</td>
</tr>
<tr>
<td></td>
<td>F        86.1</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>B        5.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>~        2.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ø        2.8</td>
<td></td>
</tr>
<tr>
<td>FB Stems</td>
<td>3 Syllables</td>
<td>DA Suffix</td>
</tr>
<tr>
<td></td>
<td>F        2.4</td>
<td>7.3</td>
</tr>
<tr>
<td></td>
<td>B        4.9</td>
<td>68.3</td>
</tr>
<tr>
<td></td>
<td>~        14.6</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>Ø        4.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 Syllables</td>
<td>DA Suffix</td>
</tr>
<tr>
<td></td>
<td>F        25.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B        75.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>~        25.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ø        25.0</td>
<td></td>
</tr>
</tbody>
</table>
Though the correspondences are fairly good for certain categories, such as the male speakers’ four syllable BF stems in which there was an 86.1% correspondence, in general the correlations were lower than expected from a language such as Finnish with a shallow orthography. The correspondences were highest for those stems that orthographically require front suffixes. These higher rates were not due to the fact that these stem types displayed a greater correspondence per se but occurred instead because most speakers produced a high proportion of front oral allomorphs, which then happened to coincide with the normative written forms in these stem types.

While some speakers, such as 16MY and 6MO, demonstrated fairly high overall correlations (81% and 72% respectively), most had lower rates of correspondence. In particular one speaker, 7FO, had an extremely low correspondence rate of only 17%. Overall, males appeared to be likely to have higher correspondences, which is expected since overall the females produced more front spoken allomorphs. The older females, who were more likely to apply the prescriptive rule concerning the BF disharmonic loans in writing thereby increasing the number of written back allomorphs, displayed the lowest degree of correlation between their written and spoken forms.

5.4 Discussion

In this section the results are discussed first in terms of the phonetic stem harmonization in section 5.4.1 and then subsequently in terms of the suffix F2 values and discriminant analysis categorizations in section 5.4.2. Finally, the implications of the correspondences between the spoken and suffix realizations are discussed in section 5.4.3.

5.4.1 Stem Harmony

Previous studies have assumed that the disharmonic stem vowels are pronounced as they are written without explicitly verifying that assumption (e.g. Ringen and Heinämäki 1999; Kimper 2011; Mahonen 2011; Välimaa-Blum 1999). While stem harmonization is known to have
occurred in the past and has been suggested as a synchronic possibility in some cases (see section 2.3.1 for details), to my knowledge no studies of the process of harmonization, including the direction and potential triggers, have been undertaken. As a result, little is known about the actual process of harmony: does it occur synchronically and, if so, how? In this experiment, in which the assumption that orthographic and phonetic vowels are equivalent in disharmonic stems was explicitly tested, some stem harmonization was found though it was not as extensive as might be expected from a fully active, robust phonological process.

While some degree of stem harmonization was much more common in the spoken forms than the written forms, it still occurred only 25.0-43.8% of the time, depending on the stem type and syllable count. However, much of the apparent harmonization amongst the four syllable words was partial; complete harmonization occurred in 11.1% of the four syllable BF words and 12.6% of the four syllable FB words. Still, that complete harmonization occurred even to this degree (11.1-29.2%) in this study illustrates that harmonization is a process which does occur synchronically and must be acknowledged in studies of the disharmonic loanwords. The quality of the stem vowels is of utmost importance in examinations of suffixal harmony and those studies which do not verify the actual stem vowels may wrongly classify stems resulting in potentially inaccurate results.

The complete harmonization results, shown below in (31), support Wiik’s (1965: 51) statement that speakers have greater difficulty pronouncing disharmonic vowels which occur within a stress unit, which is typically a disyllable, and are therefore more likely to regularize harmonic violations within a disyllable than disharmonic vowels within adjacent disyllables\textsuperscript{125}. The four syllable words in which harmonization necessarily occurred across a boundary displayed substantially less harmonization than did three syllable words.

\textsuperscript{125} Note though that Wiik (1965: 51) treats the trisyllabic word \textit{pom.pöö.si} ‘pompous’ as comprising two stress units [pom] and [pöösi].
Average Percentage of Complete Harmonization in Different Stem Types

a. Three Syllable BF 25.0
b. Three Syllable FB 29.2
c. Four Syllable BF 11.1
d. Four Syllable FB 12.6

Even though the rates of harmonization seen in Experiment 2-B are fairly low, they are still much more extensive than was seen in Experiment 1, discussed in Chapter 3, in which harmonization was exceedingly rare and was largely confined to the speech of the young female speaker. The apparent lack of harmonization in Experiment 1 may have related in part to the method of analysis; while partial harmonization was considered in this experiment and was, in fact, the more common type amongst the four syllable words, it was disregarded in Experiment 1. As well Experiment 1 examined only four syllable BF loanwords. The percentage of complete harmonization in Experiment 2-B in this word type was only 11.1%, which, while still greater than that seen in Experiment 1, is much more similar. An additional factor may have been differences in the participant groups. As was demonstrated in Table 5-5, there was a great deal of inter-speaker variation in the amount of demonstrated harmonization. It is possible, particularly with the small participant group in Experiment 1, that the lack of harmonization may also relate to the particular speakers’ idiosyncratic likelihood of harmonization.

In terms of the actual process of harmonization, several theoretical possibilities are available. The resultant harmonic class of vowels may be dependent upon the class of the vowel in the initial, stressed syllable, the metrically strongest position in the stem. Spreading from the initial vowel would also allow for progressive harmonization, which is the direction of harmony in Finnish. As vowels are sometimes assumed to have varying harmonic strengths in relation to their strength as a trigger for suffixal harmony, it is also possible that different vowels may vary in their stem harmonic strength with some more likely to serve as triggers and others as targets of harmonization.
Overall, progressive harmony seems to be the predominant pattern for BF loanwords of both three and four syllables when the resultant harmonization is complete. In these cases the resultant word is back harmonic. However, harmonization does not always propagate from the stressed vowel, as was suggested by Skousen (1975: 52). Three syllable FB words display both progressive and regressive harmony at comparable levels. In these cases the resultant vowel class is approximately equally likely to be either front or back.

The results suggest there are competing pressures: the preference for progressive harmony and the strength of the [+back] feature. The progressive nature of stem harmonization accords well with the native harmony process which is root-controlled and progressive. The strength of the [+back] feature may relate to inherent phonetic/phonological characteristics such as markedness or may be partially due to the structure of the Finnish lexicon in which back vowel phonemes have greater frequency than front vowel phonemes (Hakulinen 1961: 5; Hakulinen et al. 2005: 43; Karlsson 1982: 75). When progressive harmony and the spread of the [+back] feature converge, as they do in BF disharmonic words, harmonization is most common.

Though certain vowels may be more likely targets, the stem harmonization facts do not support the suggestion that low vowels are better harmony triggers due either to their sonority or their perceptual impoverishment nor that high vowels are better targets (Kimper 2011: 192; Ringen and Heinämäki 1999: 320).

The tendencies are more difficult to examine in the four syllable words since there were many instances of partial harmonization and the number of four syllable FB tokens is so low. Overall though, the four syllable BF words seem to exhibit the same tendency towards progressive harmony seen amongst the three syllable BF words. Again, this may be related to the strength of the back vowels as triggers. The partial harmonization which occurred with four syllable BF

126 Skousen (1975: 51-2, 54) suggested that speakers could also maintain the non-initial stress of the donor language and stress could then propagate from that syllable. Though stress was not examined in this study this explanation is not available for all instances of regressive harmonization. In some cases speakers did not know the given word yet still harmonized regressively e.g. 14FY’s pronunciation of the unknown word <förskotti> ‘custom’ as [forskotti].

127 Note that Kimper’s (2011: 192) and Ringen and Heinämäki’s (1999: 320) claims were in relation to suffixation.
words typically arose from leftwards spreading from the front vowel. That the expected phonological harmony process is instead progressive and that this is incomplete indicates that these forms are subject not to phonological harmonization but instead to anticipatory phonetic assimilation. Support for this analysis is Hyman’s (2002) observation that phonetic vowel coarticulation is typically anticipatory. Treating the partial harmonization as a distinct phonetic process drastically reduces the overall amount of harmonization amongst the four syllable stems, as seen in (31).

Though some lexical items did demonstrate a greater degree of harmonization, which may indicate some degree of lexicalization, harmonization does not appear to be confined to only a few lexical items and may occur also with words that are unknown to the speaker e.g. 7FO’s pronunciation of the unknown word <kutyymi> ‘custom’ as [kutuumi]. While some of the harmonizations may therefore be fossilized pronunciations for certain lexical items, others must be seen as the result of some active phonological process operating to eliminate stem harmony violations. Based on these results the determination of whether stem harmony is seen as a robust synchronic process or as an analogical remnant of a previously productive process is difficult to resolve. The low overall degree of complete harmonization shown in (31) indicates that harmony may not be strongly active but is suggestive that some degree of harmonization occurs, possibly based on resemblance to the mostly harmonic lexicon. Fully productive vowel harmony processes might be expected to operate near exceptionlessly or at least to a greater degree than seen here. However, the influence of the orthography cannot be ignored and may have encouraged speakers to maintain the disharmonic forms in accordance with the written forms in spite of the violation of stem harmony.

Although harmonization was not as common as might be expected from a robust phonological process, it did occur often enough to illustrate the need for phonetic confirmation of stem vowels in discussions of harmony. This lack of correspondence between the written and spoken forms is not confined to vowels but has been observed with consonants as well. In the past, foreign consonants were replaced with native segments or clusters e.g. Swedish kaffe → Finnish kahvi ‘coffee’ (Campbell 1998: 61). Synchronically though the graphemes may be maintained in the orthographic forms some speakers, depending on various sociolinguistic factors may still replace these segments with native consonants and/or clusters (Suomi et al. 2008: 35-36, 56, 59). In
Experiment 1 described in Chapter 3 the sole monolingual speaker, an older woman, often substituted similar native segments for the foreign segments, as shown in (32a) and reduced consonant clusters, as shown in (32b). Mahonen (2011: 48) also noted that older speakers in her experiment occasionally substituted native phonemes for foreign ones and reduced initial clusters.

(32)  Online Adaptation of Consonants in Loanwords

   a. Substitution of foreign consonant:   atmosfäärri → [atmosʃääri]

   b. Simplification of foreign cluster:   krokiilili → [rokotilili]

Leskinen (1981: 319-322) found that consonant gemination was also not reliably represented in the orthographic forms of Anglicisms. These examples, alongside the examination of phonetic stem harmony, suggest that orthographic forms may be insufficient for the examination of many types of phonological processes, not only harmony.

5.4.2 Suffixal Harmony

Overall, the statistical analyses with F2 as the dependant variable and the categorical vowel classification as the dependant variable both demonstrate statistically significant tendencies for suffixes to be more front when appended to a stem in which the final harmonic vowel is front than when it is back. There are also tendencies for BN stems, both three and four syllables in length, to be appended with more front suffixes than FB disharmonic stems. However, though the tendencies are in the correct direction, many more stems were affixed with front harmonic suffixes than was expected according to the harmony rules.

In the discriminant analysis categorization of the suffix vowels both female and male speakers treated BF stems differently than BN and FB stems, with the former receiving a very high percentage of front allomorphs and the latter stem types exhibiting greater variation. The relatively high percentages of front allomorphs for both genders and all stem types were unpredicted.
Based on both the orthographic and phonetic stem types, females suffixed all stem categories with front allomorphs a majority of the time though different stem types had varying front-back ratios. Though the suffixation of the BF stems was near categorical, the disharmonic BF stems do not appear to behave in a completely identical manner to those words which are expected to suffix exclusively with front allomorphs; there was a small amount of allomorph variation with the BF stems which was not seen with the harmonized FN stems. This suggests that there may potentially be some uncertainty concerning these suffixes.

Although the disharmonic BF stems, in particular those which were trisyllabic, were predicted to exhibit variation based on the height of the final harmonic vowel, very few back allomorphs were actually produced with these stems and there appeared to be no relation between the vowel height and allomorph choice. The high proportion of front allomorphs was especially unexpected for the disharmonic FB stems and the three syllable BN stems, both of which were expected to suffix exclusively with back suffixes.

Male speakers also had an unexpectedly high percentage of front allomorphs though generally lower than those of the female speakers. While the allomorphs appended to orthographic BF stems were predominantly front, those of the orthographic FB and three syllable BN stems were predominantly back, and those of the four syllable BN stems were close to equal. When the stems were examined according to their phonetic realizations the three syllable BN and four syllable FB stems increased in the percentage of front allomorphs resulting in a fairly even distribution between the front and back forms.

The examination of the F2 suffix allomorph means indicated that, for both males and females, the mean F2 of suffixes appended to BF disharmonic words was significantly higher than the mean F2 of suffixes appended to BN and FB words. This would seem to indicate that the BF words were suffixed with front allomorphs while the BN and FB words were suffixed with back allomorphs. However, a comparison with the means of the low vowels [ä] and [a] demonstrated that for females the suffix means for all the stem types are closer to the front [ä] mean with the expected front suffix means being substantially higher than the [ä] mean and the expected back means somewhat lower. For males the expected front suffix means were very close to the [ä] mean while the suffix means for the BN and FB stems were neither clearly front nor back.
Therefore while the BF suffixes appear to be unequivocally front for both females and males, the phonological category of the BN and FB suffixes is ambiguous. Since the binary distinction between the suffixes appended to the BF stems vs. the BN and FB stems is statistically significant, it is possible that the suffixes are phonologically front and back and the high mean F2 values are merely due to phonetic coarticulation. Tokens with higher than expected mean F2s could then, mistakenly, have been classified as front allomorphs by the discriminant analysis resulting in the unexpectedly high percentages of front allomorphs in the discriminant analysis classification.

While the comparison vowels were extracted from many disparate environments the suffix vowels were always word final normally following [i] but in a some few cases following [t], both positions which likely would have produced some degree of fronting. The only verb used in the experiment with a similar environment, ajattelee ‘s/he thinks’, also exhibited fronting, especially in the speech of the females, providing support for the influence of coarticulation. If the fronting of the suffix vowels is related to coarticulation, it is unclear though why it appears to be more extensive in the speech of the female speakers, as evidenced both by the more extensive fronting in ajattelee ‘s/he thinks’ and the higher mean F2 suffix values relative to the low vowel means as produced by females.

To determine whether the fronting was due to coarticulation the individual productions of all eight speakers were examined and each speakers’ suffix vowels were compared to their stem [ä/ää] and [ä/aa] vowel realizations. If the vowels display the expected suffixal harmony, the suffix vowels are predicted to maintain a front-back distinction where those suffixes associated with BF words are more front and those associated with BN and FB words are more back. The coarticulation would result in phonetic realizations produced somewhat farther front than the stem front and back vowel tokens.

The phonetic realizations of many speakers conformed to these expectations (see Appendix 8 for results for all speakers). The productions of speaker 16MY are provided below as an example of this type of speaker. As shown in Figure 5-5, although there are some instances of vowels which are realized either farther front or back than expected, overall the low stem vowels are clearly distinct for this speaker with the division between the two categories at approximately 1350 Hz.
An examination of the suffix vowels for the same speaker, shown in Figure 5-6, demonstrated that although the suffix vowels demonstrated some degree of fronting as compared with the stem [ä/ää] and [a/aa] vowels with the division between the two suffix vowels slightly closer to 1400 Hz and most back allomorph realizations farther front than the stem back vowels, the coarticulation was not substantial enough to cause overlap and the front and back suffix categories were discrete. Most suffixes could be clearly classified into front and back vowels which corresponded to the stem class with front allomorphs appended to BF stems and back allomorphs to BN and FB stems.
Figure 5-6: Suffix Vowels Appended to Loanwords as Produced by Speaker 16MY

However, not all speakers exhibited unambiguously discrete front and back suffix allomorphs. The productions of speaker 7FO serve as an illustration. Although there is a minimal amount of overlap, this speaker, like 16MY, produces distinct front and back low vowels in the native stems with the division between [ä/ää] and [a/aa] at just over 1500 Hz, as shown in Figure 5-7.\(^{128}\)

\(^{128}\) Note that, as shown in Appendix 8, some of these speakers have a greater degree of stem vowel overlap than speaker 7FO.
Figure 5-7: Low Vowels in Native Stems as Produced by Speaker 7FO

However, the same speaker’s suffix vowel realizations, shown in Figure 5-8, demonstrate that almost all of her suffix vowels are produced with F2 values greater than 1500 Hz situating them within the same phonetic space as the front low stem vowel [ä/ää]. Though the suffixes appended to the BF loanwords are typically somewhat farther front, the realizations of the suffix vowels do not display discrete front and back categories as seen in the speech of speaker 16MY, shown in Figure 5-6. Speaker 7FO appeared to generally suffix all stem types with front allomorphs.
As speaker 7FO had distinct low vowels in the native stems, as shown in Figure 5-7, any lack of definite \([ä/ää]\) and \([a/aa]\) suffix categories could not be seen as a general low vowel merger. This behaviour is specific to the suffix vowels.

Though all eight speakers typically suffixed BF stems with front allomorphs, the treatment of BN and FB stems exhibited inter- and intra-speaker variation. While not exceptionless, there appeared to be gender-based patterning with females tending to display ambiguous suffixation patterns similar to Figure 5-8 and males, discrete patterns similar to Figure 5-6. For graphs illustrating the phonetic realization of the stem low vowels and suffix vowels for all speakers, see Appendix 8.

As all of the suffix vowels appeared in the same \(i_#\) or \(t_#\) environment the two behaviour patterns exemplified by Figure 5-8 and Figure 5-6 could not be based on coarticulation. While coarticulation appeared to produce some fronting for all speakers, which in some cases may have been sufficient to cause (mis)categorization as a front allomorph, it cannot be seen as the sole cause of the high percentages of front allomorph categorizations. To assume that the high percentages of front allomorphs are due only to coarticulation would require some explanation of why some speakers exhibit a substantial amount of coarticulation while others remain largely
impervious. As well, for some speakers, such as 7FO, the suffix allomorph patterns are ambiguous and cannot be treated as distinct front and back categories.

The phonetic results then seem to indicate that the BN and FB stems demonstrated inter- and intra-speaker suffix variability, which was not seen with the BF stems. Even those word types which have not previously been reported to demonstrate variation displayed allomorph variation in this data. The stem type which was perhaps the most surprising was the tri-syllabic BN stems which were often suffixed with front allomorphs, e.g. *atelje-tä* ‘atelier (part.)’. This was unanticipated because these words are too short to be analyzed as pseudo-compounds. However, Kiparsky (2003: 140 note 22) has suggested words of this type may retain latent accents based on primary stress in the donor language which may initiate a new harmonic domain. However, in some cases trisyllabic BN words were suffixed with front allomorphs even when the speaker did not know the word and so could not have access to any underlying latent accent e.g. 14FY’s pronunciation of the unknown word *<puustelli>* as [puustelli-ä] ‘type of official residence (part.).’

Moreover, as shown in (33) below, while several of the words tested do have primary stress on a neutral syllable the donor language, others do not and the difference does not appear to be relevant to the percentage of front allomorphs, as determined by the discriminant analysis.

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129 Note that *puu* is a common word meaning ‘wood, tree’ which might suggest a potential compound to a speaker. However the remaining section of the word, *stelli*, is not an existing word and also violates Finnish phonotactics with the initial consonant cluster.
(33) **Original Stress Patterns for Trisyllabic BN Loanwords**

<table>
<thead>
<tr>
<th>Finnish</th>
<th>Donor Language</th>
<th>Original Stress</th>
<th>% F</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. aprilli</td>
<td>Swedish</td>
<td>apríl</td>
<td>69%</td>
</tr>
<tr>
<td>b. ateljee</td>
<td>Swedish</td>
<td>ateljé</td>
<td>50%</td>
</tr>
<tr>
<td>c. graffiti</td>
<td>Swedish or English?</td>
<td>graffíti</td>
<td>50%</td>
</tr>
<tr>
<td>d. puustelli</td>
<td>Swedish</td>
<td>bóstålle</td>
<td>75%</td>
</tr>
<tr>
<td>e. muffinssi</td>
<td>Swedish or English?</td>
<td>múffins or múffin</td>
<td>69%</td>
</tr>
<tr>
<td>f. hobitti</td>
<td>English?</td>
<td>hóbbit</td>
<td>50%</td>
</tr>
<tr>
<td>g. hostelli</td>
<td>English?</td>
<td>hóstel</td>
<td>50%</td>
</tr>
</tbody>
</table>

Thus there is no available phonological account which predicts their behaviour.

The exceptional number of front suffixes seen in this experiment which, in some cases is associated with a harmony mismatch between the stem and suffix vowels, is its most salient result. While the fronting may have its origins in coarticulation, phonetics alone cannot explain why some speakers maintain discrete front and back suffix categories which are only slightly fronted while other speakers allow such a degree of fronting that the back suffix vowels overlap with the front vowels. Perception studies would be useful to determine how listeners classify such vowels.

When the rates of stem harmonization (see Table 5-5) were examined for those speakers such as 7FO with ambiguous suffixal harmony and those such as 16MY with robust suffixal harmony, it was apparent that there was no correlation between the two. For example, speakers 3MY and

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130 Stress patterns for Swedish words provided by Johan Gross (p.c. Nov. 9, 2014).
5FY displayed identical low rates of stem harmonization (16.7% of trisyllabic orthographically disharmonic stems) but only speaker 3MY produced discrete front and back suffix vowels. Speakers 16MY and 7FO both had high levels of stem harmonization in the trisyllabic orthographically disharmonic stems (29.6% and 33.3% respectively) but while speaker 16MY evidenced clear suffix allomorphs, speaker 7FO displayed indistinct suffix categories. In Table 5-10 where the stem and suffix harmony rates are compared for each speaker, a speaker is assumed to have stronger stem harmony if they harmonized over 25% of the three syllable words and stronger suffix harmony if they demonstrated discrete front and back suffix allomorphs.

**Table 5-10: Comparison of Stem and Suffix Harmony by Speaker**

<table>
<thead>
<tr>
<th>Suffix Harmony</th>
<th>Stem Harmony</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Stronger</td>
<td>16MY</td>
<td>3MY</td>
</tr>
<tr>
<td></td>
<td>6MO</td>
<td>23MO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11FO</td>
</tr>
<tr>
<td>Weaker</td>
<td>14FY</td>
<td>5FY</td>
</tr>
<tr>
<td></td>
<td>7FO</td>
<td></td>
</tr>
</tbody>
</table>

These results suggest that stem and suffixal harmony are distinct in Finnish with some speakers displaying strong stem harmony and ambiguous suffixal harmony (e.g. 7FO) and others the opposite pattern with weak stem harmony but robust suffixal harmony (e.g. 3MY). Some, such as 5FY, appeared to have weak stem and suffixal harmony and others, such as 16MY, displayed strong stem and suffixal harmony. The differing patterns of the two types of harmony indicate that, while they are related, they may be implemented differently. Further study is required to examine the prevalence of these patterns.

### 5.4.3 Correlation between Written and Spoken Forms

The suffixal harmony results differ according to the medium of the data. It appears that, in most cases, the participants were using more or less standardized written suffix allomorphs while their spoken forms diverged, in many cases, from the expected suffixes, resulting in low correspondences between the written and phonetic forms.
The normative orthography and the prescriptive rule concerning `<y>`, which appeared to be utilized by the older female students, exerted greater influence on the written behaviour suggesting that phonetic studies are perhaps more appropriate to determine phonological behaviour. As a heavily standardized language with a high percentage of literate speakers, it is perhaps unsurprising that the written norms and spoken productions differ somewhat. In a pilot study concerning the integration of recently borrowed Angliscisms into the phonology of Finnish Leskinen (1981) found orthographic-phonetic mismatches relating not only to harmony but also gemination, as shown below in (34).

\[(34)\] Orthographic-Phonetic Mismatches

a. Harmony Mismatches

- `Sprite (part.)` [spraitti-a] 94% <Spritea> 57%
- `Fairy (a detergent brand) (part.)` [fairi-a] 97% <Fairya> 80%

b. Gemination Mismatches

- `jeep (part. sg.)` [jeeppiä] 97% <jeeppiä> 73%
- `Fiat (part. pl.)` [fiatteja] 99% <Fiatteja> 59%

Leskinen’s (1981) findings are confirmed by the data in this experiment which indicate that the written and spoken forms may not correspond in all cases. The lack of correlation between the written and phonetic forms re-affirms the need for phonetic studies to confirm and/or complement those based on written forms. Especially in a language such as Finnish, where the standard dialect is partially contrived being learned in school and spoken only in more formal situations, and the population has high degrees of both literacy and education, the realities of the written form may not be entirely consistent with the spoken forms. Without phonetic studies, it is unclear to what degree the written forms are responses to orthographic norms and how much they are influenced by actual phonetic practices.
5.5 Conclusions

Though a majority of tokens were pronounced with harmonic patterns equivalent to their orthographic representations, still a large percentage were harmonized to some degree. In these cases, the orthographic representation cannot be assumed to be an adequate proxy for the spoken form. However, the rate of stem harmonization is still low and less than might be expected of a robust phonological rule, especially when only complete harmonization is considered. The loanwords though are encumbered by their normative forms and are heavily reliant on written forms. To truly test the productivity of harmony, these confounding factors must be eliminated. This sort of additional evidence is provided by the wug forms created by the language game, which will be discussed in Chapter 6.

While the discriminant analysis and F2 results indicate that those suffixes appended to stems with final front vowels are more likely to be front than those attached to stems with final back vowels, the categorical front-back alternation expected of a robust suffix harmony system was not observed for all speakers. Front suffix allomorphs were more common than expected for all word types. The overall results of this study are summarized in Table 5-11 and compared with Experiment 1, Experiment 2-A, and previous research.

<table>
<thead>
<tr>
<th>Stem Type</th>
<th>Expected Suffix Allomorph Based on Previous Research</th>
<th>Experiment 1 Findings</th>
<th>Experiment 2-A Findings</th>
<th>Experiment 2-B Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>BN</td>
<td>F ~ B</td>
<td>mostly F</td>
<td>B</td>
<td>F ~ B</td>
</tr>
<tr>
<td>BF</td>
<td>F ~ B (degree of variation dependant on height of front vowel)</td>
<td>mostly F (no height effect)</td>
<td>F ~ B (degree of variation dependant on height of front vowel)</td>
<td>mostly F (no height effect)</td>
</tr>
<tr>
<td>FB</td>
<td>B</td>
<td>n/a</td>
<td>B</td>
<td>F ~ B</td>
</tr>
</tbody>
</table>

The results of Experiment 2-B display more front allomorphs than expected based on previous research. While coarticulation is a possible source of some fronting, the variation cannot be attributed solely to environmental factors, suggesting a change in the suffixation patterns for some speakers. The speakers which have atypical harmony patterns may append front allomorphs to loanword stems which do not contain front harmonic vowels and are too short for the pseudo-compound hypothesis.
That the unexpected pattern is more common amongst female speakers may suggest the possibility of a synchronic change. While some degree of phonetic neutralization of the harmonic feature might be possible in a harmony language, the very high percentages of front suffixes, especially seen with the females, appear to be extreme. Since young females are reported to lead many linguistic changes, the females’ increased percentages of front suffixes, the innovative forms, are typical of the weakening of harmony being seen as a change in progress. Without discrete suffixal vowels, suffixal harmony is weakened.
Chapter 6
Experiment 2-C: Language Game Responses

Where existing words may be subject to many factors influencing phonological behaviour, nonce forms may provide forms which are relatively unencumbered. Recently language games, which create nonce forms, have been acknowledged as a valuable additional source of data concerning active phonological processes and phonotactic patterns (e.g. Campbell 1986; Ohala 1986; Bagemihl 1995; Vaux 2011). Though these games consciously manipulate phonological constituents, it is generally accepted that the processes involved do not deviate in any significant way from natural linguistic processes. Only those phonological processes which are already present in the language (or are explicitly part of the game) may apply; the game must obey all phonological rules and restrictions of the language. The use of language games as phonological evidence is discussed in section 6.1.

Language games are plentiful in Finnish and several have been well-described in the literature. In section 6.2, several Finnish language games are illustrated and previous accounts of the game siansaksaa ‘Pig German’, which is the focus of this chapter, are presented. These language game results are from Experiment 2, discussed in Chapter 4 and Chapter 5. The purpose of the language game and the insight it may provide are discussed in section 6.3. Details concerning the participants, materials, methods, and analysis which differ from those discussed previously in Chapter 4 and Chapter 5 are described in section 6.4. Section 6.5 presents the findings relevant to the vowel harmony system of the language, which are then discussed in section 6.6.

6.1 Language Games as Phonological Evidence

Language games or ‘ludlings’, as such games are often termed following Laycock (1972), are somewhat exterior to the normal functioning of a language. As opposed to natural language, ludlings are consciously created and taught to other speakers. Linguistic forms are deliberately modified and manipulated for amusement or to create linguistic systems understandable only to a
subset of speakers. Normally one or two phonological or morphological rules are applied to the normal language, which serves as the input to the game.

The main issue which has emerged concerning language games is how much (or even whether) language games can inform our understanding of native phonology, given that they are consciously created and used and are therefore outside of the general workings of the language. Though some were initially skeptical of the use of language game data, language games have since come to be seen as important sources of external evidence (e.g. Campbell 1986; Ohala 1986; Bagemihl 1995; Vaux 2011).

A possible criticism concerning the use of language games as linguistic evidence has been offered by Niemi and Laine (1997: 162) who suggest that inherent in language games is “the possibility of intervention of metalinguistic knowledge during the creation of output structures.” Niemi and Laine (1997: 162) compare the evidence for Finnish vowel harmony provided by language games and slips of the tongue. In their analysis of 1,300 Finnish slips of the tongue containing 245 phonological errors, they state there were nine potential harmony violations all of which were resolved, obeying the vowel harmony constraints \(^{131}\) (Niemi and Laine 1997: 168-173).

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\(^{131}\) However, Niemi and Laine (1997: 173 footnote 4) list an additional four slips of the tongue in which vowels are not pronounced with the correct [back] specification. Two cases illustrate suffixal disharmony, one stem disharmony, and two opposite [back] specifications, as shown below:

1. Unharmonized Slips of the Tongue
   a. Suffixal Disharmony
      Köhniö-llä expected Köhniö-llä ‘in Köhniö’
      kansallisi-ssä ‘national (iness.)’
   b. Stem Disharmony
      läsku-n expected lasku-n ‘bill (acc.)’
   c. Opposite [back] specification
      yleis-yr...yleis-urheilu-kilpailui-ssa expected kansallisi-ssa yleis-urheilu-kilpailuissa ‘at national athletics meets’
      tällaiset leksikon...leksikon lisäykset osoittavat, että lauseparien välillä... expected tällaiset leksikon lisäykset osoittavat, että lauseparien välillä... ‘these kinds of additions to the lexicon indicate that between sentence pairs...’

Though Niemi and Laine (1997: 173) exclude these examples from analysis stating that “the speakers’ ‘vowel harmony specifier’ is more drastically malfunctioning” these forms do not damage their overall observations...
The slips of the tongue evidence closely mirrors the language game evidence indicating that vowel harmony is persistent whether the output form is produced subconsciously or consciously. Overall Niemi and Laine (1997) conclude that the types of phonological operations evidenced by slips of the tongue are analogous to those seen in the Finnish language games, providing evidence that the language games do, in fact, reflect the reality of the functioning of the phonological component of the language.

Some language games though have been reported to create phonological outputs unattested in the native language. For example, Harrison and Kaun (2001) present data on two Hungarian word games which create surface forms unattested in native Hungarian. In native Hungarian, there is a change in vowel quality for two long-short vowel pairs; the vowels [e:] and [a:] alternate with [æ] and [ɔ] respectively. However, the two games presented by Harrison and Kaun (2001) create the unattested vowels [e], [a], [æ:], and [ɔ:]. Vaux (2011: 737) states that language games may provide evidence that certain unattested forms in a language are not assumed to be impossible by speakers but are treated more as an accidental gap. It is possible that the vowels created by the Hungarian ludlings are of this type.

Most researchers now accept that language games “differ not so much qualitatively from ordinary language, but rather quantitatively in the degree to which ordinary language operations were modified or extended in the derivation of language game forms” (Bagemihl 1995: 697). In Finnish, ludlings have been used as evidence for underlying representations, phonotactics, phonological constituents, and the psychological reality of rules (Campbell 1980, 1981, 1986; Harrikari 2000; Vago 1985, 1988).

concerning the close correspondence between slips of the tongue and language games. Only three of these forms, the disharmonic suffixes and the disharmonic stem, are truly instances of harmony violations. Overall only an extremely small number of harmony errors are found in their corpus, indicating that harmony violations are uncommon among slips of the tongue and harmony is persistent even in language errors.
6.2 Description of Finnish Language Games

A considerable number of Finnish language games have been recorded, several of which are well-described in the literature (see Ojansuu 1907 for many examples). These games employ a range of linguistic strategies including movement of phonological material, affixation, and templatic assignment with many games combining multiple strategies (Bagemihl 1995). Some representative games from various Finnish-speaking areas are shown below in (35). In the examples below from Hänninen (2007), categorized broadly using Bagemihl’s (1995) classifications, elements which have moved or were inserted are separated with ‘+’.

(35) Examples of Finnish Language Games

a. Primarily Movement Game

**Elastakaseksi/Rentu: Move first syllable to end of word**

Input: kyl.lä tä.mä tun.tuu vä.hän lap.sel.li.sel.ta pu.hu.a täl.lais.ta kiel.tä
mut.ta hu.vin vuok.si

Output: lä+kyl mä+tä tuu+tun hä+vä selliselt+lap huu+puh lästä+täl tä+kiel
ta+mut vin+hu si+vuok (from Pyhäjärvi, Vyborg region, Russia)

Gloss: ‘Yes it seems a little childish to speak this language but it is fun.’

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132 Translations by author.

133 Note that the input was provided in standard Finnish. Some phonological processes appear to have occurred in the output e.g. the monophthongization of the sequence [ua] in /puhua/. 
b. Primarily Insertion Games

**her-language:** Prefix [her-] to beginning of each syllable

**Input:** tu.le tän.ne.päin

**Output:** her+tu her+le her+tän her+ne her+päin (from Heinävesi, Finland)

**Gloss:** ‘Come over here’

**ver-language:** Suffix [-ver] to end of first C0V, lengthen original vowel, delete rest of original word

**Input:** o.pet.ta.ja on lai.ha kuin kart.ta.kep.pi [köppi dialectal form of ‘keppi’]

**Output:** oo+ver oo+ver laa+ver kuu+ver kaa+ver köö+ver134 (from Suoniemi, Finland)

**Gloss:** ‘The teacher is as thin as a pointer’

**Lampaanlatina:** Infix [-ti-] after first C0V

**Input:** mi.nä luon la.pi.ol.la lun.ta

**Output:** mi+ti+nä lu+ti+on la+ti+piolla lu+ti+nta (from Eurajoki, Finland)

**Gloss:** ‘I will shovel snow’

---

134 Note that the compound word karttakeppi ‘pointer’, karttaköppi, in this dialect, is treated as two separate words by the speaker.
c. Primarily Templatic Game

**Nipu: nipu n+[word-C;] pus [word]**

**Input:** tu.le meil.lä käy.mään

**Output:** nipu n+ule pus tule nipu n+eillä pus meillä nipu n+äymään pus käymään (from Ilomantsi, Finland)

**Gloss:** ‘Come and visit us’

Interestingly many of the Finnish language games involve the first consonant and vowel, which is not a phonological unit but was also seen to be commonly switched in Niemi and Laine’s (1997) speech error data. As seen in the treatment of /lun.ta/ in *lampaanlatina* and /lai.ha/ in verbal language, coda consonants and the second vowel of a diphthong are excluded from this commonly manipulated unit.

In the examples above in (35), there are no necessary harmonic changes to the original vowels as all the games involve either the insertion of material containing only consonants and neutral vowels or the movement of existing phonological material from within the word. However, regressive harmonization does occur in (35a) in that the disharmonic form *tällaista* ‘this kind of (part.)’ becomes lästä+täl. It is unclear whether the original form is subject to the normative disharmonic pronunciation [*tällaista*] and the game form applies the phonological rule of vowel harmony or if the speaker uses a dialect which has the harmonized form [*tälläistä*] (see section 2.3.1 for details).

Several language games do potentially involve reharmonization. In the games shown below in (36) from Campbell (1980: 246-248), Hänninen (2007), and Harrikari (2000), either the affixed material includes harmonic vowels, as in (36a) and (36b), or the moved phonological material originates outside of the word, as in (36c). In such games when the harmonic class of the original vowels clashes with that of the newly inserted material, the harmonic vowels of both roots and suffixes are reported to reharmonize and are adjusted to accord with the new first harmonic vowel of the word. It is only in the context of these types of language games in which root
vowels ever alternate in Finnish. In the following examples of all three language games, reharmonized vowels are underlined and morpheme divisions are provided in the input forms.

(36) Examples of Reharmonization in Finnish Language Games

a. Primarily Insertion Game

/-tA-/ Infixation: Infix /-tA-/ after the first syllable

Input: ka.la → Output: ka+tä+la ‘fish’
Input: kä.de-s.sa → Output: kä+tä+dessä ‘in hand’

b. Reversing/Templatic Game

Kontinkieli: ko+[word - initial C0V] [initial C0V]+ntti

Input: mi.nä me.n-i-n ky.lä-än lau.an.tai.-na

Output: minä kontti ko+na mi+ntti ko+nin me+ntti ko+laan ky+ntti ko+uantaina la+ntti (from Ilmajoki)

‘I am going to the village on Saturday’
c. Reversing Game

**Siansaksa/Sananmunnos: Exchange the initial CcV of adjacent words**

Input: tyk.kä-än ur.hei.lu-s.ta

Output: u+kkaan ty+rheilystä

Input: ko.va tuu.li

Output: tu+va ko+oli

The reharmonization stated to be part of the Finnish ludlings can be seen as evidence for both the active phonological process of suffixal harmony and the phonotactic restriction of stem vowel harmony. While stem harmony is normally viewed as a static morpheme structure constraint due to the lack of alternations in the normal grammar, in the language game it may be seen as a productive process actively eliminating violations.

While [i] and [e] are transparent and neutral in the harmony system, in some cases in the ludlings they have been reported to trigger harmony. Whether or not switched neutral vowels cause fronting in *siansaksa* appears to be variable. The following examples demonstrate that neutral vowels may trigger the fronting of subsequent harmonic vowels in some cases, as in (37a), while in other contexts fronting does not occur, as in (37b). In these examples, the potentially harmonized vowels are underlined in the output forms. Morpheme divisions are provided in the original forms.

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135 Interestingly a majority of the slips discussed by Niemi and Laine (1997) examined involved the transposition of the initial consonant and vowel of adjacent words, a process identical to that of the language game *siansaksa*.

136 When long vowels are involved, the vowel quality moves but the skeletal tier remains unaltered, as shown in the output form of *kova tuuli* ‘a strong wind’, where the second word retains a long initial vowel in the output.
(37) Conflicting Behaviour of Neutral Vowels in Siansaksa

a. Neutral Vowels Cause Fronting: (Seppänen 1982 as reported in Vago 1988: 195)

Input: leipä taikina → Output: ta+ipa le+ikinä ‘bread dough’

b. Neutral Vowels Do Not Cause Fronting: (Campbell 1980: 247)

Input: otsa-nsa hie-ssä → Output: hi+tsansa o+essa ‘in the sweat of his brow’

Though it is unclear if the behaviour is consistent or varies according to dialect or speaker, the fronting or lack thereof may also relate to either the quality of the neutral vowel or the number of neutral vowels. Anderson (1980: 274) found that in the native grammar [i] and [e] have differing harmonic strengths with [e] being more harmonic. Count effects, whereby neutral vowels are more likely to control harmony as their numbers increase, have been reported in Hungarian (Hayes and Londe 2006), though they have not been reported for Finnish and were not seen in Experiment 1 or 2. In the past the more common vowel pattern within stems was NF, though synchronically NB is more likely (Suomi et al. 2008: 51-2) so it is also possible that the dialects which allow fronting are somehow more conservative.

Neutral vowels in slips of the tongue which involve initial C0V exchanges also display variable behaviour as seen in Niemi and Laine (1997: 167, 169). Slips which are analogous to the siansaksa examples above in (37) are shown below in (38). In (38a) and (38b) the erroneous initial-syllable neutral vowel causes fronting of subsequent harmonic vowels while it does not in (38c). Relevant harmonic vowels are underlined.

137 Note that leipä ‘bread’ is also a front harmonic stem while hiki ‘sweat’ is a neutral stem. Campbell (1981: 178 note 6) states that in the context of the language game kontinkieli some speakers attempt to retain the front harmonic value of the input word even when it would otherwise be eliminated according to the game rules e.g. leipä ‘bread’ → ko+ipa le+ntti – lõ+ntti.
Conflicting Behaviour of Initial Neutral Vowels in Slips of the Tongue

a. [e] Causes Fronting:

expected [ota ennää] ‘take any more’ → produced [e+tä o+nnaa]

b. [e] Causes Fronting:

expected [ol-laan ja ele-tään] ‘being and living’ → produced [el+lään ja ole+taan]

c. [e] Does Not Cause Fronting:

expected [romantiikka ja realismi] ‘romanticism and realism’ → produced [re+mantiikka ja ro+alismi]

Niemi and Laine’s (1997: 169) examples also demonstrate that the fronting may occur in both roots, as in (38a), and suffixes, as demonstrated by the behaviour of the present passive indicative suffix /-tAAn/ in (38b).

In the /-tA-/ infixing ludling neutral vowels may also cause fronting (Campbell 1980: 247). In the ludling forms of merta ‘sea (part.)’ and versta ‘blood (part.)’ the infix /-tA-/ and the subsequent partitive case may surface as front e.g. mer+tä+tä and ver+tä+tä respectively. However, these forms are both already exceptional in their back vowel partitive affixation and the pronunciation of these forms varies dialectally being exceptionally suffixed with back partitive allomorphs in many parts of the country and front allomorphs in others (see Kettunen 1940 map 172). Unfortunately no other examples are given of back harmonic stems with initial neutral vowels so it is unclear if this is specific to these lexical items, which are already exceptional, or if first syllable neutral vowels are capable more generally of causing fronting in this game.

Though harmonic vowels in native words are expected to reharmonize, as shown in (36), Campbell (1981: 159) presents examples of disharmonic loanwords having undergone the language game kontinkielo without reharmonization. These words are treated as exceptions even within the game and, unlike native words, retain their original vowels and resist reharmonization, as shown in (39) with relevant vowels underlined (Campbell 1981: 159). Since kontinkielo
always consists of the addition of the back vowel prefix *ko*-; it is impossible to determine whether or not back stem vowels in disharmonic FB loanwords would behave analogously and resist harmonization.

(39) Lack of Harmonization of Disharmonic BF Loanwords in Kontinkieli

a. Native Word  nälkä → ko-lkä nä-ntti  ‘hunger’

b. Disharmonic Loanword  jonglööri → ko-nglööri jo-ntti  ‘juggler’

Within the /-tA-/ infixation ludling front and back vowels in disharmonic words do not behave identically and reharmonization may occur only in some contexts. As shown in (40a) from Campbell (1980: 247), while the initial front vowel in FB disharmonic words, e.g. the loanword *dösa* ‘bus’ and the slang word *fyssa* ‘physics class’, causes the infix to surface as front and the back harmonic root vowels to reharmonize to conform with the preceding vowels, the initial back vowel in BF disharmonic words does not cause the expected harmonization of either the infix or the stem vowels. Unlike all other word types, the initial vowel in BF disharmonic words does not appear to control the harmonic class of the infix, as shown in (40b). Instead, the infix surfaces as front and the remaining stem vowels retain their original front harmonic class138 (see Campbell 1980: 246-7 and Vago 1988 for discussion).

(40) Varying Harmonization of Disharmonic Words in -tA- Infixation

a. FB Disharmonic Words

\[ \text{dösa} \rightarrow \text{dö-tä-sä} \quad \text{‘bus’} \]

\[ \text{fyssa} \rightarrow \text{fy-tä-ssä} \quad \text{‘physics class’} \]

b. BF Disharmonic Words

\[ \text{jonglööri} \rightarrow \text{jong-tä-lööri} \quad \text{‘juggler’} \]

138 An interesting word type which is not shown would be a longer BF word such as *analyysi*. 
Loanword behaviour has been discussed for only kontinkieli and /-tA-/ infixation but is unknown for siansaksa. However, that loanwords have aberrant behaviour as compared with native stems in kontinkieli and, to some degree, in /-tA-/ infixation suggests that a lack of harmonization or irregular patterns of harmonization might be expected in siansaksa as well. Harrison and Kaun (2001: 17) report disharmonic loanwords in Tuwan and Turkish also behave aberrantly under reduplication and tend to resist harmonization. The differences in reharmonization of harmonic and disharmonic words have been argued to be evidence for differences in underlying feature association in Finnish (Vago 1988).

6.3 Experimental Purpose

In Experiment 1 and Experiment 2-B presented in Chapter 3 and Chapter 5 respectively phonetic stem harmonization occurred in some instances but with perhaps less regularity than might be expected of a productive rule; most orthographically disharmonic words were pronounced as such. In Finnish it is as yet unclear whether the synchronic presence of disharmony is merely a typical, expected stage before harmonization ultimately occurs, possibly artificially extended due to the influence of the orthographic form in a highly literate society, or if its persistence is a sign that stem harmony is weakening in the language.

The determination of which scenario best fits modern Finnish is neither trivial nor simple. The lack of harmonization of the loanwords may not necessarily indicate that harmony is not productive since the quality of the stem vowels may have been partly motivated by a number of non-phonological factors including orthographic representation and lexical frequency. In an attempt to eliminate as many of these confounding factors as possible, this chapter examines harmony in nonce forms created by a language game.

Not only do such games provide an opportunity for the examination of stem harmonization but they also potentially provide additional disharmonic suffixed forms which are unencumbered by frequency and other lexical factors which burden existing lexical items, essentially forming a ‘wug’ test.
6.4 Methods

6.4.1 Participants

Of the participants selected for the acoustic analysis in Experiment 2-B, discussed in section 4.2, a subset were selected for acoustic analysis of the game output based on their ability to play the language game. All participants were subjectively rated on their game ability from 0 (low ability) to 1 (average ability) to 2 (high ability). Participants rated 0 were excluded from acoustic analysis since the language game data was of experimental interest and extreme difficulty with the task might have reduced the quality of the resultant data. One participant representing each participant group (gender and prescriptive rule knowledge) was then selected randomly from the speakers rated average or high ability. In the future, a comparison between speakers with low and high ability to play the game could be performed\textsuperscript{139}.

6.4.2 Materials

The ludling utilized in both phonetic experiments, alternately termed \textit{siansaka} ‘Pig German’ or \textit{sananmunnos} ‘word exchange’ has been described in the Finnish literature at least since Ojansuu (1907), and has been previously discussed by Campbell (1980), Harrikari (2000), and Vago (1988). While the subtle details of the game, particularly concerning the treatment of diphthongs, differ according to various linguistic descriptions and appear to be subject to inter-speaker variation, the basic description of the game states that the initial consonant and vowel of adjacent words are transposed, as was shown in (36c) (Campbell 1981: 178).

In Experiment 1, discussed in Chapter 3, the harmonic classes of the adjacent verbs and nouns were not structured in a manner that allowed any conclusions to be drawn concerning reharmonization of the disharmonic loanwords and so the game functioned merely as a

\textsuperscript{139} Since all participants had instruction in the game, the difference in ability could be attributed to differing facility with manipulation of phonological material. It is perhaps worth examining whether people who have lower ability to manipulate phonemes behave differently in terms of either the reharmonization involved in the game or the suffixation of the loanwords.
distractor. In Experiment 2, discussed in Chapter 4 and Chapter 5, verbs and nouns were paired in an attempt to determine whether the initial syllable of the loanword would trigger reharmonization of the verb and also whether the remaining loanword stem would be reharmonized with the concatenation of the initial syllable of a different harmony class. For a complete list of the sentences, see Appendix 9.

To allow for the experimental examination of the possibility that native words and harmonic and disharmonic loanwords will reharmonize within the context of this language game, there are four types of sentence combinations which may result in reharmonization, shown below in (41) and (42). In the first two types of sentences, the harmonic behaviour of the harmonic verb is tested. Some sentences, such as that in (41a), have a verb with at least one front vowel in a non-initial syllable followed by a noun with a back vowel in the initial syllable. Other sentences, such as that in (41b), have the opposite situation where the verb has at least one back vowel in a non-initial syllable and the noun an initial front vowel. When, the initial C0V’s switch in the context of the game, there is potential for either maintenance of the original stem vowels or reharmonization of the verb. Should harmonization occur, it may proceed progressively from the new vowel or regressively from the original stem vowels. As harmony is normally progressive in Finnish and harmonization has been reported, stems are expected to reharmonize with the switched initial C0V, as shown. The switched elements are marked with a + and potentially reharmonized vowels are underlined. In cases such as those below where the front-back quality of the suffix vowel is unknown, it is represented by uppercase A.
Potential Reharmonization of Verbs in Game Output

a. Harmonic Category of Switched Vowel: Back

Normal Reading: häpeää kutyymi-A
Gloss: ‘S/he disgraces the custom’
Expected Game Output (reharmonization): ku+peaa hä+tyymi-A

b. Harmonic Category of Switched Vowel: Front

Normal Reading: arvostelee syntaksi-A
Gloss: ‘S/he criticizes the syntax’
Expected Game Output (reharmonization): sy+rvöstelee a+ntaksi-A

The potential reharmonization situations for the verbs and nouns are not identical. Within the experiment the verbs are initially harmonic while many of the nouns are not\textsuperscript{140}. In all accounts of Finnish language games involving potential reharmonization, harmonic words are always expected to reharmonize. Though the behaviour of disharmonic words in siansaksa specifically was not discussed in the literature, as discussed in section 6.2, the behaviour of disharmonic words in other language games was indeterminate\textsuperscript{141}. As with the verbs, nouns were also placed in sentential positions in which they were potentially subject to harmonization with the affixation of the new initial C\textsubscript{0}V. The evidence from other language games suggests that BF disharmonic nouns may not harmonize while FB disharmonic and harmonic nouns will. In the examples

\textsuperscript{140} This is a property only of the lexical items selected for the experiment. A number of disharmonic verbs have also been borrowed into Finnish and their behaviour would be expected to be similar to the disharmonic nouns examined here e.g. flygata ‘to fly’ from Swedish flyga and lynkata ‘to lynch’ from English (Campbell 1980: 249).

\textsuperscript{141} A possible issue is that disharmonic BF words were not reported to cause reharmonization in the -tA- infixation game though FB words do, as shown in (40b). It may be that the back vowels in this word type cannot spread their feature for some reason. Additional research could examine this possibility more closely.
below in (42) the switched elements are marked with a + and harmonized vowels are underlined in the output forms.

(42) Potential Reharmonization of Nouns in Game Output:

a. Harmonic Category of Switched Vowel: Back

Normal Reading  

harkitsee kulööri-A

Gloss  

‘S/he considers the hue/shade’

Expected Game Output (no harmonization)  

ku+rkitsee ha+lööri-A

b. Harmonic Category of Switched Vowel: Front

Normal Reading  

säälii kyklooppia-A

Gloss  

‘S/he pities the cyclops’

Expected Game Output (reharmonization)  

ky+ylii sä+klööppi-A

c. Harmonic Category of Switched Vowel: Front

Normal Reading  

pyytää kompromissi-A

Gloss  

‘S/he asks for a compromise’

Expected Game Output (reharmonization)  

ko+otaa py+mpromissi-A

While the language game provides the opportunity to examine the potential reharmonization of stem vowels, it also creates suffixed disharmonic nonce words, which allow for examination of suffixal harmony. If reharmonization of the nouns does not occur in the output, then the suffix category of these disharmonic nonce words may be examined in parallel with the actually occurring disharmonic test words, as shown below in (43).
Comparison of Disharmonic Loanword with Disharmonic Nonce Word

a. BF Loanword with Vowel Sequence [a-öö-i]

houkuttelee šarmööri  ‘S/he persuades the charmer’

b. Game-Created BF Nonce Word with Vowel Sequence [a-öö-i]

Input: harkitsee kulööri-A → Output: kurkitsee halööri-A

In essence the language game results in a wug test with novel words identical in terms of the vowel sequences but not subject to frequency or usage effects. These words may behave as the phonology alone dictates concerning the suffixation.

6.4.3 Procedure

During the training portion, participants were taught the game alternately known as siansaksa ‘Pig German’ or sananmunnos ‘word exchange’, which consisted of switching the initial consonant, if present, and vowel of two adjacent words. Many participants indicated that they were already aware of and had previously played the game. The examples provided to each participant concerning how to play the game are shown below in (44). Those segments which move were both underlined and bolded, as indicated. Participants were permitted to refer to the examples at any time during the course of the experiment, if they wished.

Language Game Examples

a. Kißä pesee → Pessä kisee ‘The cat washes.’

b. Isä puhuu → Pu̯a ihuu. ‘Father speaks.’

c. Odotan bussia → Budotan ossia ‘I wait for the bus.’

142 Note that orthography remains as a potential confounding factor as the game is played using written prompts.
Though stem vowel harmony was not directly addressed in the written or verbal instructions, in example (44b) vowels are shown to reharmonize in response to the harmonic class of the new initial syllable.

In order for the language game results to be as naturalistic as possible, participants were not instructed as to how to deal with diphthongs, long vowels, or complex onsets. If participants asked explicitly about these elements, as a few did during the course of the experiment, they were instructed to treat them however they felt was most natural.

Each sentence provided was first read aloud by the participant in the normal manner inflecting the noun into the partitive case as required by the verb and then the game was played with the resultant sentence, as shown below in (45).

(45) Sample Application of Language Game to Test Sentence

a. Given: Inhoaa __________ (kauravelli)

b. Normal Reading: Inhoaa kauravelliä ‘S/he hates oatmeal gruel.’

c. Game Reading: kanhoaa iuravelliä

The length of time required for the experiment varied widely depending on the language game’s degree of difficulty for each participant. Some found it very challenging while others were extremely adept at manipulating the segments. Unlike in Experiment 1, discussed in Chapter 3, all participants proved able to complete the experiment using the game throughout.

A single repetition of each of the four selected speakers’ game sentence productions (14FY, 11FO, 16MY, and 23MO) was utilized for the game data analysis. For all speakers, the second repetition was used as this repetition typically contained fewer hesitations and skipped forms. For the complete list of sentences, see Appendix 9.
6.4.4 Analysis

As for the normal reading vowels, Praat scripts using the Burg algorithm and a window length of 0.025s were run to extract the F1 and F2 values at the midpoint of all vowels in the game readings. Those vowels with formant values more than two standard deviations from the formant mean for the given vowel for that speaker based on the control and normal reading verb vowels were re-examined manually to ensure the correct formant values were recorded. In total 1,406 game reading vowels were analyzed.

Using the control and verb vowels as a model, discriminant analysis was used to determine the quality of the game reading vowels. See sections 5.2.4 and 5.3.1 for discussion of discriminant analysis. Since the amount of data was small, all vowels which were unexpected, such as the second vowel in 16MY’s pronunciation of /vähentää/ classified as [vahäntaa] and the first vowel in 23MO’s pronunciation of /käytää/ classified as [koyttää], were also verified auditorily. On the basis of the discriminant analysis classification, the game reading productions were then examined to determine whether they were phonetically harmonized and, if so, in which direction. A token was considered to be harmonized if the resultant form was not disharmonic.

Table 6-1 below provides the number of each type of potential reharmonizations for each speaker. Though most sentences contained only a single possible harmonization, two allowed for the possibility that both the verb and the noun could reharmonize.

<table>
<thead>
<tr>
<th>Harmonic Category of Switched Vowel</th>
<th>Potential Reharmonized Verb Tokens</th>
<th>Potential Reharmonized Noun Tokens</th>
<th>Total Potential Reharmonized Tokens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>10</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>Front</td>
<td>9</td>
<td>8</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>23</td>
<td>42</td>
</tr>
</tbody>
</table>

For the normal reading suffixes in Chapter 5, all front suffixes were combined into a front class and all back suffixes into a back class, regardless of height. For the normal reading, this was considered appropriate since the number of mid vowel suffixes was very low and it was therefore assumed that those vowels classified as mid were, in fact, either mispronounced in terms of height or misclassified if they were somewhat higher than a typical low vowel. However, the
number of mid vowels was substantially higher in the game reading so the mid suffixes are presented separately.

6.5 Results

The game responses which were not expected to result in reharmonization demonstrate that all four speakers were reasonably competent at playing the game though the game responses were, not unexpectedly, slower and contained more hesitations than did the normal readings. Though there were some erroneous or unusual responses, the main results were similar to previous accounts of *siansaksa* (Campbell 1980, 1981, 1986; Vago 1985, 1988; Harrikari 2000) and diverge only in several minor aspects mostly concerning the long vowels and diphthongs.

(46) Sample Game Output

<table>
<thead>
<tr>
<th>Given:</th>
<th>Har.kit.see (hos.tel.li)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Output:</td>
<td>hor.kit.see has.tel.li-A</td>
</tr>
<tr>
<td>Actual Output:</td>
<td>hor.kit.see has.tel.li-ä</td>
</tr>
<tr>
<td></td>
<td>hor.kit.see has.tel.li-a</td>
</tr>
</tbody>
</table>

The results are discussed first in relation to stem harmony in section 6.5.1 and then in relation to suffixal harmony in section 6.5.2. The game harmony is then compared with that of the normal reading, which was presented in Chapter 4. Complete results for all four speakers are presented in Appendix 9.

6.5.1 Game Stem Harmony

Both verbs and nouns were potentially subject to reharmonization. Though partial reharmonization occurred sporadically in a few nouns, in the following chart only instances of
full harmonization are included\textsuperscript{143}. In practice there were several repair strategies. Some forms were harmonized by switching the harmonic class of any harmonic vowels, many allowed harmonic vowels to surface as neutral, and in one case the offending syllable was deleted.

Within each category individual words may have markedly different shapes which may have affected the harmonization. Verbs range from two to four syllables in length while noun stems are either three or four syllables long. For some words the harmonizing vowel is in the adjacent syllable while for others, the harmonic vowels are separated by a neutral vowel. Vowel quality itself was not controlled so both the moved vowel and the original vowels were of varying heights.

Table 6-2 indicates the absolute number and percentage of harmonized forms for each of the four potentially harmonized word types: verbs which may harmonize to back or front and nouns which may harmonize to back or front. For example, the first word type is back harmonic verbs which were in a position to harmonize to front, which would include the original sentence [odottaa bänarit-A]. When the initial C\textsubscript{0}V’s are switched, the preliminary game verb form would be /bä+dottaa/, which places the verb vowels in the position of potentially harmonizing to conform to the new front vowel. In one instance, this is exactly what happened with the speaker producing [bädettää]. Two speakers allowed the verb to remain disharmonic with all vowels retaining their original [back] specifications. The final speaker actually harmonized the first vowel to conform to the back specification of the verb producing [baottaa]. These outputs would then be classified respectively as one instance of harmonization to front, two disharmonic tokens, and one instance of harmonization to back. In the table below instances of progressive harmonization are shaded.

\textsuperscript{143} Partial harmonization occurred in only three forms: molekyyli → tulökkyyli-ä; kuvernööri → tovärmööri-ä; and konduktööri → änduktuuri-e.
Table 6-2: Stem Reharmonization in Language Game

<table>
<thead>
<tr>
<th></th>
<th>Verbs Potentially Harmonized to F (n=35)</th>
<th>Verbs Potentially Harmonized to B (n=38)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonized to F</td>
<td>Harmonized to B</td>
<td>Harmonized to F</td>
</tr>
<tr>
<td>11%</td>
<td>26%</td>
<td>39%</td>
</tr>
<tr>
<td>Remain Disharmonic</td>
<td>63%</td>
<td>59%</td>
</tr>
<tr>
<td>Nouns Potentially Harmonized to F (n=32)</td>
<td>Nouns Potentially Harmonized to B (n=60)</td>
<td></td>
</tr>
<tr>
<td>Harmonized to F</td>
<td>Harmonized to B</td>
<td>Harmonized to F</td>
</tr>
<tr>
<td>28%</td>
<td>3%</td>
<td>8%</td>
</tr>
<tr>
<td>Remain Disharmonic</td>
<td>69%</td>
<td>90%</td>
</tr>
<tr>
<td>Nouns Potentially Harmonized to B (n=60)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Though overall rates of stem harmonization are low in most cases, there are several tendencies which are apparent in Table 6-2 above. Most strikingly, in all word types the majority of tokens remained disharmonic, resisting harmonization.

The lack of harmonization may be a property of the disharmonic BF nouns. As discussed in section 6.2, the BF disharmonic loanwords did not trigger the spread of the [+back] feature in /-tA-/ infixation, e.g. jonglööri ‘juggler’ → jong+tä+lööri, nor did they reharmonize in kontinkieli, e.g. jonglööri ‘juggler’ → ko+nglööri. Conversely the harmonic and FB disharmonic words were still seen to trigger and undergo harmony, e.g. kala ‘fish’ → ka+ta+la and dösa ‘bus’ → dö+tä+sä. If the back vowels of BF disharmonic loans do not trigger harmony and their front vowels do not reharmonize, then some of the lack of reharmonization is predicted.

To determine whether the lack of harmonization seen in Table 6-2 was a consequence of the behaviour of the BF loanwords, the output forms with these words were excluded and the remaining game outputs examined144. Though there were no nouns remaining which could potentially harmonize to back, all other categories were represented. When the disharmonic BF loanwords and their associated verbs were removed there did not appear to be any substantial differences in the rate of disharmony, which actually rose in both cases, indicating that the BF loanwords were not the sole basis for the low harmonization rates. However, that the BF disharmonic nouns resisted harmonization so strongly may indicate that they are somehow more

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144 The nouns potentially reharmonized to back could not be examined as all the original nouns in this category were BF disharmonic loanwords. The category verbs potentially reharmonized to front did not contain any BF disharmonic loanwords.
resistant than other word types or it may relate to the larger number of BF disharmonic nouns in the lexicon. As there seem to be more BF nouns than FB nouns in the lexicon, the BF pattern may be more entrenched and accepted by speakers.

When the nouns were examined on the basis of word length, there did not appear to be any difference in harmonization of words of different lengths. Words in which the target and trigger harmonic vowels were in different disyllables, for example su.te.nöö.ri ‘pimp’ → [va+te][nöö.ri] → [va.te][nee.ri-ä], appeared approximately as likely to harmonize as those in which the word was too small to form multiple domains and so the target and trigger were necessarily within the same domain, for example tur.nyy.ri ‘bustle’ → [ko+r.nyy.ri] → [kor.nee.ri-ä]. However, since the number of harmonizations was extremely low, these must be considered to be preliminary observations.

The height of the trigger and target vowels was also examined but again, due to the small numbers and the varied pronunciations, these observations must be considered preliminary. It appears that vowels of all heights were potentially subject to harmonization.

The [+back] feature appears to be a stronger harmony trigger in the verbs; almost all instances of harmonization in the verbs resulted in back outputs, regardless of the direction of harmony that entailed. The same tendency was not seen in the nouns, however. Only the nouns which could potentially harmonize to front tended to harmonize and these words did, in fact, typically harmonize to the new front vowel.

As discussed in section 6.2 neutral vowels have been presented as possible triggers in the literature. There were only two possible instances in the experimental data (Sentences 19 and 24 as listed in Appendix 9) in which neutral vowels were moved into a position in which they could potentially reharmonize a word to front. In both cases, the neutral vowels [i] and [e] failed to trigger fronting of the following back stem vowels for all speakers. However since the harmonic vowels did not regularly trigger harmonization, it is perhaps unsurprising that the neutral vowels also failed to cause fronting.
The degree of complete harmonization exhibited by each speaker in the game reading was compared with their harmonization of three syllable disharmonic loanwords (see Table 5-5). Note that the forms in the game reading varied in terms of syllable count.

### Table 6-3: Normal and Game Reading Harmonization Rates Compared by Speaker

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Normal Reading</th>
<th>Game Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>14FY</td>
<td>41.1</td>
<td>31.0</td>
</tr>
<tr>
<td>11FO</td>
<td>1.8</td>
<td>28.6</td>
</tr>
<tr>
<td>16MY</td>
<td>29.6</td>
<td>23.8</td>
</tr>
<tr>
<td>23MO</td>
<td>20.4</td>
<td>25.0</td>
</tr>
</tbody>
</table>

While both the male speakers displayed similar rates of harmonization in both the normal reading and the game reading, the female speakers’ behaviour was different in the two tasks. Speaker 14FY harmonized slightly less overall in the game while 11FO displayed a marked increase in harmonization. Although the four speakers exhibited diverse behaviour in the normal reading, they all harmonized a similar amount in the game. However, their rates of harmonization did differ depending on the direction of harmonization, original word type, and trigger harmonic class. As only a single repetition of four speakers was analyzed, the amount of data is insufficient to determine any tendencies.

### 6.5.2 Game Suffix Harmony

The newly generated pseudo-word ‘nouns’ in the game output created a wug test. Since none of the generated forms are actual words, all are unencumbered by any frequency effects or other such factors.

The table below displays the suffixation for each stem type by speaker. To avoid the proliferation of stem types, stems were categorized according to their length, harmony, and final harmonic vowel. Thus, both nonce stems [än.duk.töö.ri] and [tu.le.kyy.li-e] were classified as four syllable Disharmonic F-Final stems. The actual vowel patterns for the four syllable stem types in particular are broader than in the normal reading, in part because of these grouping decisions. For example, a stem such as [pym.pro.mis.si] is classified as a four syllable Disharmonic B-Final stem. However, the structure of this word is quite different than a stem such as [pu.yn.lan.ti],
which is also classified as a four syllable B-Final stem. For this reason, the results for the four syllable stems will be presented but will be discussed in less depth than the results of the three syllable stems. In Table 6-4 the expected suffix values are shaded, assuming the allomorph is selected based on the final harmonic vowel of the stem.

Table 6-4: Realization of Suffix Vowels in Three Syllable Game Reading Words by Speaker

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Suffix</th>
<th>B</th>
<th>Disharmonic B-Final</th>
<th>Disharmonic F-Final</th>
<th>F</th>
<th>N</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>14FY (29)</td>
<td>e</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11FO (29)</td>
<td>e</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
<td>none</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16MY (31)</td>
<td>e</td>
<td>3</td>
<td>6</td>
<td>6</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>3</td>
<td>3</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
<td>none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23MO (29)</td>
<td>e</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>8</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
<td>none</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Though some sporadic suffixes in the normal reading were classified as [-e], unexpectedly a substantial number of game suffixes surfaced as the neutral vowel [-e], especially in the productions of 11FO and 16MY. In addition to the neutral suffixes one speaker, 11FO, also produced a number of front rounded vowel suffixes though this was not seen with the other participants.
Based on the discriminant analysis, far fewer stems than expected are suffixed with back vowels. Of the three syllable back stems, which should be suffixed exclusively with back suffix allomorphs, all speakers unexpectedly suffixed a majority of these tokens with either [-e] or [-ä]. In fact, only 10 such stems were suffixed with back allomorphs. In an effort to determine if there was some sort of count effect, the three syllable back stems were analyzed to determine whether the number of neutral vowels preceding the suffix vowel affected the suffix selection. However, for all speakers both BBN and BNN stems were sometimes suffixed with back and sometimes non-back suffixes. Stem vowel height did not appear to be relevant either.

Though there were typically few such words, for most speakers three syllable disharmonic back-final words were even less likely than three syllable BN words to be suffixed with back allomorphs. All four speakers clearly preferred front [-ä] and neutral [-e] suffixes. Only 16MY produced more back suffixes than front or neutral for the disharmonic back-final words, though he produced more non-back suffixes for the BN words. Both 14FY and 23MO produced mostly front [-ä] suffixes while 11FO and 16MY produced a mixture of front [-ä] and neutral [-e] suffixes, with 11FO also producing a number of [-ö] suffixes.

The suffix allomorphs for the four syllable nonce words are presented below in Table 6-5. The expected suffix allomorphs based on the final harmonic vowel of the stem are shaded.
<table>
<thead>
<tr>
<th>Speaker</th>
<th>Suffix</th>
<th>Back</th>
<th>Back-Final Disharmonic</th>
<th>Front-Final Disharmonic</th>
<th>Front</th>
<th>Neutral</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>14FY</td>
<td>e</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>a</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>11FO</td>
<td>e</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td></td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>none</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16MY</td>
<td>e</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>o</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>none</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23MO</td>
<td>e</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ä</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ö</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>none</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Four syllable results are comparable to the three syllable results and illustrated an increase in [ä] and [e] allomorphs with only very few [ö] suffixes produced by 11FO and one [a] by 11FO. The almost complete lack of back suffixes appended to the four syllable words may be due to the harmonic back words being almost exclusively BN words with neutral vowels in the final disyllable. As shown in section 5.3.3.2, this word type often suffixes with front suffixes among these speakers.
6.6 Discussion

6.6.1 Game Stem Harmony

Complete stem harmony was unexpectedly infrequent in the game reading. Though the verbs were expected to always reharmonize, in practice harmonization occurred in less than half of the tokens (see Table 6-2). Nouns harmonized even less. The low harmonization could not be attributed to the BF disharmonic nouns failing to act as either triggers or targets as lack of harmonization was seen to a comparable degree with all word types. However, these results are substantially higher than the percentage of harmonization of disharmonic loanwords in the normal reading, which was discussed in Chapter 5.

(47) Comparison of Complete Harmonization

a. Experiment 2-B Normal Reading\(^{145}\)

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Nouns</td>
<td>11-29% (all eight speakers)</td>
</tr>
<tr>
<td>3 Syllable Nouns</td>
<td>2-41% (four speakers included in Experiment 2-C)</td>
</tr>
</tbody>
</table>

b. Experiment 2-C Game Reading

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verbs</td>
<td>37-41%</td>
</tr>
<tr>
<td>Nouns</td>
<td>10-31%</td>
</tr>
</tbody>
</table>

While the nouns exhibited complete harmonization to a similar degree in both the normal and the game readings in Experiment 2, the verbs displayed much more harmonization. As a vast majority of the nouns were originally disharmonic, this may indicate a tendency for the vowels in disharmonic words to remain invariable. This is only a tendency though since there were many originally disharmonic words which harmonized and the two harmonic BN loanwords in a position to reharmonize surfaced as harmonized in only 25% of the output forms. Additional

\(^{145}\) See Table 5-1 and Table 5-5 for details.
research should compare the behaviour of harmonic native nouns and disharmonic loanwords to determine if the lack of harmonization is a property of the nouns or their disharmonic nature.

In the game reading, when verb vowels harmonized, they were most likely to harmonize to back, regardless of the direction of spread this would entail, possibly due to the greater markedness of the front vowels, which is also revealed by their infrequency in the lexicon. Therefore, both the switched vowel originating from the noun and the original verb vowels were possible triggers of harmony, though the switched back vowels were more likely to trigger harmony, which is expected as harmony in Finnish is progressive. Reharmonization was most likely when the spread of the [+back] feature and the progressive direction coincided. Though the rate of harmonization was slightly higher for the verbs in the game reading, these results are similar to those seen in the normal reading in Chapter 5 in which progressive harmony was also found to be most likely and [+back] was a stronger trigger.

The nouns behaved quite differently. Those which were potentially harmonized to back were very resistant to harmonization while those which were potentially harmonized to front harmonized to a comparable overall degree as those verbs which were potentially harmonized to front, though the class of the resultant word differed. The answer to this incongruity may lie in the structure of the nouns. The vowel sequence of the nouns expected to harmonize to back was always one of BNFN or BFN. When the new back vowel was inserted, the structure of the word did not change; the target front vowel was either flanked by neutral vowels or preceded by a front vowel and followed by a neutral vowel. Conversely, the original vowel sequence for the nouns expected to harmonize to front, which did undergo some degree of harmonization to front, was one of BBFN, NBNN, or FBN. When the new front vowel was inserted, the target back vowel was always adjacent to two phonetically front vowels, which may have facilitated the assimilation to front. It may be the case that the phonetic harmonization to front was closely related to the heavy presence of phonetically front vowels. In most verb stem types which were potentially harmonized to front, the target back vowels would not have been similarly flanked by phonetically front vowels.
Ogden (1996: 213-4) discusses the possibility of some form of harmony within feet. He found that back vowels that are within feet with only neutral vowels, which are phonetically front, have higher F2 values than phonologically similar vowels in back environments. In the example in (48) the bolded low suffix vowel is in a disyllable with only neutral vowels. While the F2 of this vowel is 1885 Hz the F2 values of the two preceding back vowels were in the 1500-1600 Hz range. So, it seems possible that at least some degree of phonetic fronting is natural in these types of words.

(48) Possible Harmony Within Feet


As Ogden (1996) does not provide F2 measurements for the front vowel [ä], it is unclear whether the phonologically back vowel in (48) above is merely a fronted variant of [a] or if it is sufficiently front as to be confusable with [ä].

Therefore while [+back] is seemingly harmonically stronger in the verbs triggering harmony in either direction, harmonization in the nouns appears to be predominantly progressive but may be related to a phonetic assimilation rather than phonological harmony per se. As this implies that phonological harmony is occurring in the verbs but not the nouns, additional study is necessary examining the behaviour of harmonic nouns in greater depth.

An additional possibility could be the effects of an asymmetry in the lexicon. While both disharmonic FB and BF nouns have been borrowed (e.g. tyranni ‘tyrant’ from Swedish tyrann and analyysi ‘analysis from Swedish analys), impressionistically BF nouns appear to be more common and both seem to be more common than disharmonic verbs. As discussed in section 4.2.2, many of the FB words were slang and only a single four syllable FB loanword was found. However, inclusion in a dictionary doesn’t necessarily imply that a given word is part of a

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146 Wiik (1965: 50-2) also suggested that vowels in disharmonic words were more likely to harmonize when they occurred within the same stress unit, which is comparable to a foot.

147 Note that the first low vowel would have primary stress and both the second low vowel and the relevant bolded low vowel would be unstressed so the difference cannot be solely due to stress.
speaker’s lexicon. An examination of the degree of participant word knowledge for the FB and BF nouns used in the experiment indicated that there was little difference between the word types, as shown below in Table 6-6.

Table 6-6: Participant Word Knowledge by Word Type

<table>
<thead>
<tr>
<th>Word Type</th>
<th>Known, Used</th>
<th>Known, Not Used</th>
<th>Unknown</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB</td>
<td>52.4</td>
<td>17.0</td>
<td>30.6</td>
</tr>
<tr>
<td>BF</td>
<td>48.3</td>
<td>16.2</td>
<td>35.5</td>
</tr>
</tbody>
</table>

Amongst borrowed verbs, FB verbs exist (e.g. flygata ‘to fly’ from Swedish flyga) but I was unable to find any examples of BF verbs in the literature. Disharmonic verbs which have been derived from BF loan nouns appear to typically receive back derivational suffixes resulting in verbs which are no longer BF e.g. analysoida ‘to analyze’ related to analyysi and manöveroida ‘to manoever’ related to manööveri. It is unclear whether these observations are, in fact, trends in the lexicon and, if so, whether they are related to the donor languages or forces within Finnish.

If these tendencies do exist, they may relate to the rates of harmonization. Game output verbs which, unharmonized, would surface as FB remained disharmonic 63% of the time while those verbs which would surface as BF, a seemingly non-existent or more rare word type in the lexicon, remained disharmonic 58% of the time. Though the difference was small, it is in the expected direction. Game output nouns which, unharmonized, would surface as FB remained disharmonic 69% of the time while those which would surface as BF strongly resisted harmonization (90% disharmonic). Though both vowel orders are extant amongst nouns, the issue may have been the word length. The slang words, which are typically FB, do not generally seem to attain lengths of more than three syllables while the loanwords, which are often BF, may be four or sometimes more syllables. Of the eight resultant nouns which were expected to harmonize to front (FB unharmonized), five were four syllables in length. Possibly the rarity of four syllable FB nouns in the lexicon contributed to their likelihood of harmonizing, as compared with the nouns expected to harmonize to back. Additional research is necessary to examine these tendencies in the lexicon.
6.6.2 Game Suffix Harmony

In terms of suffix harmony the language game results were in many ways similar to the normal reading though neutral [-e] suffixes were unexpectedly commonly produced and occurred in the productions of all four speakers\textsuperscript{148}. The back allomorphs were uncommon, even in tri-syllabic nonce words with back vowels e.g. [kinnroti-ä] and [ombuli-ä]. In words of this shape the compound analysis, which optionally treats longer words as comprising multiple disyllabic domains, is unavailable to explain the front allomorphs since these words are trisyllabic. Kiparsky’s (2003) assumption that fixed stress may initiate a new harmonic domain is also not viable because the stress would have to be fixed on the stem-final syllable to create a domain with only neutral vowels, which is an unattested stress pattern in Finnish. As well, since these were nonce words, it seems unlikely that any latent accent could account for the suffixes. Future work may wish to attempt to control factors such as vowel height and length and consonantal environment.

For these speakers, the suffixal harmony rule whereby the harmonic class of the suffix is determined by the final harmonic vowel of the stem seems to have broken down in the game pronunciations. Instead, most stems are affixed with either a front low harmonic or mid neutral vowel mostly irrespective of the quality of the stem vowels. Ultimately the phonological motivation for the back vs. non-back suffix selection which was seen remains undetermined.

6.7 Conclusions

While existing lexical items in the normal readings are expected to be affected by normative pronunciations and pressure from their orthographic forms thereby lessening the likelihood of

\textsuperscript{148} The occurrence of the [-e] suffix may be related to dialectal features. In Kettunen’s (1940) dialect atlas map 197 indicates the pronunciation of Standard Finnish piippu-a ‘pipe (part.)’ and pappi-a ‘priest (part.)’. While in the Joensuu area the partitive suffixes are reported to raise in this word type, forming long vowels e.g. piippuu and pappii respectively, in dialects to the north and east (as well as in Karelian) piippiö and pappiä are attested.

Note that while the discriminant analysis categorizes the phonetic realizations, it cannot address the speaker’s intended target nor the listener’s perceived category.
harmonization, as nonce words the game forms were expected to be less influenced by such confounds. Though the harmonization of the verbs was greater than that seen in the nouns in either the normal reading or the game reading, unexpectedly a majority of verbs remained unharmonized even when the trigger vowel also originated in a FB disharmonic or harmonic word e.g. *pyytäät kompromissi*-A ‘S/he asks for a compromise’ → kou.tää pom.pro.mis.si-ä. While a productive, robust harmony rule might be expected to apply exceptionlessly, stem harmony falls far short in this experiment.

In the language game the class of the suffix vowels does not consistently correspond with that of the harmonic class of the stem, which is the hallmark of suffixal harmony. While some allomorph variation was anticipated with disharmonic or long BN words, front and neutral vowels were unexpectedly appended also to trisyllabic back stems. The tendency for front [ä] and neutral [e] as suffix vowels was more evident in the game reading than the normal reading. While front [ä] and back [a] are maintained by the speakers as distinct vowels, as discussed in Chapter 5, based on the experimental results, they do not appear to be used consistently to instantiate harmony in the suffixes.

The language game output provides evidence that both stem and suffix harmony are weakening in the dialect of Finnish under discussion. Since the game creates nonce forms, these forms are expected to be subject only to the synchronic phonological rules of the language. The potentially confounding factors such as orthographic representations and normative rules and pronunciations which potentially influenced the output in the normal readings were absent from the game reading. That neither type of harmony consistently applied in the game indicates that neither can be seen as a robust, invariant part of the synchronic phonology for all speakers.

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149 Even when complete harmonization did not occur adjacent vowels often, though not always, harmonized.
Chapter 7
General Discussion and Conclusions

The two experiments presented in this thesis provide evidence that Finnish vowel harmony is not as robust as has been generally assumed in the literature. In section 7.1 the main findings of these experiments concerning the erosion of harmony are briefly summarized. If the harmony system is weakening, it is crucial to understand the factors which have lead to this present situation in Finnish and also those factors which have been relevant as harmony systems have decayed in other languages. Disharmonic loanwords are a possible factor and are discussed in section 7.2. While Harrison et al. (2002: 221) suggest that loanwords may “serve as a catalyst for harmony breakdown” they assert that borrowing alone is not likely sufficient to cause a decline in harmony. Similarly Binnick (1991) argues that without a massive influx of borrowed words it is unlikely that loanwords could cause any substantial changes to the grammar; instead they may serve to amplify nascent changes. The changes in related Finnic languages and dialects which have initiated a deterioration or loss of harmony are discussed in section 7.3. As Finnish has borrowed words from non-harmonic languages throughout its history, the motivation for any deterioration is more likely to be found within the language itself. Internal factors in Finnish which appear to be relevant to harmony weakening are then presented in section 7.4. Directions for future research are proposed in section 7.5.

7.1 Summary of Findings

This dissertation examines both stem and suffix vowel harmony in Finnish in an effort to understand the synchronic productivity of the harmony system. As Finnish has long been assumed to have a canonical vowel harmony system with very few exceptions, interest has focused almost exclusively on the realization of suffixes with loanwords. Stem harmonization has been a widely acknowledged but unexplored possibility (Campbell 1980: 246; Skousen 1975: 51-1; Suomi et al. 2008: 52; Välimaa-Blum 1999: 248; Wiik 1965: 51). Though stem harmony violations were consistently repaired in the more distant past, more recently many
disharmonic loanwords have been allowed to remain unaltered and slang forms have created novel disharmonic stems. The prevalence of stem harmony is relevant since not only will the degree of harmonization inform our understanding of the synchronic status of stem harmony in Finnish but also the quality of the suffix vowel is necessarily dependant on that of the stem vowels. When the stem vowels remain unexamined, little can be definitely determined concerning the phonological factors responsible for suffix variation. Phonetic stem harmony was investigated in both Experiment 1 and Experiment 2-B, as well as in the language game component of Experiment 2. The results of these investigations are summarized and discussed in section 7.1.1.

The second major objective of this thesis was to determine the phonetic realization of suffixes appended to different loanword stem types. Although there has been considerable theoretical interest in suffixal disharmony, the experimental results have not shown complete agreement. While some experiments have utilized exclusively written tasks, others have relied on phonetic results and it is possible that some of the variation is based upon differences in the medium. Therefore it was also crucial to examine the correspondences between the written and spoken mediums. The major results of Experiment 1 and Experiment 2 which relate to these aspects of suffixal harmony are examined in section 7.1.2.

7.1.1 Stem Harmony

While stem harmonization was essentially non-existent in Experiment 1 (though some vowel centralization was seen), it did occur in Experiment 2-B, though to a lesser extent than would be expected of a fully productive constraint. In Experiment 2-B, complete harmonization occurred only in 11.1-29.2% of the orthographically disharmonic loanword tokens.

The overall low degree of stem harmonization might be due to the influence of the orthography, which may have been especially strong in a formal experiment which relied on written prompts. While it was hypothesized that word knowledge might be related to harmonization, especially since speakers would need to rely exclusively on the written form in cases in which the word was
unknown, no differences were found in terms of a speaker’s word knowledge and their treatment of the loanwords.

Stem harmonization was more common in the language game results, detailed in Chapter 6. This experiment was expected to elicit less formal responses and also to be less reliant on the orthographic forms. However, even under these conditions, most resultant forms remained disharmonic. The lack of categorical (or near categorical) reharmonization in the verbs suggests that stem disharmony is tolerated and stem harmonization is no longer a fully productive rule for at least some speakers.

When stem harmonization did occur, there appeared to be a strength asymmetry. The [+back] feature was more likely to spread regardless of direction, which is surprising as the phonological rule of harmony is expected to apply only progressively as evidenced by the invariant nature of prefixes, discussed in section 2.1\(^{150}\). The strength of the [+back] feature may be related to overall frequency patterns in the language and markedness. Pääkkonen (1990), as reported in Suomi, McQueen, and Cutler (1997: 439) found that there are large frequency differences in words of different harmonic classes. While approximately 46\% of the tokens in the corpus Pääkkonen (1990) examined were back vowel words and 39\% were neutral vowel words, only 15\% were front harmonic words (Suomi et al. 1997: 439). As the front harmonic vowels are marked and are less common both within Finnish and cross-linguistically, these results are perhaps unsurprising (for grapheme frequencies in Finnish see Hakulinen 1961: 5; Hakulinen et al. 2005: 43; and Karlsson 1982: 75). The harmonic structure of the lexicon therefore seems to greatly favour back stems over front stems, which may explain the preference for the spread of [+back].

Overall the lack of disharmony repair, especially in the game, indicates that stem harmonization is no longer fully productive in Finnish\(^{151}\). Not only does it not occur with the regularity expected of an active rule, it does not occur in a consistent direction. While some stem

\(^{150}\) Bidirectionality in stems but no harmonization in prefixes could argue for the following word structure with harmonization occurring only in the lower domain: [prefix[stem+suffix]]. Note though that clitics may also harmonize in many dialects.

\(^{151}\) However note the caveat in footnote 19.
harmonization occurred in both the normal and game readings, the degree of harmonization fell far short of what would be expected if stem harmony were a robust synchronic constraint.

7.1.2 Suffix Harmony

Disharmonic suffix forms have been recorded since the earliest written forms of Finnish, e.g. *majesteti-sä* ‘majesty (iness.)’ (Rapola 1965: 251), and have been remarked on for some time in the normative grammars in Finland. Most previous linguistic work has examined this type of disharmony exclusively. While disharmonic words with final back vowels were reported to suffix exclusively with back allomorphs, disharmonic words with final front vowels and long back harmonic words with only neutral vowels in the final disyllable were reported to display suffix variation, which has been hypothesized to relate to various factors including sonority, trigger competition, differing prosodic domains, stress patterns, and stylistic factors. All of the accounts based on written behaviour make the same assumption regarding the data, namely that the orthographic form is identical to the spoken form and is therefore suitable for phonological analysis.

While previous work has mostly been focused on the written output and has extrapolated these findings to speech, the Experiment 2 data, in which the correlations between the written and spoken suffixes were explicitly compared, indicates that the correspondences between the written and spoken forms may not be sufficient as to warrant this. The individual suffix correspondences for speakers ranged between 17% and 81% and most instances of stem harmonization were not recorded in the written form, suggesting that spoken data is preferable for linguistic analysis, even in a language such as Finnish which is normally assumed to have a very close grapheme-phoneme relationship.

The phonetic results of both experiments herein indicate that BF loanwords are typically pronounced with front suffix allomorphs. That these loanwords suffix near exclusively with front allomorphs without reference to vowel height differs from previous written studies e.g. Ringen and Heinämäki (1999) and Kimper (2011), but is a common finding among other harmony languages with disharmonic loanwords. In many other harmony languages, Turkish and Kazakh
for example (Kabak and Weber 2013: 60-1; Bowman and Lokshin 2014: 2), suffixes invariably agree with the final harmonic vowel of disharmonic loanwords.

The allomorph results concerning the BN stems differed between Experiment 1 and Experiment 2-B. While the four syllable BN loanwords were typically affixed with front allomorphs in Experiment 1, in Experiment 2-B the four syllable BN loans, along with the three syllable BN loans, patterned with the FB stems though some variation was seen with the discriminant suffix categorizations. In Experiment 2-B female speakers exhibited a high percentage of front allomorphs for this word type, as determined by the discriminant analysis. As both individual variation and some degree of lexical variation were seen in both experiments, the differences may stem from either the participant group or the test items selected.

Only Experiment 2-B examined the behaviour of FB stems. While the mean F2 value of these suffixes was significantly lower than that of the BF stems, initially suggesting FB stems are suffixed with back allomorphs, when the means were compared with the front and back stem vowel means, it was noted that the FB suffix means were unexpectedly high. In fact, the discriminant analysis categorized many of these vowels as front, especially for females.

An examination of the individual suffixes of each speaker indicated that coarticulation was likely a factor in the high F2 values. For some of the speakers the front and back allomorphs were distinct and it is possible that some of the more fronted back realizations would have been classified as front by the discriminant analysis. However, certain speakers, mostly females, displayed very clearly front suffix vowel realizations for all stem types. It is unclear what phonetic or phonological explanation could explain why, in the same environment, some speakers maintain discrete front and back suffix vowels while others do not. This seems to indicate that the mostly female speakers with this fronted pattern have phonetically nearly neutralized the front back opposition for these words. In Experiment 1 suffix overlap and centralization was also evident in the young female speakers’ realizations of suffix vowels appended to compound words, providing further evidence that young female speakers may not have the expected discrete front and back suffix vowel realizations.

The language game in Experiment 2-C was structured to provide additional nonce words unencumbered by non-phonological factors for suffix analysis. While the immediate phonetic
environment was identical to that of the suffixes in the normal reading, typically i__#, these nonce forms were even more likely to receive front [ä] and neutral [e] suffix vowel classifications. In the less formal task, playing a language game, speakers, including those who displayed the distinct front back suffix pattern, increased their usage of front allomorphs. Additional research could examine differences between formal and informal speech.

Finnish is a highly standardized language and prescriptive rules have been created to stipulate correct suffixation of these loans. These normative pressures appear to impact the written forms to a greater or different extent than the spoken forms. Female participants who had been taught the prescriptive rules concerning the loanwords employed the rule concerning the disharmonic suffixation to some degree in their written behaviour but not in their spoken productions. That female speakers tend to abide by the prescriptive rules, at least to some extent, but only in writing, might account for some differences seen between the results of those experiments which rely on written responses and those which rely on spoken.

The Google results of Duncan (2011), which indicated that frequency was a major factor in the allomorph selection of BN loanwords, may also relate to the prescriptive or orthographic influence. While phonetic studies, including those in this dissertation, suggest that such words are typically pronounced either with front allomorphs or with a great deal of variation, the Google data indicated that low frequency forms selected primarily back suffixes whereas higher frequency forms selected both front and back suffixes. The Google data may be re-analyzed as a conflict between the written forms, for which normative pressures favour back suffixes, and the spoken forms, which tend towards front suffixes. The normative pressures may be strongest for those forms which have low frequency and therefore weaker spoken representations in the lexicon but for more frequent forms, the phonetic forms may interfere to a greater extent. Notably though the written allomorphs never seem to be suffixed with the same levels of front allomorphs as the spoken forms, indicating that the written norms always have significant impact though the actual degree of influence is presently unknown and requires further study.

While the specific details of the experiments differed somewhat the overall conclusions were the same: suffixal harmony appears to be in a state of flux, possibly indicative of an incipient change. However the comparison of the written and spoken behaviour of young females reveals
an apparent contradiction. While the female speakers in Experiment 2 taught the prescriptive rule applied the rule in writing with BF disharmonic stems, a conservative pattern not seen with the males, their spoken behaviour appeared innovative in comparison with the males, with a greater degree of suffix vowel overlap and fronting. However, this type of ‘gender paradox’ is discussed in detail in Labov (2001). Labov (2001: 367) states that “women deviate less than men from norms when the deviations are overtly proscribed, but more than men when the deviations are not proscribed.” The prescriptive rules concerning loanword suffixation are long-standing norms formally taught in school, exactly the type of norms which women are expected to maintain based on Labov’s (2001) gender paradox. The suffixal overlap and fronting does not appear to be specific to the loanwords though. While Experiment 2 included only suffixed loanwords, Experiment 1 included compound words as well. The younger females in Experiment 1 displayed similar overlap and fronting with these native words. It appears then that the phonetic fronting is a more general process applying to final suffix vowels, regardless of whether or not the stem is a loanword. As this process is not subject to overt norms, it is expected that females would be innovative, as the data indicates. The fronting and centralization of the suffixes appears to be more advanced in the speech of females than in that of the male speakers and as females have often been suggested to lead linguistic change (Labov 2001), this supports a change in progress concerning phonological behaviour.

The experimental phonetic findings of the studies presented herein alongside those of Välimaa-Blum (1999), which found suffix vowel centralization, focus on the behaviour of loanwords and nonce words and seem to indicate that the vowel harmony system, at least in loanwords, is weakening. No longer does stem harmony productively occur and suffix vowels do not reliably correspond to the harmonic class of the final harmonic vowel of the stem for all speakers. In some cases, as seen in Välimaa-Blum’s (1999) data, the suffix vowel is not even phonemic. While Wiik (1965: 50-1) felt that the disruption in the harmony system evident in the loanwords revealed that the system in general was in the initial stages of a weakening of the system, others, including Levomäki (1972) and Välimaa-Blum (1999), believed that the system as a whole was robust and the loanwords were somewhat exceptional. The question remains: is the behaviour of the loanwords indicative of a more general breakdown or do the loanwords constitute a separate stratum without harmony or with some diluted version while the native or nativized lexicon retains full harmony? Though the lack of harmony in the nonce words created by the language
game is highly suggestive of a loss of productivity and the resultant deterioration of harmony throughout the grammar, an examination of the native forms is necessary as well as an investigation of how the decay of harmony typically progresses.

7.2 External Factors in Finnish Relevant to Harmony Weakening

As Finland is a bilingual country with both Finnish and Swedish being official languages, it is possible that the vowel system of the Swedish dialect spoken in Finland (Finland-Swedish) has exerted some influence on the Finnish vowels[^152]. However, the Swedish speaking population is a small minority in Finland (5.6% in 2004) and is largely concentrated along the western and southern coastline[^153] (Tandefelt and Finnäs 2007: 44-5). Under these circumstances it is perhaps more expected that Finnish would influence Finland-Swedish.

While disharmonic loanwords are a potential disruption to the harmony system, the presence of such words alone is perhaps not sufficient to degrade harmony, unless there is such a massive influx as overwhelms the harmonic lexicon. The quantity of disharmonic loanwords which would cause this type of shift is unknown. The high number of Russian loans, which reached 18-20% of the corpora examined, has been suggested to be partly responsible for the decline of Itelmen harmony by Bobaljik (2009: 10-1[^154]) but additional factors including mergers and exceptional morphemes were also relevant. Similarly Harrison et al. (2002: 222) postulate that while foreign influence was certainly related to the loss of harmony in Uzbek, the weakening was the result of the combination of a high number of disharmonic Persian and Arabic loanwords and contemporaneous vowel mergers. Harrison et al. (2002: 221) note that modern Turkish with a lexicon which is 25% disharmonic still retains vowel harmony, indicating that the percentage

[^152]: For discussion of the vowels of Swedish dialects, including Finland-Swedish, see Leinonen (2010).

[^153]: Recall that the participants in both Experiment 1 and Experiment 2 resided in areas which are outside of the Swedish speaking areas although Järvenpää is close to Helsinki, which was originally heavily populated by Swedish speaking Finns (Tandefelt and Finnäs 2007).

[^154]: Note that there is no indication of the percentage of loanwords which were disharmonic.
of disharmonic words in the lexicon may be quite high without negatively impacting harmony\textsuperscript{155}. Moreover there is no evidence in Finnish that the quantity of disharmonic loanwords has neared or exceeded any such critical level which would overwhelm and devastate the harmony system on its own.

While loanword disharmony is found in all of the Finnic languages with harmony, it does not appear in these or any other harmony languages that disharmonic words may be solely responsible for a breakdown in the harmony system. On the contrary, a certain number of disharmonic words which arise due to borrowing, compounds, and invariant suffixes are typically observed in harmony languages. Unless the quantity of disharmonic words is sufficiently great, the origins of harmony weakening must be sought instead primarily in the internal mechanisms of the languages.

However, the retention of greater numbers of disharmonic loanwords may be seen as an indication of harmonic decay rather than as its catalyst, though it must be noted that stem vowel harmony violations in recent loanwords are common even among present-day languages with robust harmony systems. Ussishkin and Wedel (2003) suggest that phonotactic violations are more likely to be repaired when the segments in question are strictly adjacent and without intervening segments, which is not typically the case in harmony violations. Since loanwords have in the past ultimately tended to harmonize indicates that a lack of stem harmonization in loanwords in and of itself is perhaps not sufficient to diagnose or cause a weakening of harmony. Only when the loanwords continue to fail to respond to the harmonic constraints of the language over an extended period of time might the disharmony be seen as exceptional.

Binnick (1991: 38), in his discussion of causes of harmony loss, states “while foreign influence may accelerate or even trigger certain changes, it does not dictate the nature or sequence of such changes...language-internal developments of a relatively predictable, non-contingent sort play the dominant role in the weakening and ultimate loss of harmony.” Under this view, the root

\textsuperscript{155} Conversely Clements and Sezer (1982) and Polgardi (1999) both argue that vowel harmony is not fully active within roots in modern Turkish. But see Kabak and Weber (2013) for the opposing view.
causes of harmonic weakening should be sought elsewhere in the grammar. The disharmony of loanwords is then primarily seen as an indication of changes already occurring due to weaknesses present in the grammar or as an additional, secondary motivation for weakening.

7.3 Vowel Harmony Weakening and Loss in Related Languages

Backness harmony, which has been reconstructed as having been present in the Uralic Proto-language, originally existed in Proto-Finnic and all daughter Finnic languages (Abondolo 1998: 17; Hakulinen 1961: 6; Viitso 1998: 106-7). However, harmony has subsequently been weakened or lost in many of these languages and dialects including Vepsian, Livonian, and some dialects of Estonian (Grünthal 2000: 56; Viitso 1998: 107). In some Finno-Ugric languages, such as Khanty, Mordvin, and Mansi,156 different dialects display varying degrees of synchronic productivity of harmony (Abondolo 1998: 359; Tauli 1966: 225-7; Zaicz 1998: 190). Finnish, which is widely regarded as being among the most conservative Finno-Ugric languages (Grünthal 2003: 24; Hakulinen 1961: 18), has retained its harmony system much longer than many of the Finnic languages but appears to now also be in a period of instability which may be understood as the initial stages of loss.

As with Finnish, these Finnic languages have been exposed to the possibility of disharmonic stems throughout their history via compounds and loanwords. Though the vast majority of compounds have preserved their original vowels, there are some exceptions indicating that harmonization was possible in some cases within a compound e.g. Votian ähü(p)päälee ‘(to) on top of the stove’ < *ahjon päällen (Ariste 1968: 6). As in Finnish though, disharmony has occurred in these languages and originated from unrepaired loanwords, onomatopoeic words, and compounds which have lost their compositionality without harmonizing, as exemplified by the Votian examples shown below in (49). Note that Votian has front and central mid unrounded vowels, which pattern as front and back harmonic vowels respectively (Ariste 1968: 1, 4-5).

\footnote{Note that many of these languages have multiple names e.g. Mansi was formerly known as Vogul. Within this dissertation I have tried to use the name used by the people themselves.}
(49) Stem Disharmony in Votian\(^{157}\) (Ariste 1968: 5, 6, 120-1)

a. Unrepaired Loanwords

kläättsa ‘dried up, withered old person’
puteli ‘bottle’

b. Onomatopoeic Words

rääkumaa ‘to shout, yell’

c. Shortened Compounds

kase ‘this’
kane ‘those’

d. Non-Compositional Compounds

perzemmauttʃi < perze ‘seat, rear end’ + mautʃi ‘gut’ ‘rectum’
emätännaa < *emätä ‘mistress, lady’ + nain ‘woman’ ‘hostess’

Stem disharmony in these languages also resulted from internal phonological changes. In some languages co-articulatory effects from adjacent consonants have altered the character of stem vowels thereby creating disharmony. For example, in Vepsian the [back] feature associated with consonants may spread to adjacent vowels as from the adessive suffix [-l] in [värʲtn’ä-l] ‘spindle (ades.)’ (c.f. [värʲtnä-d] ‘spindle (pl.)’) which may be compared with the more conservative standard Finnish [värttinä-llä] ‘spindle (ades.)’ (Wiik 1989: 81). In certain cases in some languages the vowel harmony alternation has morphed into a consonant alternation, as shown in the Konda dialect of Mansi where [-käät] attaches to front stems and [-χäät] to back stems (Tauli 1966: 228). Viitso (1998: 107) notes that “the youngest speakers of North Vepsian often ascribe the feature of palatality not to front vowels but to the palatalized consonants that accompany them”. In Erza Mordvin the backness of the vowels in some suffixes actually depends on the

\(^{157}\) Transcription has been altered throughout from the Uralic Phonetic Alphabet (UPA) to the International Phonetic Alphabet (IPA).
palatalization of the stem consonants rather than that of the preceding vowel e.g. *kalʲ ‘weide’, *kalʲ-še (iness.), *kalʲ-de (abl.) but *kal ‘fish’, *kal-so (iness.), *kal-do (abl.) (Tauli 1966: 228).

Abondolo (1998: 18) states that “many Uralic languages such as Saamic, Estonian, Permian, Selkup, and most Ob-Ugrian dialects, have ‘lost’ vowel harmony through various combinations of (1) loss of the non-first syllable vowel which would have shown the alternation, (2) neutralizations, through mergers, of front/back distinctions, and (3) radical rotation of the first syllable vocalism.” Many languages such as Vepsian, Livonian, and dialects of Estonian have a synchronically impoverished vowel system in non-initial syllables. Vowels which were historically front are synchronically disallowed in syllables which are not initial or in the first two to three syllables of a word, effectively preventing or severely degrading harmony e.g. Estonian *kyla ‘town’ cf. Finnish *kylä, Vepsian *käbu ‘cone’ cf. Finnish *käpy (Comrie 1981: 111-2; Laakso 2001: 184; Tauli 1956: 103-5; Viitso 1998: 108-9; Wiik 1989). Viitso (1998: 107) includes “the rise of syllabic quantity and tone distinctions in the first syllable in Livonian and Estonian” as factors in harmony loss.

Vowel reduction and loss have altered not only stem vowels but have also affected suffixal harmony. Low vowels, especially when final, have been subject to reduction and loss in several Finnic languages and dialects which previously had robust backness harmony systems. Devoicing, reduction, and deletion of word-final vowels have commonly occurred in Vepsian, Livonian, and some dialects of Estonian and Votian (Tauli 1956: 74, 78-84; Ariste 1968: 6; Viitso 1998: 109). As shown below in the examples in (50) from Ariste (1968: 2, 6), in the Jõgõperä dialect of Votian low stem and suffix vowels may be reduced, may surface as voiceless and, in some cases may delete entirely word-finally. These processes are shown to affect not only stem vowels but also suffix vowels. In the examples in (50) below, the first transcription is the underlying form, the second is the surface form written in the UPA as used in Ariste (1968) and the third, the equivalent surface form in the IPA.\(^{158}\)

\(^{158}\) Note the transcription in original using Uralic Phonetic Alphabet (UPA) has been changed to closest IPA transcription. In the UPA there are separate symbols for reduced vowels at all positions in the vowel chart. As the IPA does not allow the same possibilities, both the original transcription and the closest available IPA transcription...
(50) Jõgõoperä Votian Low Vowel Reduction and Deletion

a. Vowel Centralization

\(/\text{paikka/} \quad \text{[paikkə]} \quad \text{[paikkə]} \quad \text{‘place spot’}\\
\(/\text{anna-mmə/} \quad \text{[annə-mmə]} \quad \text{[annə-mmə]} \quad \text{‘we give’}\\
\(/\text{tətšə-miss-æ/} \quad \text{[tetʃə-miss-ə]} \quad \text{[tetʃə-miss-ə]} \quad \text{‘doing (part.)’}

b. Vowel Reduction and Devoicing

\(/\text{tšühse-ttiú/} \quad \text{[tʃyhsettʏ̥]} \quad \text{[tʃyhsettʏ̥]} \quad \text{‘baked’}\\
\(/\text{tšültši/} \quad \text{[tʃyltʃɪ̥]} \quad \text{[tʃyltʃɪ̥]} \quad \text{‘side’}

c. Vowel Deletion

\(/\text{tuli-mmə kottoo/} \quad \text{[tulim kottō]} \quad \text{[tulimm kotto:] \quad \text{‘we came home’}

Kuznetsova (to appear) charts the development of the voiceless reduced vowels in the Lower Luga dialect of Ingrian, which is closely related to Finnish and has the same eight vowel inventory. Short vowels which were not foot initial often underwent quantitative reduction and devoicing e.g. \([\text{tyttō}]^{159}\) ‘girl (nom.)’ and \([\text{iḥmīse-d}]\) ‘man (pl.)’. Vowel merger has also occurred in Lower Luga Ingrian with \([\ddot{ə}, \ddot{ā}], \text{and } [\ddot{ē}]\) merging to \([\ddot{o}, \ddot{u}, \ddot{o}], \text{and } [\ddot{u}]\) merging to \([\ddot{e}]\). These mergers, which would seem to degrade suffixal harmony quite substantially in that they merge front and back vowels, occurred also in the geographically isolated Siberian Ingrian-Finnish dialect\(^{160}\). Vowels often were subsequently deleted, in some cases leaving secondary

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159 In the Uralic Phonetic Alphabet (UPA) transcription system the following length diacritics are used, in addition to others: \([ā] \text{ under-short, } [a] \text{ short, } [ā] \text{ half-long.}

160 Note that many morphological distinctions remain salient as they were formerly represented by vowel length and now are realized by the presence vs. the absence of a vowel e.g. former opposition (also still seen in the Soikkala Ingrian dialect) \([\text{kukkō}] \text{ ‘rooster (nom.)’ vs. } [\text{kukkō}] \text{ ‘rooster (part./illat.)’}, \text{ current opposition in Lower Luga Ingrian dialect } [\text{kukkō}] \sim [\text{kukkō}] \text{ ‘rooster (nom.)’ vs. kukko ‘rooster (part./illat.)’}.\)
palatalization or labialization on the remaining preceding consonants, as occurred in Estonian. Even prior to deletion, these vowels are often so reduced as to be imperceptible to speakers.

In many languages the vowels of nominal case suffixes are affected, which, in its most extreme form, results in a loss of suffixal harmony for affected suffixes. If a sufficient number of suffixes are affected, suffixal harmony will be completely eroded. In several Finnic languages and dialects two or more locative cases have been subject to reductive processes and have subsequently converged into forms which do not evidence vowel harmony, as shown in (51) (Tauli 1966: 25-8). For comparison the cases in Standard Finnish and reconstructed Proto-Finnic respectively are as follows: adessive -lA *-lnA; allative -lle *-lenj; and ablative -ltA *-ltA (Hakulinen 1961: 72-3).

(51) Case Reductions and Convergences

a. Olonets Karelian
adessive, allative, ablative converged → [-l] or [-le]

b. Vepsian, Ludian
adessive, ablative converged → [-l], [-l'], [-l], [-u] or vowel prolongation

c. Livonian
adessive, allative converged → [-l(o)]

d. Ingrian, Karelian Isthmus and South-West Finnish dialects
adessive, allative converged → [-l]

In the cases above, which are representative of changes in other cases in these languages, the reductions have eliminated the potential for suffixal vowel harmony in many cases. However, due to the agglutinative nature of the morphology in these languages, multiple suffixes are possible. In Olonets Karelian the suffix vowels in this adessive/allative/ablative suffix ([l(l)e]) as well as the inessive/elative suffix ([s] ~ [-z] ~ [-ssA]) are retained before the possessive suffixes allowing vowel harmony to surface for the inessive/elative in these instances e.g. peässä-ni ‘in/from my head’ (Tauli 1966: 28). While it is not explicitly stated whether the vowel resurfaces with the addition of further suffixes in other languages, examples of Vepsian from
Hienonen (2010: 288) show cases in which the adessive is followed by an indefiniteness marker without an intervening vowel indicating that the vowel may be lost in some languages or dialects e.g. mi-l-se ‘what (adess. indef.)’ and kene-l-se ‘who (adess. indef.)’.

While harmony remains in some Finnic languages and dialects, it is either absent from or heavily weakened in many other languages and dialects which have been subject to similar internal and external forces. In the context of this group of closely related languages, a weakening of harmony in Finnish is therefore not unexpected. The final vowels which instantiate the suffixal harmony are often subject to reductive processes including quantitative reductions, devoicing, and centralizations which degrade the harmony system. The persistence of harmony in Finnish may be a consequence of the overall conservativeness of the language as compared to the other, more innovative Finnic languages.

7.4 Internal Factors in Finnish Relevant to Harmony Weakening

As discussed in section 7.3, there are a number of processes shared by the Finnic languages which may result in the reduced perceptibility and ultimate loss of the very vowels which instantiate the suffixal harmony. Without suffixal harmony, stem harmony, particularly in the context of a language with many disharmonic loanwords and non-compositional compound words, may then cease to be psychologically relevant to speakers.

7.4.1 Distinctiveness of the Low Vowels

The Finnish harmony system crucially relies on distinct front and back vowels, particularly the front and back low vowels, which are over-represented especially in the nominal inflectional suffixes. In some areas of Finland though, the front-back distinction is weak for the low vowels, which are the closest front-back pair in the vowel space. For example, Iivonen and Harnud (2005: 65) refer to Kuronen’s (2000) phonetic work which indicates that the low vowels in the Tampere dialect of Finnish are barely distinct and are subject to auditory confusion. This is suggestive of a possible low vowel merger in this dialect. The difference between the front and
back low vowel means in Kuronen (2000 as reported in Iivonen and Harnud 2005: 65) is, at 198 Hz, much smaller than the differences between those means reported in Wiik (1965) (600 Hz), Iivonen and Laukkanen (1993) (578.47 Hz), or Palo, Aalto, Aaltonen, Happonen, Malinen, Saunavaara, and Vainio (2012) (473 Hz). However, the differences in the means of [ää] and [aa] produced by speakers of a South-Western Finnish dialect in Eerola and Savela’s (2012) data are, at 204 Hz, similarly small. For comparison the differences between the mean F2 values for [ä] and [a] for females and males in Experiment 1 are 383 Hz and 318 Hz respectively. In Experiment 2-B the differences between the mean F2 values for [ä/ää] and [a/aa] (extracted from the verbs) for females and males are 282 Hz and 269 Hz respectively. Though in each experiment the low vowels were statistically distinct, the F2 difference is fairly small. Excluding Kuronen’s (2000) findings, there appears to be a clear trend over time for the difference between the two low vowels to reduce.

As there is smaller articulatory/acoustic space for the low vowels, any merging or perceptual confusion might then be expected here. In fact, in the Lower Luga dialect of Ingrian, a closely related language, the merger of the short low vowels [a] and [ä], along with some instances of [e], in weak positions was the first merger to occur (Kuznetsova to appear).

7.4.2 Low Vowels in Suffixes

In Finnish any such lack of distinction between front and back vowels is most crucial in the low vowels since most inflectional suffixes with harmonic vowels contain these vowels and rely on their alternation to instantiate the harmony. Any perceptual difficulties or reduction in the harmonic vowels that are often present in the suffixes might be expected to affect the harmonic alternation normally expected in these affixes.

As part of her phonetic experiment, Mahonen (2011: 72-6) examined the suffixation of some native front and back words produced primarily by young female Helsinki dialect speakers. Though it was expected that the front and back suffix categories would be distinct, this wasn’t the case for all speakers. 20% of her participants showed massive overlap between the front and back suffixes and an additional 50% showed some substantial overlap. Mahonen (2011: 87)
herself states that “most participants did not have discrete suffix vowel F2 ranges for these word types [front and back harmonic native words]. The majority had at least some overlap between the front and back vowel ranges”\textsuperscript{161}. These results are to be expected if the low vowels are potentially non-distinct in at least some dialects but are unexpected if suffixal vowel harmony is robust and utilizes the alternation between low vowels to instantiate harmony.

Mahonen (2011: 75; 87) attributes the overlap to word-final unstressed vowel centralization, rather than the occurrence of a central suffix vowel, as was postulated by Välimaa-Blum (1999). Unfortunately Mahonen (2011) does not present any data on the F2 values for non-suffix low vowels for comparison. While Suomi et al. (2008: 22) stated that reduction is, at most, minimal for unstressed vowels, Wiik (1965: 134) found some evidence of unstressed vowel centralization which he attributed to reduced duration. Word-final vowel reduction has also been previously suggested by Skousen (1975: 104-105) who notes that word-final /a/, which is unstressed, may be reduced to [ə] for example in /talo-sta/ [talo-stə] ‘house (elat. sg.)’. As the reduction affects only the back vowel, the expected harmonic alternation [ä]~[a] is realized instead as [ä]~[ə]. The phonetic realization suggested by Skousen (1975: 104-5) therefore is not quite that described by either Mahonen (2011) or Välimaa-Blum (1999) since the harmonic alternation is retained albeit with an altered phonetic realization.

The suffix vowels appended to compound words in Experiment 1 indicated a difference in behaviour between the younger females and the other speakers. While the males and the older females maintained the expected distinct front and back suffix categories, the younger females demonstrated suffix overlap, consistent with Mahonen’s (2011) findings. The suffix vowels in Experiment 2-B also indicated differences in the production of females and males. Some, mostly female, speakers appeared to front all suffix vowel tokens to such an extent that there was almost complete overlap with the front vowel category. As the ‘front’ and ‘back’ suffix vowels were statistically distinct, this appears to be an example of near neutralization.

\textsuperscript{161} This lack of distinct suffix categories in the native words for these speakers, which Mahonen (2011: 75, 87) attributes to word-final unstressed vowel centralization, makes it difficult to conclude that these speakers have suffixal vowel harmony at all or if their harmony system is so degraded as to be defunct.
Walker (2011: 49) states that “Barnes’ cross-linguistic study of positional neutralization finds that languages evolve in such a way as to yield phonological patterns with phonetic origins. He postulates that phonological representations can undergo change through interpretation of phonetic regularities in the system. The likelihood of reinterpretation that neutralizes a phonological distinction is increased in a context where two distinct phonological elements show overlap in a significant portion of their realizations.” Whether the overlap in the suffix vowels seen in the results herein and reported by Mahonen (2011) is currently sufficient to cause a neutralization of the front and back categories requires additional study. However, even if it has not yet reached the critical level of overlap, it is clearly extensive for certain speakers exposing the possibility of complete neutralization in the future.

7.4.3 Phonetic Factors Affecting Low Suffix Vowels

Outside of their physical proximity in the vowel space, which renders [ä] and [a] inherently potentially confusabale perceptually, the word-final suffix vowels are also subject to additional internal factors including unfavourable intonation contours and non-modal phonation that may contribute to their perceptual difficulties. In Finnish primary stress is always word-initial and word and sentence intonation are falling (Suomi et al. 2008: 75, 114-5). The final syllable is often produced at very low pitch, which may result in non-modal phonation such as creaky voice, breathy voice, and devoicing (Lehtonen 1970: 45; Myers and Hansen 2007; Ogden 2001; Suomi et al. 2008: 17, 115). In the acoustic data presented in this thesis, these effects, along with final glottal frication, very frequently occurred on the harmonic suffixes, which were word and sentence-final162.

As the other Finnic languages have similar stress and intonation patterns (Ariste 1968: 15; Viitso 1998: 104), the acoustic pressures on low final vowels described above for Finnish are expected to be found also in these languages. Walker (2011: 24) referring to the work of Barnes (2006)

162 Viitso (1998: 109) notes that devoiced vowels may occur in all non-first syllables in Setu South Estonian, Ingrian, and West Finnish.
states that “…final positions tend to show certain phonetic properties that reduce perceptual robustness. These include drops in pitch and intensity, and total or partial loss of voicing or the occurrence of breathy or creaky voice. These characteristics have the potential to obscure perception of vowel quality”.

Though the low vowels are the most sonorous and inherently longest vowels, which would seem to offer protection from reduction, it may be precisely these properties which instead instigate their reduction. Crosswhite (2004) differentiates between contrast-enhancing reduction, which may result in vowels surfacing as one of the corner vowels [i], [u], or [ə] to enhance contrast, and prominence reduction, which results in vowels in unstressed positions reducing to more central positions. Under prominence reduction, the low vowels may reduce to mid vowels or [ə] “based on the desire to avoid particularly long or otherwise salient vowel qualities in unstressed positions” (Crosswhite 2004: 204). The suffix vowels in question in Finnish, which are low vowels always in unstressed positions, would then be expected to reduce.

Devoicing, centralization, and vowel reduction, processes which have been ascribed to the harmonic suffix vowels in Finnish, are all evidence of weakening. As shown in (52) below, within some dialects of Finnish, especially in colloquial speech, the lenition has ultimately led to the apocope of final suffix vowels, though final stem vowels have remained unaffected163 (Anttila 1972: 80; Karlsson 1983: 245; Tauli 1966: 26, 31, 259). See Kettunen (1940) for maps detailing the areas where deletion is common.

163 Note that Hock (2003: 451) states that in standard Finnish it is instead stem-final vowels delete while case suffix vowels are immune to apocope.
Apocope in Western Finnish Dialects

a. Deletion of Suffix-Final Vowels

/taka-nA/ [takan] ‘behind’
/mu-ltA/ [mult] ‘from me’

b. Retention of Stem-Final Vowels

/pakana/ [pakana] ‘pagan’
/multa/ [multa] ‘earth, dirt’

Apocope is an old dialectal feature which was already evident in old written Finnish (Nummenaho 1995: 72-77). Synchronically the deletion may primarily affect some suffixes, such as ablative /-ltA/, adessive /-llA/, elative /-stA/, and inessive /-ssA/, while leaving others unscathed (Päivi Koskinen p.c.). Tauli (1966: 51) though states that in South-West Finnish dialects all suffix final vowels have disappeared from case suffixes, which is similar to the case reductions and losses that have occurred in Livonian and Estonian. In many of these languages there is a tendency towards the phonological reduction and coalescence of cases resulting in a less agglutinative grammar (Comrie 1981: 13-4; Grünthal 2000: 34; Tauli 1966: 35).

While the final vowels of case suffixes have been lost only in certain dialects, all of the Finnish dialects share the internal features which likely lead to the deletions. Low pitch, non-modal phonation, and lack of stress, which have been associated with weakening cross-linguistically, are all features of these suffix-final vowels across all Finnish dialects.

Overall, there are a number of external and internal factors that may be contributing to the weakening of the harmony system in Finnish, in particular in relation to the alternation of the low vowels. Kiparsky and Pajusalu (2003: 2), discuss an observation by Wiik (1988) who notes that, in the Finnic languages, every language or dialect that has harmony has alternations among
the low vowel pair. Perhaps then the weakening of harmony in this low vowel pair is most detrimental to the harmony system.

7.4.4 Fronting of Suffixes

While centralization and reduction of the word-final unstressed low vowels of the case suffixes is perhaps unsurprising, particularly in light of changes in many closely related Finnic languages and dialects, the fronting seen especially in Experiment 2-B and Experiment 2-C requires explanation. Why would the suffix vowels surface as neutral [e] or particularly the front [ä], which is more marked than the back [a]?

Morpheme generalization has been a factor in the weakening or loss of harmony in many of the Finno-Ugric languages and dialects (Tauli 1966: 225-7). In a majority of these cases, the suffixes seem to generalize to the back allomorph though, as seen in the Moksha Mordvin examples in (53), which are contrasted with the Erza Mordvin forms which retain harmony (Tauli 1966: 225).

\[164\] Note that in Mari, a non-Finnic Finno-Ugric language, while there is a suffixal alternation between [ä] and [a], [ä] is considered non-phonemic (Walker 2011: 148).
(53) Morpheme Generalization in Moksha Mordvin

a. Erza Mordvin

<table>
<thead>
<tr>
<th>Gloss</th>
<th>Ablative</th>
<th>Inessive</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘land, country’</td>
<td>modɑ-do</td>
<td>modɑ-sɔ́</td>
</tr>
<tr>
<td>‘village’</td>
<td>viɛl-e-dɛ̱</td>
<td>viɛl-e-ʃɛ</td>
</tr>
</tbody>
</table>

b. Moksha Mordvin (dial.)

<table>
<thead>
<tr>
<th>Gloss</th>
<th>Ablative</th>
<th>Inessive</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘land, country’</td>
<td>modɑ-dɑ̆</td>
<td>modɑ-sɑ̆</td>
</tr>
<tr>
<td>‘village’</td>
<td>viɛl-o-dɑ̆</td>
<td>viɛl-e-šɑ̆</td>
</tr>
</tbody>
</table>

Invariant suffixes in Finnic languages or dialects which retain harmony also tend to be back harmonic. For example, in Votian dialects with harmony, where some inflectional and derivational suffixes do not conform to vowel harmony, all but possibly the genitive plural and the derivational affix [-lein] appear to surface as back\(^{166}\) (Ariste 1968: 5, 18, 33, 35, 116, 118).

The neutral [e] suffix is very likely a result of reduction as it occurs near the centre of the vowel space. In the Savo dialect of Finnish, [e] has previously been recorded as an alternative to the low vowel alternation e.g. 2pl imperative mäŋ-kee < *mäŋ-kä-tä and tul-kee < tul-koa < *tul-ka-tä (Tauli 1966: 249). The use of the front unrounded mid vowel appears to be a possible stage in the weakening of the suffix vowels and is also seen in the Jõgõoperä dialect of Votian in which many of the low suffix vowels are optionally realized as front or central mid vowels (Ariste 1968).

\(^{165}\) See footnote 159 for length diacritics in UPA.

\(^{166}\) Though Ariste (1968: 18) lists front and back variants of the genitive plural, he also provides several examples where it appears that the front allomorph has attached to a back stem e.g. oonejee ‘buildings (gen.pl.)’ where [ɛ] is a back vowel and [e] front. While the derivational suffix [-lein] is listed only with a front suffix, unfortunately no back stem examples are provided to determine whether it would harmonize (Ariste: 1968: 116).
The front [ä] allomorph is still unexpected though as it is more marked than its back counterpart. The occurrence of [ä] may be potentially explained by coarticulation and/or the typical comparative height realizations of the low vowels. Since the low suffix vowels generally follow [i] in both experiments herein, some degree of fronting is expected.

Though adjacent voiceless segments are primarily expected to affect vowel height, Cole, Linebaugh, Munson, and McMurray (2010: 175) found that vowels preceding voiced consonants had lower F2 values. If these effects occur also in Finnish, the suffix vowels which appear before final [h] may be somewhat fronted. As well breathy voice, which was a common occurrence in the data, may cause raising in some languages (Gordon and Ladefoged 2001). Barnes (2006: 149) also discusses raising seen in word-final open syllables due to the decreased amplitude and delayed F1 peak of the final vowel, which may cause misperception of the vowel height. Either of these accounts could be connected to the raising seen in the language game to [e]. However, the raising may not be sufficient to reach [e]. In Wiik (1965) and Experiment 1, the front low vowel was found to be slightly higher than the back low vowel (though the opposite pattern was seen in Iivonen and Laukkanen 1993 and Experiment 2-B). In dialects where [ä] is higher, slight raising might cause a misperception of the vowel as being front [ä] rather than back [a], resulting in the otherwise unexpectedly frequent use of [ä].

7.5 Future Directions

In an effort to fully understand the synchronic state of harmony in Finnish, there is yet more phonetic and phonological work to be done. All the previous studies, including Experiment 1 and Experiment 2 discussed herein, have been formal experiments and thus have not had access to casual speech; it is now crucial to determine what is happening in everyday speech situations.

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167 It is unclear whether this finding is a general tendency or is specific to American English or what would be the cause.

168 While the language game data was expected to produce less formal results due to the reduced reliance on written forms, the attention paid to the workings of the game over the normative outputs, and the inherently less formal style of game speech over normal speech, the setting remained formal.
with native or fully nativized vocabulary. Studies of casual speech would also have the advantage of reducing orthographic influence as much as possible. At present it appears likely that orthography does have some role though the nature and degree of its involvement is currently unknown.

Recently loanwords have typically been the focus of most examinations of vowel harmony in loanwords. As Finnish has a limited set of possible final consonants, epenthetic final vowels are commonly added to borrowed words. While other vowel qualities were formerly possible as epenthetic vowels, synchronically [i] is almost invariably selected (Suomi et al. 2008: 59-60). Thus, many recent loanwords have stem-final [i], which may cause fronting, immediately preceding suffixes, which in the case of the partitive is vowel initial on the surface. The behaviour of other word types with different final vowels should be examined as well as comparisons made between different cases e.g. *koivu-a* ‘birch (part.)’, *koivu-j-a* ‘birch (part. pl)’, *koivu-sta* ‘birch (elat.)’.

In terms of vowel position, all the studies have also examined only word-final, often also sentence-final, suffixes. Since Finnish can have sequences of several suffixes and/or clitics e.g. *pullo-sta-han* ‘from the bottle (emphatic)’ or *kirja-sto-ssa-ko* ‘in the library?’, it is important to contrast the behaviour of non-final and final-suffixes as well as stem-final vowels to determine if the changes seen are specific to word-final suffix vowels or if they are more general and are applicable to all suffixes or even low vowels in all positions. As discussed in section 7.3 some languages such as Jõgõperä Votian appear to reduce all non-initial low vowels, while others, such as Olonets Karelian, have positional neutralization affecting only the final vowel. Similarly, the word-final suffixes which are not phrase-final could provide evidence to determine whether the reductive effects are present only in phrase-final position. These examinations would provide additional evidence concerning the current degree of weakening vs. productivity.

Studies have thus far examined only the alternation of the low vowels because it is these vowels which occur in the nominal inflectional suffixes. However, there are some non-low vowel nominal derivational suffixes and clitics and future work may choose to examine their behaviour as well as the behaviour of the non-low verbal suffixes.
Non-Low Suffixes/Clitics

pullo-ko  ‘bottle? (interrogative clitic)’
nimi-tön  ‘nameless’
lopetta-nut  ‘finished (past participle)’

Additionally, perception tests to determine how speakers themselves classify the relevant suffix vowels may provide evidence concerning their phonological representation and the degree to which phonetic reduction is psychologically relevant.

The results of the experiments discussed herein, in conjunction with the additional evidence concerning low vowel realization in Finnish discussed above, suggest that the robust, regular, fully productive harmony system normally described for Finnish is perhaps, at this point, merely an idealization. Unrepaired stem disharmony in the loanwords and, more crucially, the lack of harmonization in the language game seem to indicate that stem harmony is not presently fully productive. The suffix realizations in both Experiment 1 and Experiment 2-B, alongside Mahonen’s (2011) findings of front and back overlap and Välimaa-Blum’s (1999) findings of central suffix vowels seem to indicate that suffixal harmony is also eroding.

The harmony decay may have been precipitated by a number of internal and external factors which, for Finnish, may include the susceptibility of the low vowels, the vowels often occurring in the inflectional suffixes, to reduce and often delete. These vowels which are close in proximity occur in final position, a position with inherent instability often characterized by low pitch, non-modal phonation, and lack of stress. Over time the combination of these internal factors may have begun to obscure the harmonic alternations. The phonetic neutralization of suffix vowels inevitably leads to a breakdown in suffixal harmony as no discrete front or back surface forms would occur on the surface resulting in the eventual erosion of suffixal harmony. While the weakening may have been slowed by the conservative nature of the Finnish grammar as compared to other Finnic languages (Grünthal 2003: 24), combined with the orthographic norms, it seems that Finnish vowel harmony may have already entered into the perhaps inevitable phase of harmony loss.
References


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Appendices

Appendix 1: Dialect Map of Finland (Kettunen 1940)
Appendix 2: Etymology of Experiment 1 Target Words (Koukkunen 1990)

The target loans were primarily borrowed via Swedish and most were included in Finnish dictionaries in the mid-1800s. This, of course, does not mean that they entered the language at the same time, merely that they were sufficiently well known by this period to be included in contemporary dictionaries. The three loanwords which were not listed in Koukkunen (ed.) (1990) are presumably the most recent of the loanwords.

<table>
<thead>
<tr>
<th>Date of Inclusion in Finnish Dictionary</th>
<th>Language of Origin</th>
<th>Word</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>1838</td>
<td>Swedish</td>
<td>amatööri</td>
<td>‘amateur’</td>
</tr>
<tr>
<td>1838</td>
<td>Swedish</td>
<td>arkkitehti</td>
<td>‘architect’</td>
</tr>
<tr>
<td>1838</td>
<td>Swedish</td>
<td>atmosfäär</td>
<td>‘atmosphere’</td>
</tr>
<tr>
<td>1838</td>
<td>Swedish</td>
<td>krokotiili</td>
<td>‘crocodile’</td>
</tr>
<tr>
<td>1853</td>
<td>Swedish</td>
<td>adjektiivi</td>
<td>‘adjective’</td>
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<td>‘analysis’</td>
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<td>1853</td>
<td>Swedish</td>
<td>karamelli</td>
<td>‘caramel, candy’</td>
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<tr>
<td>1853</td>
<td>Swedish</td>
<td>kunduktööri</td>
<td>‘conductor’</td>
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<td>‘career’</td>
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<td>Swedish</td>
<td>karuselli</td>
<td>‘carousel’</td>
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<td>Swedish</td>
<td>konstaapeli</td>
<td>‘constable’</td>
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<tr>
<td>1865</td>
<td>Swedish</td>
<td>molekyyli</td>
<td>‘molecule’</td>
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<tr>
<td></td>
<td></td>
<td>kuvernööri</td>
<td>‘governor’</td>
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<td>manikyyri</td>
<td>‘manicure’</td>
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<tr>
<td></td>
<td></td>
<td>miljonääri</td>
<td>‘millionaire’</td>
</tr>
</tbody>
</table>
Appendix 3: Sociolinguistic Questionnaire – Experiments 1 and 2

Miespuolinen ☐  Naispuolinen ☐

Syntymävuosi:

Syntymäpaikka:

Nykyinen asuinpaikka:

Muut asuinpaikat:

<table>
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<tr>
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<th>Useita vuosia</th>
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</thead>
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</table>

Syntymäkieli:

Toiset kielet:

<table>
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<th>Kirjoittaa</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>huonosti hyvin sujuvasti</td>
<td>huonosti hyvin sujuvasti</td>
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<td>huonosti hyvin sujuvasti</td>
<td>huonosti hyvin sujuvasti</td>
</tr>
</tbody>
</table>

Äidin syntymäkieli:

Isän syntymäkieli:

Mikä on korkein koulutustaso, jonka olet suorittanut?

Kiitos avusta!
Male ☐ Female ☐

Year of birth:

Birth place:

Current place of residence:

Other places lived:

<table>
<thead>
<tr>
<th>City</th>
<th>Country</th>
<th>Number of years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Native language:

Other languages:

<table>
<thead>
<tr>
<th>Language</th>
<th>Spoken</th>
<th>Written</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>poorly well</td>
<td>poorly well</td>
</tr>
<tr>
<td></td>
<td>fluently</td>
<td>fluently</td>
</tr>
<tr>
<td></td>
<td>poorly well</td>
<td>poorly well</td>
</tr>
<tr>
<td></td>
<td>fluently</td>
<td>fluently</td>
</tr>
<tr>
<td></td>
<td>poorly well</td>
<td>poorly well</td>
</tr>
<tr>
<td></td>
<td>fluently</td>
<td>fluently</td>
</tr>
</tbody>
</table>

Mother’s native language:

Father’s native language:

What is the highest level of education you have completed?

Thank you for your help!
Appendix 4: Experiment 1 ANOVA Results Compared with LMER Results

For comparison with Experiment 2, the data in Experiment 1 was re-examined using a linear mixed effects model to determine if there were any differences between it and the ANOVA reported in the body of Chapter 3. Contrast coding for factors was performed. The model was as follows: lmer(F2~Gender*Age*WordType+(WordType|Participant)+(1|LexicalItem),data). Note that this analysis, unlike the ANOVA, includes the BF word type. As there was a three-way interaction whereby the effect of word type on the dependent variable F2 differed by the age and gender of the participants, separate analyses were run on the males and females. The results are presented below.

Females:
Fixed effects:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1744.6</td>
<td>37.2</td>
<td>46.8</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>ageY</td>
<td>-139.3</td>
<td>73.5</td>
<td>-1.9</td>
<td>0.059</td>
</tr>
<tr>
<td>wordtypeBF</td>
<td>291.3</td>
<td>29.7</td>
<td>9.8</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>wordtypeBN</td>
<td>255.6</td>
<td>32.7</td>
<td>7.8</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>wordtypeF</td>
<td>282.3</td>
<td>27.4</td>
<td>10.3</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>wordtypeN</td>
<td>293.2</td>
<td>31.8</td>
<td>9.2</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>ageY:wordtypeBF</td>
<td>-188.0</td>
<td>48.6</td>
<td>-3.9</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>ageY:wordtypeBN</td>
<td>-151.1</td>
<td>52.4</td>
<td>-2.9</td>
<td>0.004 **</td>
</tr>
<tr>
<td>ageY:wordtypeF</td>
<td>147.8</td>
<td>42.2</td>
<td>-3.5</td>
<td>0.001 ***</td>
</tr>
<tr>
<td>ageY:wordtypeN</td>
<td>-181.4</td>
<td>50.1</td>
<td>3.6</td>
<td>0.000 ***</td>
</tr>
</tbody>
</table>

Significance codes: *** 0.001 ** 0.01 * 0.05

Males:
Fixed effects:

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>Std. Error</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1513.8</td>
<td>96.3</td>
<td>17.53</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>ageY</td>
<td>9.1</td>
<td>171.4</td>
<td>0.05</td>
<td>0.958</td>
</tr>
<tr>
<td>wordtypeBF</td>
<td>298.0</td>
<td>32.5</td>
<td>9.18</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>wordtypeBN</td>
<td>252.3</td>
<td>61.1</td>
<td>4.13</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>wordtypeF</td>
<td>283.9</td>
<td>33.2</td>
<td>8.55</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>wordtypeN</td>
<td>318.6</td>
<td>37.2</td>
<td>8.55</td>
<td>0.000 ***</td>
</tr>
<tr>
<td>ageY:wordtypeBF</td>
<td>69.1</td>
<td>24.4</td>
<td>2.83</td>
<td>0.005 **</td>
</tr>
<tr>
<td>ageY:wordtypeBN</td>
<td>-14.9</td>
<td>101.0</td>
<td>-0.15</td>
<td>0.883</td>
</tr>
<tr>
<td>ageY:wordtypeF</td>
<td>23.0</td>
<td>24.4</td>
<td>0.94</td>
<td>0.347</td>
</tr>
<tr>
<td>ageY:wordtypeN</td>
<td>54.9</td>
<td>28.4</td>
<td>1.93</td>
<td>0.054</td>
</tr>
</tbody>
</table>

Significance codes: *** 0.001 ** 0.01 * 0.05

---

169 The p-values were determined using a t-test with a degree of freedom calculated by taking the number of observations and subtracting the number of fixed effect parameters (Baayen 2008).
As in the ANOVA, the female results show a significant effect of Age with the mean F2 of the older speakers being slightly higher than that of the younger speakers. WordType is significant for both females and males. The mean F2 of the suffix vowels of Back-Final Compounds was significantly lower than the means of the other word types, Front-Final Compounds, Neutral-Final Compounds, BN Loans, and BF Loans, which were not significantly different from each other as revealed by post hoc tests.

There was a significant interaction between Age and WordType for both males and females. For females, for the BF Loans, BN Loans, Front-Final Compounds, and Neutral-Final Compounds the difference between the suffix values of these word types and the Back-Final Compounds is reduced for the younger speakers. For males, the interaction between Age and BF loanwords is significant and the interaction between Age and Neutral-final compounds is nearly significant. Younger male speakers produce the BF loanword suffixes slightly higher than older male speakers. Younger male speakers produce the Neutral-final compound suffixes higher than older male speakers. This pattern differs from that of the females.

Overall, both the ANOVA and the LMER were very similar. They both indicated that the Back-Final Compounds had significantly lower F2 values than the Front-Final Compounds, Neutral-Final Compounds, and BN Loans. The LMER included BF loans which patterned with the (more) front-selecting word types. The suffix values for the Front-Final Compounds, Neutral-Final Compounds, BN Loans, and BF Loans were not significantly different from each other. Both analyses indicated that the behaviour of females differed by age in terms of their suffixation of the (more) front suffixes. Older female speakers had a greater difference between their front and back suffixes than did the younger females.

An examination of the lexical effects was also performed with the following model: \( \text{lmer(F2} \sim \text{gender} \ast \text{age} + (1 \mid \text{Participant}) + (\text{gender} \mid \text{LexicalItem}), \text{data.BN}) \).

<table>
<thead>
<tr>
<th>Estimate</th>
<th>Std. Error</th>
<th>t-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1656.3</td>
<td>31.9</td>
</tr>
<tr>
<td>genderM</td>
<td>-238.1</td>
<td>63.6</td>
</tr>
<tr>
<td>ageY</td>
<td>-95.7</td>
<td>52.2</td>
</tr>
<tr>
<td>genderM:ageY</td>
<td>120.2</td>
<td>104.5</td>
</tr>
</tbody>
</table>

While the ANOVA had shown that age and the interaction between age and gender was significant, the LMER did not find either to be significant. Both analyses though indicated that the interaction between the lexical items and gender was significant. Further analysis indicated that all BN loanword lexical items showed a more exaggerated deviation from the mean for males than females.
### Appendix 5: Experiment 2 Verbs

<table>
<thead>
<tr>
<th>Finnish</th>
<th>Translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ajattelee</td>
<td>‘s/he thinks’</td>
</tr>
<tr>
<td>arvostelee</td>
<td>‘s/he criticizes’</td>
</tr>
<tr>
<td>auttaa</td>
<td>‘s/he helps’</td>
</tr>
<tr>
<td>harkitsee</td>
<td>‘s/he considers’</td>
</tr>
<tr>
<td>houkutteleee</td>
<td>‘s/he persuades’</td>
</tr>
<tr>
<td>häpeää</td>
<td>‘s/he disgraces’</td>
</tr>
<tr>
<td>ihailee</td>
<td>‘s/he admires’</td>
</tr>
<tr>
<td>kannustaa</td>
<td>‘s/he supports’</td>
</tr>
<tr>
<td>karttaa</td>
<td>‘s/he avoids’</td>
</tr>
<tr>
<td>kieltää</td>
<td>‘s/he prohibits’</td>
</tr>
<tr>
<td>kiinnostaa</td>
<td>‘s/he is interested in’</td>
</tr>
<tr>
<td>kokeilee</td>
<td>‘s/he tries on’</td>
</tr>
<tr>
<td>kunnioittaa</td>
<td>‘s/he respects’</td>
</tr>
<tr>
<td>kuuntelee</td>
<td>‘s/he listens to’</td>
</tr>
<tr>
<td>käskee</td>
<td>‘s/he commands’</td>
</tr>
<tr>
<td>käyttää</td>
<td>‘s/he uses’</td>
</tr>
<tr>
<td>odottaa</td>
<td>‘s/he waits for’</td>
</tr>
<tr>
<td>puolustaa</td>
<td>‘s/he defends’</td>
</tr>
<tr>
<td>puree</td>
<td>‘s/he bites’</td>
</tr>
<tr>
<td>pyytää</td>
<td>‘s/he asks for’</td>
</tr>
<tr>
<td>rakastaa</td>
<td>‘s/he loves’</td>
</tr>
<tr>
<td>rääkkää</td>
<td>‘s/he torments’</td>
</tr>
<tr>
<td>seuraa</td>
<td>‘s/he follows’</td>
</tr>
<tr>
<td>suosittelee</td>
<td>‘s/he recommends’</td>
</tr>
<tr>
<td>säälii</td>
<td>‘s/he pities’</td>
</tr>
<tr>
<td>totteleee</td>
<td>‘s/he obeys’</td>
</tr>
<tr>
<td>tutkii</td>
<td>‘s/he examines’</td>
</tr>
<tr>
<td>varoitaa</td>
<td>‘s/he warns’</td>
</tr>
<tr>
<td>varoo</td>
<td>‘s/he is wary of’</td>
</tr>
<tr>
<td>vähenää</td>
<td>‘s/he reduces’</td>
</tr>
<tr>
<td>ymmärtää</td>
<td>‘s/he understands’</td>
</tr>
<tr>
<td>ärstytää</td>
<td>‘s/he irritates’</td>
</tr>
</tbody>
</table>
Appendix 6: Mean Suffix F2 Values (in Hz) by Phonetic Stem Type – Experiment 2-B

The following chart graphs the mean suffix F2 values by phonetic stem type, as determined by the discriminant analysis, and gender.
Appendix 7: Discriminant Analysis Suffixes by Phonetic Stem Type – Experiment 2-B

The following charts graph the suffix discriminant analysis classification, front vs. back, by phonetic stem type for (a) males and (b) females. As in the discussion of mean suffix F2 in relation to stem type, the following stem types have been excluded due to their low token counts: four-syllable BB; four-syllable FF; four-syllable FN; and three-syllable neutral stems. In the graphs the stem types based on their phonetic form, as determined by the discriminant analysis, are listed above the columns. For each stem type, the ratio of front and back suffixes are shown with back suffixes shown above the front suffixes.
Appendix 8: Comparison between Stem and Suffix Vowels by Speaker – Experiment 2-B

Low Vowels in Native Stems as Produced by Speaker 3MY

Suffix Vowels Appended to Loanwords as Produced by Speaker 3MY
Low Vowels in Native Stems as Produced by Speaker 16MY

Suffix Vowels Appended to Loanwords as Produced by Speaker 16MY
Low Vowels in Native Stems as Produced by Speaker 6MO

Suffix Vowels Appended to Loanwords as Produced by Speaker 6MO
Low Vowels in Native Stems as Produced by Speaker 23MO

Suffix Vowels Appended to Loanwords as Produced by Speaker 23MO
Low Vowels in Native Stems as Produced by Speaker 5FY

Suffix Vowels Appended to Loanwords as Produced by Speaker 5FY
Low Vowels in Native Stems as Produced by Speaker 14FY

Suffix Vowels Appended to Loanwords as Produced by Speaker 14FY
Low Vowels in Native Stems as Produced by Speaker 7FO

Suffix Vowels Appended to Loanwords as Produced by Speaker 7FO
Low Vowels in Native Words as Produced by Speaker 11FO

Suffix Vowels Appended to Loanwords as Produced by Speaker 11FO
Appendix 9: Language Game Results – Experiment 2-C

The sentences are shown as they were presented to the participants. The language game responses for the four participants analyzed are presented below as follows: (a) 14FY; (b)11FO; (c)16MY; and (d) 23MO. The responses are grouped according to the expected harmonization patterns: no expected harmonization; expected harmonization of the verb to back; expected harmonization of the verb to front; expected harmonization of the noun to back; and expected harmonization of the noun to front. Sentences involving more than one type of reharmonization are repeated. Syllable divisions are marked and elements which have been switched are underlined. Some speakers appeared to treat some loanword initial syllables as having long vowels e.g. kykloppi ‘cyclops’, brosyyri ‘brochure’, Grönlanti ‘Greenland’. Since quantity was not the object of analysis, these differences are not discussed.

No Expected Harmonization
1. Pu.ree ___________________ (muf.fins.si)
   a. mu.ree puf.fens.si-ä\textsuperscript{170}
   b. mu.ree puf.fins.si-ä
   c. mu.ree puf.fins.si-ä
   d. mu.ree puf.fins.si-ä
2. Va.roo ___________________ (ho.bit.ti)
   a. ho.roo va.bit.ti-ä
   b. ho.roo va.bit.ti-ö
   c. ho.raa vo.bit.ti-a
   d. ho.roo va.bit.ti-ä

\textsuperscript{170} Note this could be switching of initial CV or initial C. Since the majority of the data indicates that it is the initial CV which switches, cases such as this are marked as the movement of CV.
3. Har.kit.see ______________ (hos.tel.li)
   a. hor.kit.see has.tel.li-ä
   b. hor.kit.see has.tel.li-ä
   c. hor.kit.see has.tel.li-ä
   d. hor.kit.see has.tel.li-a

4. I.hai.lee ______________ (puus.tel.li)
   a. pu.hae.lee i_hus.tel.li-ä
   b. pu.hai.lee iis.til.li-ö
   c. pu.hae.lee i.has.tel.li-e
   d. pu.hai.lee jus.tel.li-ä

5. Har.kit.see ______________ (a.tel.jee)
   a. ur.kit.see ha.tel.jee-ta
   b. ar.kit.see ha.tel.jee-ta
   c. or.kit.see hael.jee-tä
   d. ar.kit.see ha.tal.jee-ta

6. Kan.nus.taa ______________ (graf.fi.ti)
   a. gran.nus.taa kaf.fi.ti-ä
   b. gon.nus.taa ka RAF fi.ti-ö
   c. gron.nus.taa ka RAF fi.ti-a
   d. kan.nos.too ka RAF fi.ti-ä

7. Kuun.te.lee ______________ (or.kes.te.ri)
   a. oon.te.lee kur.kes.te.ri-e
   b. oon.te.lee kur.kes.te.ri-ö
   c. uun.te.lee kur.kes.te.ri-ä
   d. urun.te.lee kur.kes.te.ri-ä

____________________________

171 Note that [æ] is not a diphthong in the standard language. As discussed in section 5.2, [ae] may result from the lowering of high vowels in this dialect.
8. O.dot.taa ________________ (pa.ra.tii.si)
   a. pa.ot.taa u.ra.tii.si
   b. pa.dot.taa o.ra.tii.si-ö
   c. pa.ot.taa a.ra.tii.si-e
   d. pa.dot.taa o.ra.tii.si-e

Possible Verb Harmonization to Back

9. Hä.pe.ää ________________ (ku.tyy.mi)
   a. ku.pe.aa hä.tyy.mi-ä
   b. ku.pe.ää hä.tyy.mi-ä
   c. ku.pi.ää hä.tyy.mi-e
   d. ku.pe.ää hä.tyy.mi-e

10. Är.sy.tää ________________ (jong.löö.ri)
    a. jo.sy.tää än.löö.ri-ä
    b. jor.sy.tää än.löö.ri-ä
    c. jor.sy.tää än.loo.ri-a
    d. jo.sy.tää yn.loo.ri-a

11. Vä.hen.tää ________________ (vo.lyy.mi)
    a. vo.hen.taa va.lyy.mi-ä
    b. vo.hen.tää vää.lyy.mi-e
    c. vu.hen.taa vää.lyy.mi-e
    d. vo.hen.taa va.lyy.mi-ä

12. Pyy.tää ________________ (par.fyy.mi)
    a. päy.taa pyr.fyy.mi-e
    b. paa.tää pyr.fyy.mi-ä
    c. pa.y.tää pör.fyy.mi-e
    d. pa.y.tää pyr.foor.mi-ä
13. Ym.mär.tää _______________ (ap.ril.li)
   a. ap.mär.tää ym.ril.li
   b. ap.mor.taa yp.ril.li-e
   c. a.mer.taa ym.pril.le-ä
   d. ap.mär.tää ym.pril.li-ä

14. Vä.hen.tää _______________ (va.löö.ri)
   a. va.hen.taa vä.löö.ri-ä
   b. va.hen.taa vä.löö.ri-e
   c. va.hen.taa vä.löö.ri-e
d. vo.hen.tää vä.lee.ri-ä

15. Pyy.tää _______________ (kom.pro.mis.si)
   a. ko.y.tää pom.pro.mis.si-ä
   b. ko.o.taa pym.pru.mis.si-e
   c. ko.y.tää pym.pro.mis.si-ä
   d. ko.y.tää pym.prö.mis.si-ä

16. Käyt.tää _______________ (hu.möö.ri)
   a. hu.yt.tää kä.mää.ri-e
   b. huut.taa kä.möö.ri-ä
   c. puut.taa kä.möö.ri-e
   d. hu.yt.tää kä.me.ʔe.ri-ä

17. Är.syt.tää _______________ (kon.duk.töö.ri)
   a. kor.sut.taa än.dyk.töö.ri-ä
   b. kor.sut.taa än.dyk.tuu.ri-e
   c. kor.sy.tää än.duk.töö.ri-ä
   d. ko.syt.tää är.ndyk.töö.ri-ä

18. Kiel.tää _______________ (a.fää.ri)
   a. ael.tää kį.ä.fää.ri-n
   b. aal.taa kį.fää.ri-ä
   c. äil.tää kį.ää.ri-e
   d. skipped
Possible Verb Harmonization to Front

19. Kiin.nos.taa _________________ (Lön.nrot)
   a. löin.nos.taa kin.ne.ro.ti-ää
   b. leen.nes.tää kin.nrut
   c. löen.nos.taa kin.nro.ti-e
   d. lyy.nos.taa kin.nro.ti-ää

20. A.jat.te.lee _________________ (sym.bo.li)
   a. su.jat.te.lee gm.bu.li-ää
   b. sy.jat.te.lee gm.bu.li-ö
   c. syt.te.lee gm.bu.li-ää
   d. sy.jat.te.lee gm.bu.li-ö

21. O.dot.taa _________________ (bä.na.rit)
   a. ba.ot.taa o.da.rei-ta
   b. bä.dot.taa o.na.ri-ö
   c. bä.nat.taa o.nä.ri-ää
   d. bä.det.tää u.na.rei-tää

22. Kart.taa _________________ (styyr.puu.ri)
   a. styrt.taa kou.puu.ri-n
   b. sart.taa ka.tyyr.puu.ri-ö
   c. styrt.taa ka.yr.puu.ri-e
   d. skipped

23. Va.roo _________________ (fö.na.ri)
   a. fö.roo vä.nä.ri-ää
   b. fö.roo va.no.ri-ö
   c. fö.roo va.na.ri-ää
   d. fy.ryy va.no.ri-ää

24. Seu.raa _________________ (fö1.je.to.ngi)
   a. feu.roo sel.je.to.ņi-ää
   b. føy.raa sel.ji.to.ņi-ō
   c. feu.raa syl.jin.to.ņi-e
   d. fy.y ra sel.je.to.ņi-ää
25. Puo.lus.taa __________________ (Grön.lan.ti)
   a. groo.lus.taa pun.lan.ti-e
   b. gruu.lus.taa pu.rön.lan.ti-a
   c. guo.los.taa puo.lan.ti-e
   d. groo.lus.taa pu yn.lan.ti-ä

26. Va.roo ________________ (ty.ran.ni)
   a. ty.roo va ran.ni-ä
   b. ty.roo va nan.ni-a
   c. tö.roo va ron.ni-ä
   d. ty.roo va ron.ni-ä

27. Ar.vos.te.lee ________________ (syn.tak.si)
   a. sy.vos.te.lee arn.tak.si-a
   b. syr.vos.te.lee an.tak.si-e
   c. sy.vos.te.lee arn.tak.si-a
   d. syr.vos.te.lee arn.tak.si-ä

Possible Noun Harmonization to Back

28. Har.kit.see ________________ (ku.löö.ri)
   a. kur.kit.see ha löö.ri-ä
   b. kur.kis.tee ha löö.ri-ä
   c. kur.kit.see ha löö.ri-e
   d. kur.kit.see hä löö.ri-ä

29. Tut.kii ________________ (mo.le.kyy.li)
   a. mot.kii tu le.kyy.li-e
   b. mot.kii tu le.kyy.li-e
   c. mot.kii tu le.kyy.li-e
   d. mot.kii tu löö.kyy.li-ä
30. Tōttelee ___________________ (ku.ver.nöö.ri)
   a. kut.te.lee to.vär.nöö.ri-ä
   b. kut.te.lee to.ver.nöö.ri-e
   c. kut.te.lee tu.ver.nää.ri-ä
   d. kut.te.lee to.ver.nee.ri-ä

31. Va.roit.taa ___________________ (su.te.nöö.ri)
   a. su.roit.taa va.te.nöö.ri-ä
   b. su.roit.taa va.te.nöö.ri-ä
   c. su.roet.taa va.te.nee.ri-ä
   d. su.roit.taa va.te.nee.ri-ä

32. Ra.kas.taa ___________________ (vam.pyy.ri)
   a. va.kas.taa ram.pyy.ri-ä
   b. va.kas.taa ram.pyy.ri-e
   c. va.kas.taa ram.pöö.ri-e
   d. va.kas.taa ram.pyy.ri-ä

33. Hou.kut.te.lee ___________________ (šar.möö.ri)
   a. šau.kut.te.lee huar.myy.ri-ä
   b. šau.kut.te.lee hor.möö.ri-e
   c. šau.kut.te.lee hur.myy.ri-e
   d. šau.kot.te.lee hor.möö.ri-ä

34. Kun.ni.oit.taa ___________________ (mont.töö.ri)
   a. mon.ne.oet.taa kunt.töö.ri-ä
   b. mon.ni.oit.taa kunt.töö.ri-ä
   c. mon.ni.oet.taa kunt.töö.ri-ä
   d. mon.ni.oet.taa kunt.töö.ri-e

35. O.dot.taa ___________________ (ma.ni.kyy.ri)
   a. ma.ot.taa od.ni.kyy.ri-ä
   b. ma.dot.taa un.i.kyy.ri-e
   c. ma.ot.taa ud.ni.kyy.ri-e
   d. ma.dot.taa on.i.kyy.ri-ä
36. Kuun.te.lee ________________ (u.ver.tyy.ri)
   a. uu.un.te.lee ku.ver.tyy.ri-e
   b. uu.un.te.lee ku.ver.tyy.ri-e
   c. uu.un.te.lee ku.ver.töö.ri-e
   d. uu.un.te.lee ku.ver.tyy.ri-ä

37. O.dot.taa ________________ (kam.bäk.ri)
   a. ka.ot.taa odyn.bäk.ri-ä
   b. ka.dot.taa om.bäk.ri-e
   c. ka.ot.taa odn.bäk.ri-e
   d. ka.dot.taa om.bäk.ri-ä

38. Kan.nus.taa ________________ (vul.gää.ri)
   a. vun.nus.taa kol.gää.ri-e
   b. vun.nos.taa kal.gää.ri-e
   c. van.nus.taa kal.gee.ri-e
   d. vun.nos.taa kal.gää.ri-ä

39. Suo.sit.te.lee ________________ (bro.syy.ri)
   a. broo.sit.te.lee suo.syy.ri-ä
   b. bo.sit.te.lee su.ro.syy.ri-e
   c. broo.sit.te.lee suo.ryy.ri-e
   d. bruu.sit.te.lee su.syy.ri-e

40. Aut.taa ________________ (sa.ni.tää.ri)
   a. saut.taa a.ni.tää.ri-e
   b. saut.taa a.ni.tää.ri-ö
   c. saat.taa a.ni.tää.ri-ä
   d. saut.taa a.ni.tää.ri-ä

41. Pu.ree ________________ (blo.bää.ri)
   a. blo.ree pu.bää.ri-ä
   b. bu.ree pu.lo.bää.ri-e
   c. blu.rii pu.bää.ri-e
   d. bu.lee plo.bää.ri-ä
42. Ko. kei. lee ______________ (tur. nyy. ri)
   a. tu. kei. lee kor. nee. ri-ä
   b. tu. kei. lee kor. nyy. ri-e
   c. tu. kei. lee kor. nyy. ri-e
   d. tu. kei. lee kur. nöö. ri-ä

Possible Noun Harmonization to Front

43. Sää. lii ______________ (a. ma. töö. ri)
   a. aä. lii sää. ma. tyy. ri-e
   b. aä. lii sää. mä. töö. ri-e
   c. aä. lii sää. ma. tee. ri-ä
   d. aä. lii sää. ma. töö. ri-ä

44. Är. syt. tää ______________ (kon. duk. töö. ri) (sentence (17) repeated)
   a. kor. syt. täa än. dyk. töö. ri-ä
   b. kor. sut. täa än. dyk. tuu. ri-e
   c. kor. syt. tää än. duk. töö. ri-ä
   d. ko. syt. tää än. dyk. töö. ri-ä

45. Pyy. tää ______________ (kom. pro. mis. si) (sentence (15) repeated)
   a. kou. tää pom. pro. mis. si-ä
   b. koo. taä pym. pru. mis. si-e
   c. ku. y. tää pym. pro. mis. si-ä
   d. ku. y. tää pym. prö. mis. si-ä

46. Käs. kee ______________ (vo. lon. tää. ri)
   a. vos. kee kä. lön. tää. ri-e
   b. vos. kii kä. lön. tää. ri-e
   c. vos. kii kä. lon. tee. ri-e
   d. vu. kee va. lon. tää. ri-e
47. Käyt.tää ________________ (ni.ko.tii.ni)
   a. ni.yt.tää kä.ku.tii.ni-ä
   b. niut.taa kä.ko.tii.ni-ä
   c. ni.yt.tää kä.ko.tii.ni-e
   d. ni.yt.tää kä.ko.tii.ni-ä

48. Rääk.kää ________________ (äs.mol.li)
   a. ä.säk.kää räs.mel.li-ä
   b. ääk.kää räs.mol.li-ö
   c. ä.säk.kää rääs.mol.li-a
   d. ä.säk.kää rä.mol.li-ö

49. Sää.lii ________________ (kyk.loop.pi)
   a. ky.ä.lii säyk.loop.pi-e
   b. kyy.lii säk.luup.pi-ö
   c. ku.ä.lii säyk.loop.pi-ä
   d. ky.ä.lii säyk.löop.pi-e

50. Pyy.tää ________________ (förskot.ti)
   a. föy.tää pyrs.kot.ti-e
   b. föö.tää pyrs.köt.ti-e
   c. föy.tää pörs.kot.ti-a
   d. föy.rää pyrs.kot.ti-a