RELATIVE FREQUENCY OF PATTERNS AND LEARNABILITY:

THE CASE OF PHONOLOGICAL HARMONY

by

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FINAL READING APPROVAL

To the Graduate Council of the University of Utah:

I have read the dissertation of Aleksandra Zaba in its final form and have found that (1) its format, citations, and bibliographic style are consistent and acceptable; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the supervisory committee and is ready for submission to The Graduate School.

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ABSTRACT

The crosslinguistic frequency of phonological patterns has been commonly linked to their learnability. Experimental work investigating the relation between frequency and learnability has provided controversial results. For example, some researchers have found that the frequency and learnability of attested vs. unattested, arbitrary patterns are related such that unattested, arbitrary patterns are less learnable than attested patterns. Others did not confirm this relation for more vs. less frequently attested patterns. The two listening experiments presented in this dissertation provided no support for a relation between the frequency and the learnability of attested vs. unattested nonarbitrary patterns, nor of more vs. less frequently attested harmony types. Some support was provided for such a relation in more vs. less frequently attested harmony directionalities.

Experiment 1 tested whether the relative crosslinguistic frequency scale, back vowel harmony>>nasal consonant harmony>>labial consonant harmony (unattested), is related to the corresponding learnability scale. Subjects were trained on nonwords containing one of the three harmony types and subsequently tested on their learning of the pattern. Results showed that none of the three training conditions learned better than the others. To exclude the possibility that these results were due to individual differences in attention or learning ability, analyses were repeated with subjects in each condition whose d-prime scores were within 1 *SD* from the mean, and with subjects

whose d-prime scores exceeded 0. Both measures did not provide any support for the relation between frequency and learnability.

Experiment 2 used the same methodology as Experiment 1 to detect whether the relative frequency scale, progressive nasal consonant harmony (P)>>regressive nasal consonant harmony (R), is related to the same learnability scale. Results with all subjects included showed that no harmony condition was learned better than the other. When the same cutoff procedures as in Experiment 1 were used, the learning scale was P>>R.

Several possible explanations exist for why only Experiment 2 revealed a relation between frequency and learnability, and future work is needed. Among these explanations is that frequency and learnability may be related only in some patterns; in other patterns, relative frequency may be related to different factors.

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CHAPTER 1

INTRODUCTION

Some phonological patterns are crosslinguistically more frequent than others (Shaw 1991; Gafos 1996; Hume 2000; Hansson 2001). For example, assimilation and deletion occur more frequently across languages than does phonological metathesis (Hume 2000), and vowel harmony is more frequent across languages than is consonant harmony (Hansson 2001). The frequency of patterns has been commonly linked to their learnability, in the sense that patterns are frequent since they are learnable (based on cognitive biases) (see, e.g., Chomsky and Halle (1968:4, 251, 296-297); Prince and Smolensky (1993:3, 201-202); Steriade (2001:235-237)).[1]

Recently, researchers have used experimental methods to test whether relative crosslinguistic frequency of patterns and learnability are indeed related. More specifically, are patterns that are frequent more learnable than patterns that are less frequent or unattested? For example, Wilson (2003) tested whether unattested arbitrary patterns are harder for subjects to learn than are attested (nonarbitrary) patterns. He used an artificial language learning paradigm in listening experiments and found that

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[1] Note that other approaches, such as Blevins (2004:108-109), assume that frequency is related to factors other than learnability, namely strong phonetic precursors (see, e.g., Section 4.2). The view advocated here (see also Moreton (to appear)) is that both learnability and phonetic precursors are necessary to account for typology. See Chapter 4, in particular Section 4.2, for a justification of this view.

the frequently attested patterns of nasal consonant harmony (triggered by nasal consonants) and nasal consonant disharmony are more learnable by adults than are unattested arbitrary patterns like the nasalization of a consonant triggered by a dorsal consonant.[2,3]

Koo and Cole (2006), who tested whether frequently attested patterns correspond to easier learning than less frequently attested patterns, found that the more frequent back vowel harmony is not more learnable than the less frequent liquid harmony. Thus, previous studies that investigated the relation between frequency and learnability have provided contradictory results. More specifically, it seems as if the relation between frequency and learnability holds in attested vs. unattested patterns, but not in more vs. less frequently attested patterns.

The present dissertation followed up on these studies to contribute to a fuller understanding of the relationship between frequency and learnability via listening experiments involving phonological harmony. The broadest question behind this dissertation was whether relative crosslinguistic frequency is related to learnability. This question was addressed by the following sub-questions:

1. Is the relative frequency of phonological harmony related to its relative learnability (Experiment 1)?

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[2] An arbitrary pattern was understood here as a pattern in which no formal relation holds between the property that triggers the pattern and the pattern itself.

[3] Note that Wilson (2003) did not explicitly state that the purpose of his study was the investigation of the relation between frequency and learnability, but rather between frequency/attestedness and cognitive bias. However, since cognitive bias was operationalized as learnability in Wilson (2003), the study can be said to have investigated the relation between frequency and learnability.

2. Is the relative frequency of different directionalities of phonological harmony related to their relative learnability (Experiment 2)?

The dissertation attempted to make three novel contributions:

First, whereas previous work such as Wilson (2003) investigated the relation between the frequency and the learnability of attested (nonarbitrary) patterns and unattested patterns that were arbitrary, Experiment 1 of the present dissertation studied the relationship between the frequency and the learnability of attested (nonarbitrary) patterns (back vowel harmony and nasal consonant harmony) and an unattested pattern that was nonarbitrary (labial consonant harmony, which is unattested in adults).

Second, Experiment 1 used new harmony types than so far to test the robustness of the finding in previous work (such as Koo and Cole (2006)) that more frequent harmony types are not more learnable than less frequent harmony types. Specifically, here the relation between the frequency and the learnability of back vowel harmony (highly frequent) and nasal consonant harmony (less frequent) was investigated.

Third, Experiment 2 of the present dissertation studied the relationship between frequency and learnability using new patterns than in previous work (such as Wilson (2003) and Pycha, Shosted, Shin, and Shosted (2003)), namely more vs. less frequent harmony directionalities.

1.1 Organization of the dissertation

The remainder of Chapter 1 presents the concepts of phonological harmony and learnability. The discussion of harmony includes a definition of harmony and examples of the harmony types, directionalities, and harmony blocking relevant for the present experiments. Further, to explain why harmony patterns exist in the world's languages, Chapter 1 also presents how harmony has been approached in the literature. Finally, previous studies are presented that have examined learnability, some of which were used as models for the present experiments.

In Chapters 2 and 3, two experiments are presented that investigated the relationship between the relative frequency and learnability of harmony types and harmony directionalities. A summary of the results, explanations of the results, limitations, and implications, along with some possible future directions, are discussed in Chapter 4.

1.2. Background/literature review

1.2.1 Harmony types

Without committing to any specific phonological theory, harmony can be defined as long-distance assimilation between one segment and one or more other segment(s) in some phonological domain (e.g., within a morpheme or across several morphemes).[4] The two kinds of harmony in focus in this dissertation were vowel harmony (long-distance assimilation between one vowel and one or more other vowels) and consonant harmony (long-distance assimilation between one consonant and one or more other consonants).[5]

One example of vowel harmony is the frequent harmony type back vowel

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[4] Phonological harmony can thus have different domains, such as a single morpheme or two or more morphemes (see, e.g., Hansson (2001)). The only harmony domain considered here was crossmorphemic harmony with two morphemes (stem plus suffix).

[5] A further kind of harmony is vowel-consonant harmony (see, e.g., Hansson (2001)). Vowel-consonant harmony was not in focus in this dissertation.

harmony (Hansson 2001), also referred to as palatal, gravity, or horizontal harmony (Aoki 1968). Back vowel harmony turns one or more nonback vowels in a harmony domain into back vowels due to other back vowels in the domain, or one or more back vowels in a harmony domain into nonback vowels due to other nonback vowels in the domain (see, e.g., Dasinger (1985) for vowel harmony in Finnish). Back vowel harmony is exemplified in (1) by the Altaic language Turkish, where the stem vowel /u/ triggers back vowel harmony of the suffix vowel /e/.[6,7]

(1) Turkish back vowel harmony; data from Gafos (1996)

a. /pul-ler/ [pullɑr] 'stamp-nominative plural'

b. /ip-ler/ [ipler] 'rope-nominative plural'

(1a) shows that the nonback vowel /e/ in the suffix /-ler/ changes to the back vowel [ɑ]. The reason for the change is the back vowel /u/ (triggering back vowel harmony) in the stem (/pul-/). In (1b), the suffix vowel remains unchanged since the stem vowel /i/ is not back, and thus does not trigger back vowel harmony.

Back vowel harmony is a very frequent vowel harmony type, attested in some of the major language families, such as in the Altaic language family of Central Asia and Eastern Europe (Jakobson 1942; Ladefoged 1963; Chang and Shefts 1964) and the Uralic language family of Eastern and Northern Europe and North Asia (Dezsö 1999). This harmony type was among the three harmony types considered in the first experiment,

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[6] In addition to back vowel harmony, Turkish also has round vowel harmony, which was not in focus in this dissertation.

[7] Based on the examples in (1), back vowel harmony in Turkish can thus occur across morphemes where longer stretches than one consonant intervene between trigger and target. In all the instances of back vowel harmony in this dissertation only one consonant intervened.

as an example of a highly frequent type of harmony. Frequency of a pattern was defined in this dissertation based on the number of languages in which the pattern is encountered. Back vowel harmony is encountered in several major language families, and was thus categorized as 'frequent'. Nasal consonant harmony (see below) is predominantly attested in the Bantu languages only, which is why it was categorized as 'less frequent'. Labial consonant harmony (see below) is unattested in adults, and consequently it was here categorized as 'least frequent/unattested'.

The two other harmony types considered in the first experiment were nasal consonant harmony and labial consonant harmony. Nasal consonant harmony refers to harmony in which nasality spreads from nasal consonants onto nonnasal consonants, or, less frequently, to harmony in which nonnasality spreads from nonnasal consonants to nasal consonants (Hansson 2001). Nasal consonant harmony is exemplified in (2). The example is taken from the Bantu language Yaka spoken in the Central African Republic.[8]

(2) Yaka nasal consonant harmony; data from Hyman (1995)

a. /són-ele/ [sónene] 'to color-perfective'

b. /sól-ele/ [sólele] 'to deforest-perfective'

In the example in (2a), the nonnasal consonant /l/ in the perfective suffix /-ele/ becomes a nasal (/n/), since a nasal (/n/) precedes in the stem. In (2b), no nasal occurs in the stem. Therefore, the suffix consonant does not change. Nasal consonant harmony is crosslinguistically relatively rare (Hansson 2001), and occurs mainly in languages of the

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[8] Nasal consonant harmony in Yaka can also occur across morphemes where longer stretches than a vowel intervene between trigger and target (Hansson 2001). Such cases were not in focus in this dissertation (see also footnote 7).

Bantu language family of Africa, spoken for example in South Cameroon, Nigeria, the Central African Republic, Tanzania, and South Africa (Meinhof 1932; Doke 1938; Greenberg 1951; Johnson 1972; Howard 1972; Viljoen 1973; Collins 1975; Ellington 1977; Booysen 1982; Tirronen 1986; Odden 1994; Hyman 1995; Hyman 1996; Hyman and Inkelas 1997; Newman 2000). In the present Experiment 1, nasal consonant harmony was the second most frequent harmony type, following the more frequent back vowel harmony.

Labial consonant harmony is unattested in adult language (Hansson 2001), and was used in Experiment 1 as the least frequent (that is nonoccurring) harmony type. If labial harmony did exist, it might look like the example provided in (3a).[9]

(3) Nonce example of labial consonant harmony

a. /ɹub-ɛd/ [ɹubɛb]

b. /ɹug-ɛd/ [ɹugɛd]

In (3a), nonlabial /d/ in the suffix becomes labial [b] under the influence of the last stem consonant (i.e., the labial /b/). No harmony applies in (3b), since no labial consonant precedes the suffix. Whereas adult languages lack labial consonant harmony, labial

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[9] Hansson (2001) claimed that if labial harmony existed, the prime candidates for harmonizers would be labial sounds that differ only slightly from each other, such as labiodentals like /v/ and bilabials like /m/. This claim is based on the fact that harmonizers tend to be similar to each other (Hansson 2001), e.g., sibilant harmony, which is the most frequent type of consonant harmony, only holds among coronals. However, in light of the absence of evidence for this claim with respect to labial consonant harmony in adult language, it was assumed here that if labial harmony existed, it could also hold between nonlabials (although nonlabials may not be the prime candidates for the harmony). This is the case especially since some harmony types hold between segments that show a lower level of affinity among each other than sibilants. An example of a harmony type that holds between such less related segments is nasal consonant harmony that holds between liquids and nasals.

consonant harmony has been reported for child English (see (4) for examples).

(4) Labial harmony in child language; data from Pater and Werle (2003)

a. /bɛd/ [bɛp] 'bed' (age [1;6,17][10] years)

b. /tɔp/ [pɔp] 'top' (age [1;6,8] years)

In (4a), the child applied labial harmony from /b/ in bed to the following coronal /d/, turning /d/ into the labial [p]. (4b) illustrates that the child used labial harmony from /p/ in top to the preceding coronal /t/, turning /t/ into the labial [p]. These patterns were observed at ages 0-1;9,2 years.

Due to the fact that labial consonant harmony is attested in child language, the choice of labial consonant harmony for the purposes of the present experiments may not have been optimal since subjects' performance may not have reflected the inherent learnability of a pattern if they were familiar with this pattern. However, there exists support for the assumption that what seems to be labial consonant harmony in child language is in fact a different phenomenon, e.g., Gafos (1996) made the claim that what appears to be labial consonant harmony in children is in fact a mistake in the pronunciation of coronals. Coronal sounds involve the coordination of the tongue tip-blade, which needs to make a constriction in the alveolar region, and the jaw, which needs to raise to help with this constriction. Together with the jaw, the lower lip is raised. In children, whose motor system is not yet fully developed, the lips may not return to their neutral position after producing a preceding labial stop, and the lower lip may touch the upper lip, creating another bilabial instead of a coronal sound. Labial harmony as

[10] Age 1 year, 6 months, 17 days.

exemplified in (4a) in children may thus only be an apparent case of harmony (Gafos 1996). By analogy, the apparent labial harmony exemplified in (4b) in children may be the result of the child mistakenly closing their lips when uttering a coronal in anticipation of the actual bilabial that is to follow.

Further support for the claim that labial consonant harmony in children is not harmony but the result of mispronunciation of coronals is provided by the fact that labial consonant harmony is not attested in any adult language. In contrast, other harmony types present in child language do occur in adult languages. One example is dorsal consonant harmony. See (5) for an example of dorsal, more specifically, velar consonant harmony (in place of articulation) in child language.

(5) Dorsal consonant harmony in child language; data from Pater and Werle (2003)

/dɔg/ [gɔg] 'dog' (age [1;5,14] years)

In (5), the nonvelar /d/ becomes a velar /g/ under the influence of the velar word final /g/. Dorsal consonant harmony in adult language is for example attested in the Totonacan languages of South America as minor place of articulation harmony. The example in (6) is from Misantla Totonac spoken in Mexico, where velar /k/ in the body-part prefix /maka-/ becomes uvular /q/ under the influence of uvular /q/ in the stem.

(6) Dorsal consonant harmony in Misantla Totonac; data from MacKay (1999)

/ut-maka-ʃqat/ [ʔṵ́t maqáʃqɛ́t] 'she/he scratches X (with hand)'

Based on the claim purported by Gafos (1996) that what appears to labial consonant harmony in children may not be indeed harmony, but instead instances of mistakes in the pronunciation of sounds, and the fact that labial consonant harmony is not attested in adult language, labial consonant harmony was regarded as unattested for the purposes of this dissertation, and used as the least frequent harmony type. Note that claims exist that consonant harmony in adults originated as mispronunciations/speech errors as well, which then became phonologized (Hansson (2001); see, for example, Sections 1.2.4 and 4.2). However, since labial consonant harmony is only attested in children, this consonant harmony type appears to be a different type of speech error than the source of those consonant harmony types that are attested in adults. That is, labial consonant harmony seems to be an error that results from the specifics of the motor system of children.

As shown, some harmony types are more frequent than others. For example, back vowel harmony is frequent, nasal consonant harmony is less frequent, and labial consonant harmony is unattested. These three harmony types were used in Experiment 1 of the present dissertation in the investigation of the relation between frequency and learnability.

1.2.2 Harmony directionalities

The phenomenon considered in the second experiment was harmony directionality. Harmony directionality refers to the direction in which a given harmony type applies. Harmony can apply either from left to right (progressively), or from right to left (regressively). For example, in nasal consonant harmony in the Bantu language Yaka, exemplified in (2) and repeated here as (7a), harmony in the stem-suffix domain proceeds from the stem to the suffix. As an example, nonnasal /l/ in the perfective suffix /-ele/ becomes nasal /n/ under the influence of a nasal consonant in the stem. Thus, a sound at the left (/n/) influences a sound at the right (/l/), which means that this example is