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ABSTRACT

This paper presents the results of an experiment designed to investigate some of the effects of bilingualism on perception. The subjects were Icelandic monolinguals and Icelandic-English bilinguals. The phonetic parameter under investigation was duration. The experiment was designed to test which of the following three hypotheses accurately predict the perceptual responses of bilinguals: (1) the null hypothesis (predicting no interference between the two languages); (2) the awareness hypothesis (predicting more accurate perception in bilinguals); and (3) the confusion hypothesis (predicting less accurate perception in bilinguals). A listening test was administered which consisted of stimuli based on the minimal pair "is" [i:s] and "iss" [is:]. Findings include the following: (1) vowel length is a more salient clue than consonant length in the perception of the quantity opposition; (2) significant support is found for the third hypothesis which predicts confusion in the perception of the bilinguals; and (3) there is a significant difference in the perception of the quantity system of Icelandic between monolingual and bilingual native speakers of the language. (AM)

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Some Effects of Bilingualism on Perception*

Sara Garnes

1. Statement of the problem.

In this paper I present the results of an experiment designed to investigate some of the effects of bilingualism on perception. The subjects were Icelandic monolinguals and Icelandic-English bilinguals (see discussion in the next section). The phonetic parameter under investigation was duration.

In Icelandic, quantity is phonemic and is distributed over the syllable: a long vowel is followed by a short consonant or a short vowel is followed by a long consonant, e.g. *ís* [i:s] 'ice' vs. *íss* [is:] 'of ice'; *vaka* [va:ka] 'to wake' vs. *vagga* [vak:a] 'to rock' (see Garnes, in press, for discussion). In contrast, English has no phonemic quantity opposition. Vowels before voiceless stops are two-thirds the duration of vowels before voiced stops; however, this difference is sub-phonemic, e.g. *bet* [bɛt] vs. *bed* [bɛ:d] (Peterson and Lehiste 1960).

Since the second language, English, has a different quantity system than the native language, it could be expected that the perceptual responses of the bilinguals would fall into one of three categories predicted by three different hypotheses. The null hypothesis predicts no interference between the two languages. According to this hypothesis, each linguistic system is self-contained so that the perceptual responses of the monolinguals and of the bilinguals will not be different. The other two hypotheses both predict that contact with a second language will produce a change in perception. The second hypothesis predicts that bilinguals will perceive the contrast in their native language *more accurately* than do the monolinguals. Since the bilinguals have been exposed to a contrasting system their perception of the opposition in their native language will be heightened. We can call this the *awareness* hypothesis. The third hypothesis predicts that bilinguals will perceive the contrast in their native language *less accurately* than do the monolinguals. This hypothesis, which we can call the *confusion* hypothesis, predicts that the bilinguals' perception will be confused due to a conflict between the two different linguistic systems.

2. Method.

In order to determine which of the three hypotheses is the correct one, a listening test was administered which consisted of stimuli based on the minimal pair, *ís* [i:s] 'ice' with a long vowel and a short consonant, and *íss* [is:] 'of ice' with a short vowel and a long consonant. Thirteen vowel durations ranging from 80 to

320 ms. in 20 ms. increments were combined with 13 consonant durations ranging from 200 to 440 ms., also in 20 ms. steps. Stimuli were prepared on a Glace-Holmes terminal analog synthesizer. The total 169 stimuli were randomized and spliced together into groups of ten with 5 seconds between individual stimuli and 10 seconds between groups.[1]

Two groups of subjects were tested. All were natives of Iceland and were college students at the University of Iceland or at universities in the U.S., or of that generation, at the time of testing. Since no Icelandic university students are strictly monolingual in the sense that they have never studied a foreign language, the distinction was made that to be considered monolingual, the subjects must not have studied out of Iceland. Seventeen monolinguals participated, 9 males and 8 females. The 9 bilingual subjects, 6 males and 3 females, were fluent speakers of English and had resided out of Iceland for at least one school year.[2] The forced-choice listening test was administered on a Uher 4000 Report-L tape recorder in quiet surroundings. Answers were recorded on a prepared answer sheet. The listening test was taken twice by both groups of subjects yielding two responses per stimulus from each subject.

3. Results.

The results of the listening test show a basic similarity between the two groups: vowel length is a more salient cue than consonant length in the perception of the quantity opposition. For stimuli with the shorter vowel durations all subjects agreed on íss [is:] 'of ice'; whereas with the longer vowel durations all subjects agreed on ís [i:s] 'ice'. Thus, for all 13 consonant lengths cross-over between the two lexical categories obtained, as is illustrated in Figure 1. The vertical dimension on the graphs shows the percentage of judgments for íss, the inverse of the judgments for ís. The vowel durations are given on the ordinate. The graphs show that vowel length is the most important cue in perceiving the quantity distinction.

However, consonant length also contributes to perception of the quantity contrast. As the consonant length increases, the vowel length required for cross-over between the lexical categories also increases. For example, in Figure 1 with a consonant length of 200 ms., cross-over between lexical categories occurs at ca. 155 ms. vowel length, but at a consonant length of 440 ms., as illustrated in the last graph in Figure 1, cross-over occurs at ca. 190 ms. vowel length. Thus it appears that a variable ratio of vowel to consonant length actually accounts for the responses for both the monolingual and bilingual subjects.

Figure 1. Responses to the listening test arranged by increasing consonant length from consonant length of 200 ms. to 440 ms. Vowel length appears on the ordinate ranging from 80 ms. to 320 ms. Interrupted lines show bilingual responses; connected lines show monolingual responses.

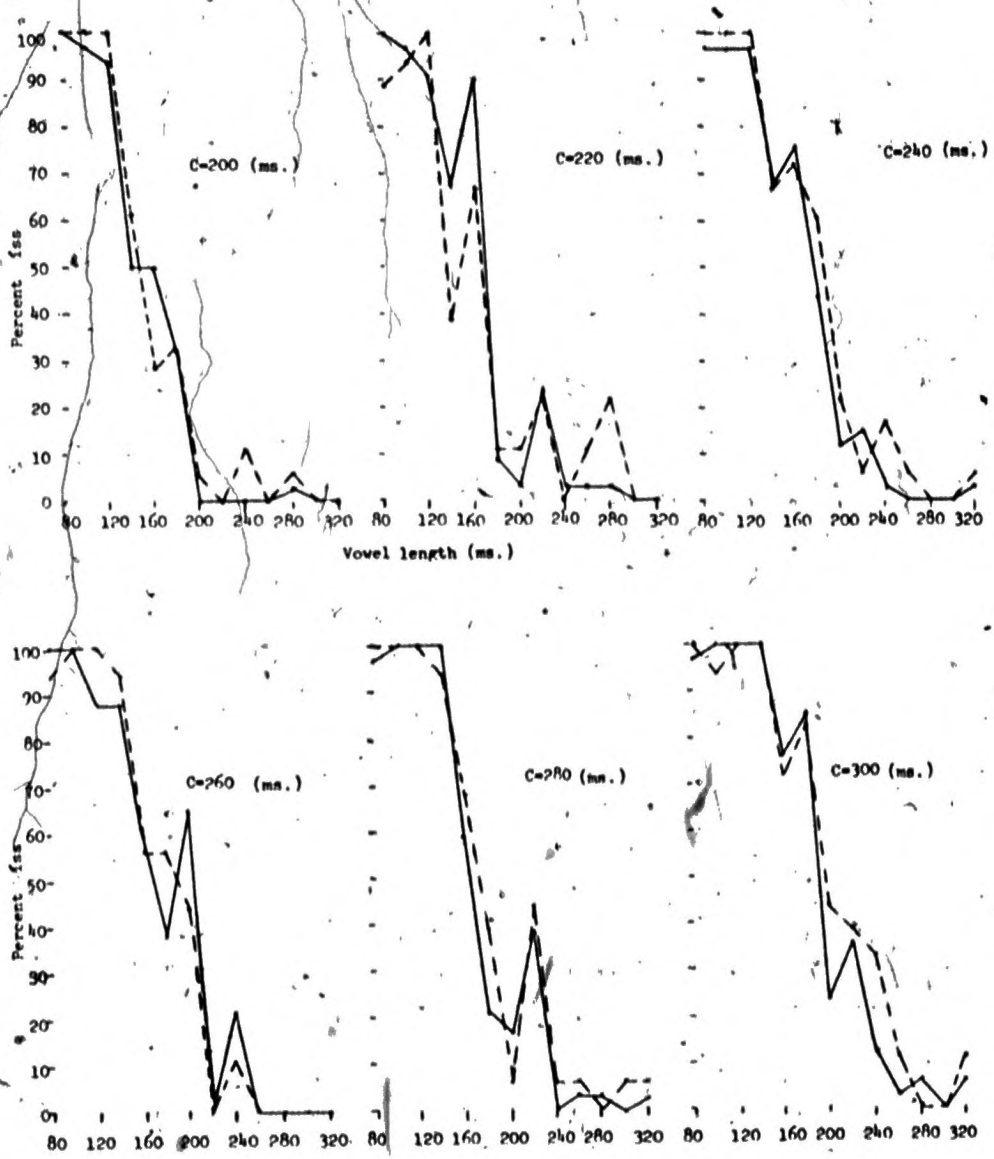
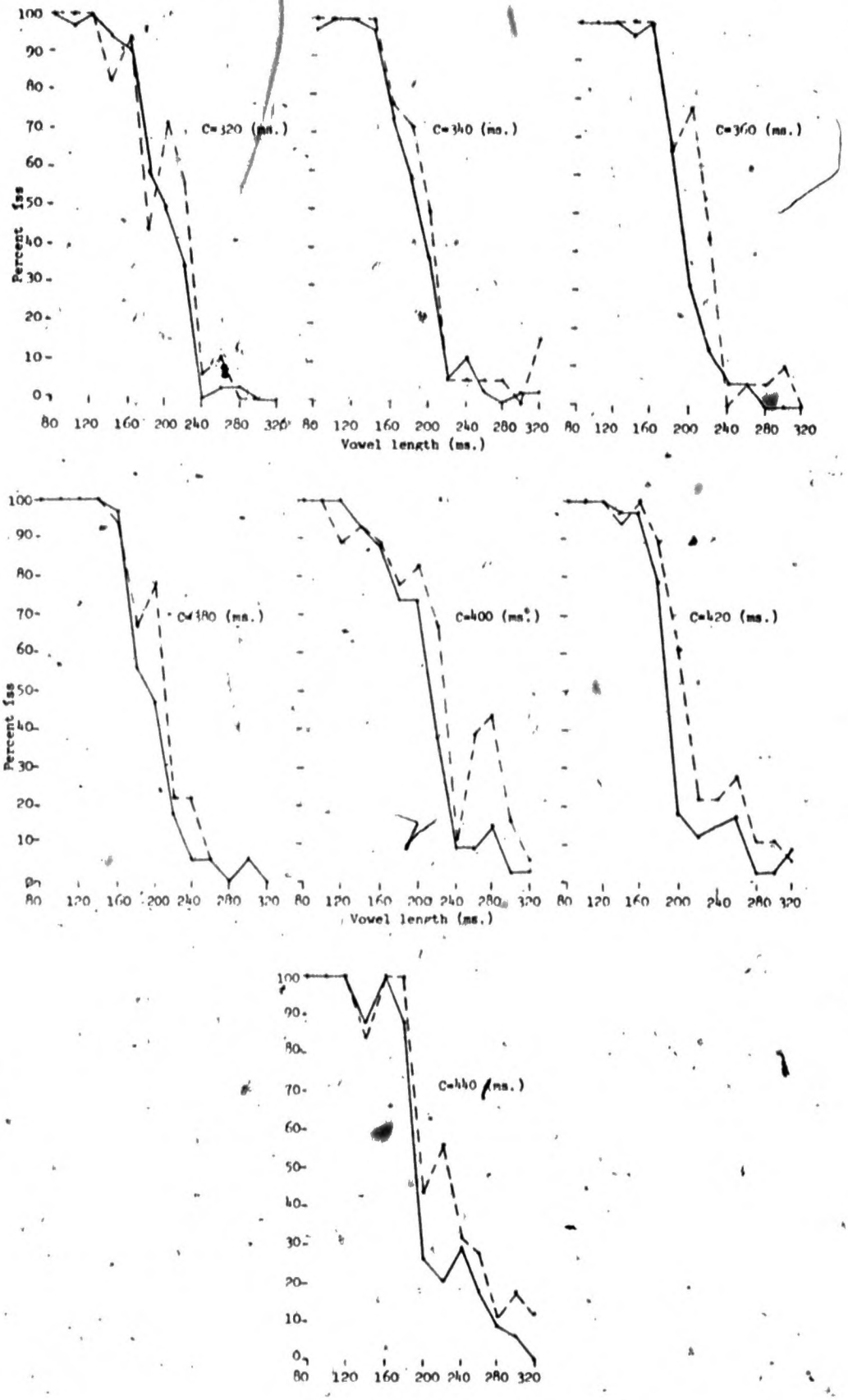


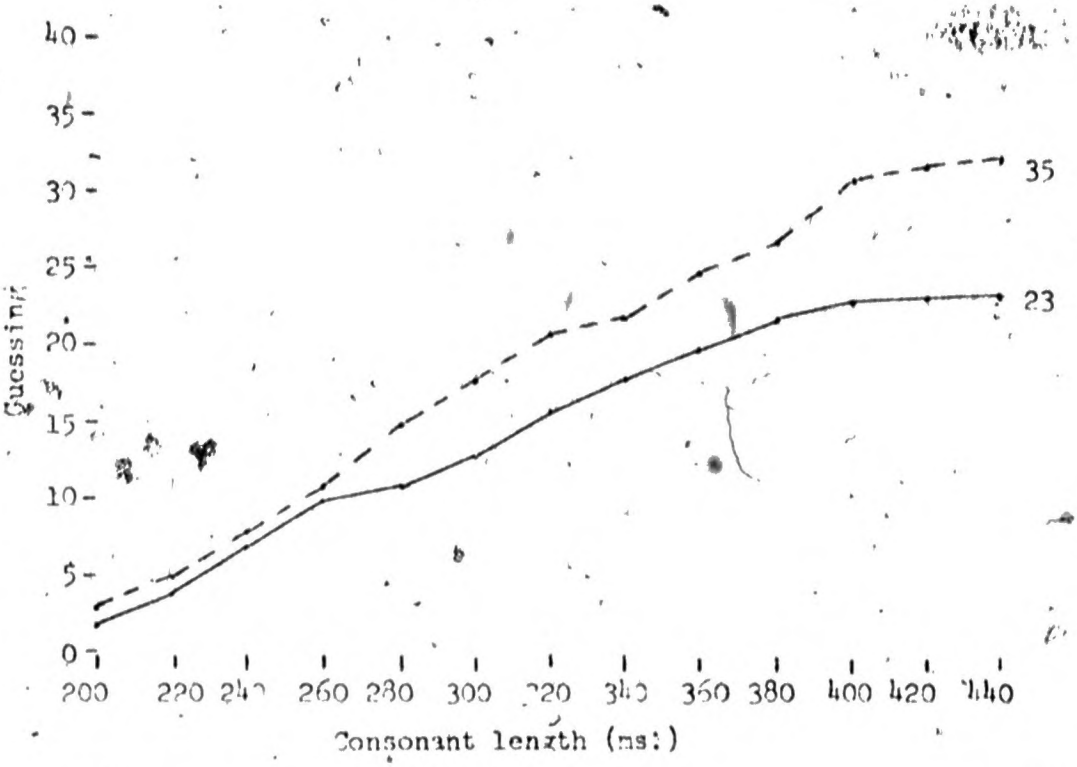
Figure 1. (continued)



The differences between the two groups of subjects are due to the different proportions of stimuli which indicate guessing between the two lexical items. The responses to the listening test were analyzed according to the following criteria. In order to consider that a stimulus was assigned to one of the two lexical categories, approximately three-fourths, or 75 percent, of the responses for each group of subjects had to agree. Since there were different numbers of responses for the two groups, the actual percentages of required responses differed slightly--73.5 percent for the monolinguals (25 of 34 responses) and 72.2 percent for the bilinguals (13 of 18 responses). If a stimulus item was judged consistently for 50 to approximately 75 percent of the responses, it was assumed that the subjects could not reliably assign that stimulus to either lexical category.

Figure 2 shows the results. The number of stimuli receiving between 50 percent, or chance, and ca. 75 percent of the responses is plotted vertically. The horizontal dimension shows the total number of stimuli which indicate guessing. The dashed line represents the responses of bilinguals, the solid line the responses of the monolinguals. The results are plotted according to the consonant durations of the stimuli which are listed across the top of the figure. For example, at a consonant duration of 200 ms., 3 stimuli fell within the cross-over zone for the bilinguals and 2 for the monolinguals. The figure shows the cumulative results; thus, at 220 ms. consonant length, 2 stimuli for both groups fell within the cross-over period, which, added to the results at 200 ms. consonant length, gives an accumulated score of 5 for the bilinguals and 4 for the monolinguals. The total number of stimuli falling within cross-over appears on the extreme right--35 for the bilinguals versus 23 for the monolinguals.

Figure 2. Number of stimuli receiving between 50% to ca. 75% of the responses.



Statistical analysis of these results shows them to be highly significant. According to the Wilcoxon matched-pairs signed-ranks test, the experimentally obtained results are significant at the .001 level. This predicts that the differences found here between the monolinguals and the bilinguals would occur only once in 1000 times if attributed simply to chance.

5. Discussion.

The results clearly do not support the null hypothesis. On the contrary, the bilinguals do respond quite differently from the monolinguals, indicating that the two linguistic systems interact and affect the perception of the bilinguals. According to the second hypothesis, the awareness hypothesis, the bilinguals would have responded more accurately than the monolinguals. This hypothesis must also be rejected since the bilinguals agreed less than the monolinguals in assigning stimuli to either lexical item. However, significant support is found for the third hypothesis which predicts confusion in the perception of the bilinguals. Apparently, mastery

of a foreign language, which has a different quantity system than the native language, affects the perceptual behaviour of the bilinguals.[3]

6. Implications.

There are several implications of this study for linguistic theory. Of interest for psycholinguistics is another documentation that the mental representations of two linguistic systems can overlap. In the experienced bilingual, the foreign language apparently interferes with the mental representation of the native language so that the phonetic representation of the quantity opposition differs between the monolingual and bilingual populations.

Caramazza, et al (1973), have reported the results of another phonetic study which deals with the voice onset time in bilingual individuals. Three groups of speakers were used: monolingual Canadian French, monolingual English, and bilingual Canadian French and English. The bilinguals were tested in both Canadian French and English speech modes. Voiced-voiceless judgments were obtained for stimuli which varied along the voice onset time continuum. Stops corresponding to three places of articulation--bilabial, alveolar and velar--in initial position before the vowel [a] were tested. Canadian French is characterized as having unaspirated voiceless stops, e.g. [pa], while English has aspirated initial voiceless stops, e.g. [p^ha]. The results of the experiment show a clear distinction between the duration of voice onset time required for the monolinguals to cross-over between the perception of voiceless and voiced stops in the respective languages. The perceptual cross-overs of the bilingual individuals fall between the perceptual cross-over of the monolingual subjects whether they are in the Canadian French or in the English speech mode. Caramazza, et al., also investigated the corresponding aspects of the production of the 4 subsets of speakers. The results indicate that the bilinguals are "better able to adapt their production mechanisms than their perceptual mechanisms to the second language." Thus it appears that "language switching is easier for production than for perception" (Caramazza, et al., 1973:427).

Using the same type of consonant-vowel stimuli, Williams (1974) reports on the perception and production of word-initial voiced and voiceless labial stops by monolingual English, monolingual Puerto Rican Spanish, and bilingual speakers of English and Puerto Rican Spanish. The segmental differences between Canadian French and Puerto Rican Spanish are similar in that voiceless stops are unaspirated. The perception of the bilingual English-Puerto Rican Spanish speakers in Williams' study shows confusion as opposed to the monolinguals' perception. Thus, there appears to be a fair amount of evidence indicating a difference between bilinguals' and monolinguals' perception of aspirated voiceless, unaspirated voiceless and voiced stops.

In general, the bilinguals' production has not been shown to become significantly different from the monolinguals' production. Although I have not systematically investigated the production of the quantity contrast for all the Icelandic subjects, preliminary investigations show no apparent systematic differences between the production of the quantity contrast between monolingual and bilingual speakers, other things being equal.

Kolers (1968) reports the results of a series of experiments dealing with syntactic and lexical effects of bilingualism. He found that subjects who read passages of mixed English and French words based on either English or French syntax took the same time when they silently read passages in either French or English. However, when asked to read aloud, the subjects took longer--ca. 33 cs. for each code-switch. In an experiment designed to determine the relationship between meaning and lexical storage, he found that words representing concrete objects such as lamb, thorn and tree, were readily accessible in either of the two languages but that the accessibility of words which were more abstract such as love/Liebe and democracy/Demokratie was closely bound to the language by which they were encoded. The experiment was based on the observation that the more often a word appears in a series of words, the more likely a monolingual subject is to recall the word. This same result was obtained whether the word was presented in the first or second language for bilingual individuals, e.g. English fold vs. French pli. Kolers' experiments show the complex and inter-related nature of some non-phonetic parameters in the bilingual individual.

The results of these experiments indicate that a detailed linguistic history of subjects needs to be considered in selecting subjects for participation in perception tests. Possible inter-language effects need to be considered in evaluating responses of bilingual individuals.

Implications for sociolinguistics are also relevant, especially in the field of languages in contact. The linguistic relationships among adstratum, substratum and superstratum languages have long been discussed (Weinreich 1974 [1953]). The results of these experiments show the psychological reality of some of the affects of languages in contact.

The line between languages in contact and language change is not a distinct one. Thus, the study of languages in contact is of interest to both socio- and historical linguists. The results of the experiment reported here could be interpreted as providing a mechanism for language change. What has been interpreted here as the bilingual speakers' indecision about the phonemic boundaries in their native language may very well lead to the acceptance of a broader variation in phonemic distinctions. If this is true, language change may proceed through several quite complicated steps: in step 1 bilinguals' perception of a given contrast becomes confused, as we have seen in this study. In step 2 bilinguals become more tolerant of variation. Since it is tolerated, more variation

actually occurs in step 3. In step 4 old boundaries begin to shift, in step 5 new boundaries are established as the old distinctions fade away.

This possible mechanism of language change presents a problem: how could the bilingual experience be transmitted to successive generations? Perception is a very personal matter; we are not able to verbalize about criteria used in making perceptual judgments. Although highly speculative, one possible mechanism for transmission is through language acquisition. Thus, bilingual parents may be permissive parents, linguistically speaking. Children of bilingual speakers may acquire a wider variation in producing contrasts. Their parents' boundaries would be less strict; thus the parents would be more likely to accept a wider variety of pronunciations. If this environmental feature is repeated over several generations by sufficient numbers of speakers, language change may occur.

7. Conclusion

In conclusion, the present study shows a significant difference in the perception of the quantity system of Icelandic between monolingual and bilingual native speakers of the language. Hopefully the results will be helpful in increasing our understanding of the complex nature of the mental representation of language and languages, as well as understanding the nature of the influence of languages in contact on phonological processes in language change.

Footnotes

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1. For a detailed description of the stimuli, see Garnes, in press.

2. There are less than 200,000 native speakers of Icelandic and the number of qualifying bilingual speakers I have been able to locate is quite small. In the autumn of 1976 I hope to be able to administer the listening test to 4 additional bilingual subjects in Ann Arbor, Michigan.

3. It might be suggested that the reason for the increased guessing was due to an increased sensitivity on the part of the bilinguals; i.e. it is precisely their heightened awareness which creates the confusion. Although this may be the source of the

increase in guessing, the fact remains that the bilinguals in this study responded less unanimously than the monolinguals.

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