Lexical adaptation to a novel accent in German:
A comparison between German, Swedish, and Finnish listeners

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Abstract

Listeners usually adjust rapidly to unfamiliar regional and foreign accents in their native (L1) language. Non-native (L2) listeners, however, usually struggle when confronted with unfamiliar accents in their non-native language. The present study asks how native language background of L2 speakers influences lexical adjustments in a novel accent of German, in which several vowels were systematically lowered. We measured word judgments on a lexical decision task before and after exposure to a 15-min story in the novel dialect, and compared German, Swedish and Finnish listeners' performance. Swedish is a Germanic language and shares with German a number of lexical roots and a relatively large vowel inventory. Finnish is a Finno-Ugric language and differs substantially from Germanic languages in both lexicon and phonology. The results were as predicted: descriptively, all groups showed a similar pattern of adaptation to the accented speech, but only German and Swedish participants showed a significant effect. Lexical and phonological relatedness between the native and non-native languages may thus positively influence lexical adaptation in an unfamiliar accent.

Index Terms: lexical adaptation, non-native listening, L2 acquisition, Swedish, Finnish, German, vowel inventories

1. Introduction

The ability to adjust to phonetic variation inherent in foreign and regional accents plays an essential role in effective communication. There is ample evidence that native (L1) listeners use their lexical knowledge to adjust to deviant or ambiguous input through retuning of phonetic categories [1, 2, 3, 4, 5, 6]. Even in artificially created accents, systematic deviations in pronunciation can be adjusted to [1, 6]. For example, after listening to a 20-min story spoken in a novel accent with lowered front vowels, English-speaking listeners showed significant adaptation to this accent, as indexed by an increased word acceptance rate in a lexical decision task [6], with adaptation effects specific to the direction of the vowel shift and not to a general shift in the entire vowel space.

Using their top-down lexical knowledge, L1 listeners thus easily master the word recognition task when confronted with novel accents. In contrast, non-native (L2) listeners usually struggle with this task [7, 8, but see 5]. Smaller vocabularies, imprecise mapping from phonetic to lexical representations, less efficient use of L2 cues, and interference from L1 phonology and lexicon add to the listening challenge [for an overview, see 9]. In order to succeed in L2 word recognition, listeners need to correctly identify and discriminate L2 speech

sounds. Identification is modulated by how well the L2 sounds match with existing L1 categories in terms of phonetic similarity [10, 11, 12, 13, 14], but the constitution of native language's phonemic repertoire also needs to be considered [15]. Models of L2 phonetic perception predict perceptual difficulties with reference to the relationship between the phoneme repertoires of the native and non-native languages [10, 11, 13]. Imprecise phonemic perception and difficulties in establishing new categories directly affect word recognition. As a result, L2 word recognition may be compromised when phonetic discrimination is required.

While phoneme discrimination and word recognition problems in an L2 have received widespread attention, the role of different L2 speakers' native language backgrounds in lexical adaptation is less clear. We know that the makeup of native phonemic repertoire is important in that vowel information constrains the activation of lexical candidates less tightly for speakers of languages with large and confusable vowel inventories [15, 16, 17], but it is less clear how this might affect L2 listener lexical adaptation to accented speech. In this study, we employed a similar design as [6], in order to examine the role of different language backgrounds in lexical adaptation. We created a novel accent of German and tested adaptation in three listener groups: Swedish and Finnish L2 learners of German, and a control group of German listeners.

The two groups of L2 learners were chosen on the basis of well-distinguished lexical and phonological features in their L1. Finnish is a Finno-Ugric language, typologically unrelated to German, and exhibits few lexical and phonological similarities to German. German and Swedish both belong to the Germanic group within the Indo-European language family. They are not mutually comprehensible, but they are typologically related and show lexical and phonological similarities [18]. Unlike German and Swedish, Finnish has a less crowded vowel system with only eight vowel qualities /i e y ø æ ɑ o u/. The realizations of the vowels /e o ø/ are halfway between [e] and [ɛ], [ø] and [œ], and [o] and [ɔ] [19]. Each vowel can be short or long with no relevant quality differences between them, and the distribution of vowels in a word is restricted by vowel harmony [19, 20]. The standard Swedish vowel system, on the other hand, has nine long and nine short vowels, with relatively large qualitative differences between them /iː ɪ eː e yː ʏ oː ɔ ɑː a ø øː ʉː θ oː ɔ uː ʊ/ [21, 22, 23]. Standard German consists of 15 full vowels /iː ɪ eː ɛː ɛ yː ʏ aː a ø œ oː ɔ uː ʊ/, and two reduced vowels /ə ɐ/ [24, 25].

Compared to German and Swedish, Finnish thus exhibits a smaller range of vowel qualities – in particular with respect to tense vowel features – that may lead to negative perceptual consequences for the distinction between L2 tense and lax

vowels and for reduced vowels [26]. In addition, differences in size and makeup of their phonemic repertoires may affect the use of vowel information to constraint lexical activation [16].

To test this issue, we constructed a novel accent of German, in which we systematically lowered the vowels /ɪ/, /iː/, /uː/, and /ʊ/. We asked participants to judge words (novel-dialect words, standard words and nonwords) in a lexical decision task prior to and following a 15-min familiarization story. We measured how the endorsement rate (percentage of accepted words) changed from session 1 to session 2 for the dialect words. Standard words and nonwords served as the control conditions. In Experiment 1, German listeners' performance was measured in a between-subject design such that each participant heard the story in one version only (dialect or standard). We predicted a replication of the adaptation effect in line with [6], thus increased word judgements for dialect words after listening to the dialect story compared to the standard story. Experiment 2 tested equally proficient Finnish and Swedish learners of German, using the dialect version of the story only. Their performance on dialect words after listening to the dialect story was compared with each other and with German L1 participants. We expected adaptation to be less pronounced for L2 than L1 participants. For the role of native language background in L2 lexical adaptation, there are at least two possible scenarios:

a) Following models of perceptual difficulties, L2 speakers with more similar vowel inventories to the L1 or with a large vowel repertoire would more easily adjust to an unfamiliar accent by accepting more potential lexical candidates. This would suggest that, all else being equal, Finnish learners of German might accept fewer words spoken in a novel German accent than Swedish learners.

b) In addition to native language background, knowledge of additional L2 languages with larger vowel inventories than the L1 may be beneficial for word recognition in an L2 with a similarly large vowel inventory [27]. Swedish is the second official language in Finland and a compulsory language taught at schools. In contrast, Finnish is not compulsory in Sweden. If listeners' additional languages influence vowel perception and lexical processing, Finnish listeners may show adaptation effects that are comparable to Swedish participants.

Table 1: *L2 learners' language background (standard deviation is shown in parentheses).*

L2 speakers	Finnish	Swedish
Age (years)	23.7 (1.8)	24.8 (3.2)
Gender	7 female	8 female
Age of German onset	11.4 (2.6)	12.5 (2.6)
Years of German study	9.4 (3.9)	7.5 (2.8)
Proficiency self-report	B2-C1	B2
LexTale score (/100)	67.98	68.58
Months immersion	3 (4.5)	6.7 (5.2)
Number of other L2s	3.7 (range 2-6)	2.8 (range 2-5)

Note. Proficiency levels follow the Common European Framework of Reference for Languages (CEFR) and range from a beginner level (A1) to an advanced level (C2).

2. Method

2.1. Participants

Two main groups of interest took part in this study. One group consisted of 21 L1-German listeners (all students). Ten of these students (mean age 24.9, SD 4.6, 7 women) listened to the standard story, eleven students listened to the dialect story (mean age 25.5, SD 4.3, 8 women). A second group of 20 L2 speakers of German (10 listeners with L1 Finnish and 10 with L1 Swedish) were exposed to the dialect story. Both L2 groups were comparable with respect to their L2-German proficiency (see Table 1). All but one Finnish participant reported good knowledge of Swedish, and all but two were fluent in three Germanic languages (German, English, and Swedish). None of the Swedish listeners reported knowledge of Finnish, and all but two reported good English proficiency.

2.2. Stimuli

The novel accent was created by lowering the front vowels /ɪ/ to /ɛ/, /iː/ to /eː/ (hence *i* to *e*), and the back vowels /uː/ to /oː/, and /ʊ/ to /ɔ/ (hence *u* to *o*). We trained a native speaker of German on this accent until she was able to fluently read both the story (an excerpt from Antoine de Saint-Exupéry's "The Little Prince") and a list of stimuli. We recorded one dialect and one standard version of the story. The recordings were made in a soundproof cabin and later adjusted in Praat to have comparable amplitude.

For the lexical decision task, which preceded (session 1) and followed (session 2) the 15-min story, three types of stimuli were constructed: dialect words (critical items), filler standard words, and filler nonwords. The frequency of all words was established using the online Duden Corpus (duden.de/hilfe/haeufigkeit, retrieved April/May 2013). Only words among the 10 000 most frequent German words were chosen. Standard items included 30 real German words with no vowel shifts and none of the critical vowels (e.g., *Wald* 'forest'). These words should be equally well accepted across both sessions and all listener groups. A set of 20 nonwords was included, with a very low acceptance rate expected across both sessions and all listener groups.

The critical dialect items were German words, altered to become nonwords in Standard German but designated as words in the novel accent. The dialect items consisted of 20 words in which the front vowels /ɪ/ and /iː/ were lowered (e.g., the German word *Ding* 'thing' was changed to *Deng*). Half of these words also occurred in the story (old words), while the other half were new words with the same type of vowel shift to test whether adaptation effects would be limited to familiarized words. Another group of 20 target words included lowered back vowels /uː/ and /ʊ/ (e.g., the German word *Buch* 'book' was changed to *Boch*). Again, half of these words occurred in the story. An additional ten target words included the front vowels /ɛ/ and /ɛː/, which were lowered to /a/ and /aː/ (hence *ae* to *a*) (e.g., the German word *Käse* 'cheese' was changed to *Kase*). These words and this vowel shift did not occur in the story, and were included to test whether adaptation effects can extend to encompass a general principle of vowel lowering.

We predicted that dialect words would initially be considered nonwords, leading to a low endorsement rate in session 1 for all vowel types. In session 2, an increase in the endorsement rate should be visible for both old and new dialect words, but only in the dialect-exposure group. If the vowel shifts employed in the dialect story were taken as sufficient evidence for a general principle of lowering rather than as context-specific rules, we would expect participants in the dialect-exposure group to show increased endorsement rates for both familiarized and non-familiarized vowel shifts.

2.3. Procedure

The experiment consisted of six parts: lexical decision task (session 1), paper-pencil math task serving as a distractor, listening to a 15-min story (in Standard German or dialect), lexical-decision task (session 2), LexTale computer-based test of German vocabulary [28], and a background questionnaire. For the listening tasks, participants were seated in front of a computer monitor and presented with the experimental items (in a randomized order using the DMDX software [29]) and the story spoken by the same voice via headphones. Following the presentation of each item, participants were asked to indicate with a button press whether the item was an existing German word or not. For a response, German participants had a 1500 ms window, while L2 participants had a 3000 ms window. Participants were asked to respond as quickly and accurately as possible. Only endorsement rates were analyzed.

3.   Results

3.1. German L1 listeners

Table 2 shows the mean proportion of accepted words (endorsement rate) and standard error for both German groups in each condition per session. Differences in endorsement rate by type of vowel shift for old and new words are shown in Table 3. As visible in Table 2, there were very high endorsement rates for standard words (ranging from 93% to 96%), low to moderate endorsement rates for dialect words (ranging from 27% to 41%), and very low endorsement rates for nonwords (ranging from 9 to 12.5%) across both sessions and groups. In what follows, we limit our analyses to the critical dialect words. Figure 1 (an effect plot based on the statistical model described below) shows that participant endorsement rates in the dialect group, but not in the standard group, increased from session 1 to session 2.

Table 2: *Endorsement rates for word responses per item type and participant group (std = standard, dia = dialect). Standard error is shown in parentheses.*

Item type:	Standard	Dialect	Nonword
German std group			
Session 1	93.1 (1.5)	35.1 (2.2)	12.5 (2.3)
Session 2	94.0 (1.4)	27.6 (2.0)	9.0 (2.0)
German dia group			
Session 1	95.0 (1.2)	27.3 (1.9)	10.5 (2.1)
Session 2	96.1 (1.1)	41.3 (2.1)	9.1 (1.9)
Swedish group			
Session 1	97.2 (1.0)	59.7 (2.3)	12.2 (2.3)
Session 2	97.7 (0.9)	75.2 (1.9)	16.1 (2.6)
Finnish group			
Session 1	95.8 (1.2)	57.3 (2.3)	12.6 (1.2)
Session 2	94.9 (1.3)	62.2 (2.2)	22.1 (1.6)

A generalized linear mixed-effects regression (glmer, implemented in the R package lme4, [30]) for binary responses was fitted to the data. Word judgments (true or false) were taken as the dependent variable. Fixed effects entered into the regression were vowel shift (*i* to *e*, *u* to *o*, and *ae* to *a*), session (1, 2), dialect word (old, new) and group (dialect, standard), all were sum-coded. Participants and items were modeled with random intercepts. Random slopes were also included in order to capture effects of session on participants and items. Random effect structure was the

maximal structure supported by the data and model selection. We used model comparisons to determine whether each fixed factor contributed significantly to the model fit. The final model with the best fit included all factors but dialect word (old, new), which was not a significant predictor of endorsement rates (χ^2 = 12.55, p > .12). We then applied Anova (type III Wald chisquare tests) to the regression model and found a significant main effect of vowel shift (χ^2 = 16.14, p > .001), indicating that shifted vowels were not all equally accepted. There was a significant interaction between vowel shift and session (χ^2 = 12.49, p = .002) and a marginally significant interaction between session and group (χ^2 = 3.4, p = .065), confirming that the exposure phase affected participants' endorsement performance in session 2.
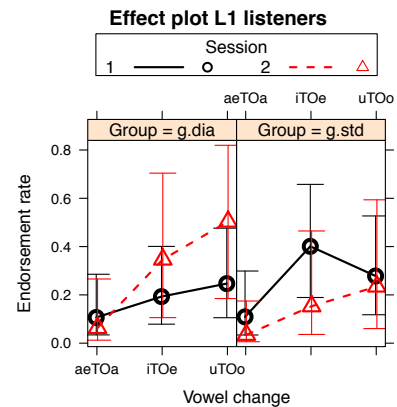

Figure 1: *Endorsement rates for dialect words in sessions 1 and 2 for the dialect group (g.dia) and the standard group (g.std) plotted as effect estimates. The error bars represent 95% confidence intervals.*

Table 3: *Difference in endorsement rates from session 1 to session 2 by vowel type and dialect word (old, new). Note: std = standard, dia = dialect.*

Vowel type:	*i* to *e*		*u* to *o*		*ae* to *a*
Group	old	new	old	new	new
German std	-7.9	-18.0	-18.0	-11.0	-12.0
German dia	18.2	12.7	23.6	12.7	3.6
Swedish	18.6	18.5	21.7	9.4	9.6
Finnish	10.0	7.3	7.0	3.9	-3.3

To evaluate how the dialect group adjusted to vowel shifts, a separate model was run with the factors session and vowel shift. The result revealed a significant main effect of vowel shift (χ^2 = 13.53, p = .001), and a significant interaction between session and vowel shift (χ^2 = 9.46, p = .009), indicating that German participants did not adjust to all vowel shifts equally well. Separate regression models restricted to pairwise comparisons for each vowel shift showed a marginally significant endorsement rate increase for the vowel shift *u* to *o* (β = 1.33, z = 1.88, p = 0.0599). The descriptively visible endorsement rate increase for the vowel shift *i* to *e* did not reach significance (β = 1.07, z = 1.51, p = 0.13).

3.2. Swedish and Finnish L2 listeners

As visible in Table 2, both Swedish and Finnish listeners returned very high endorsement rates for standard words

(ranging from 95% to 98%), moderate to high endorsement rates for dialect words (ranging from 57% to 75%), and very low endorsement rates for nonwords (ranging from 9% to 12.5%) across both sessions. L2 participants – just like L1 listeners – thus had little difficulty distinguishing between standard words and nonwords. To compare performance on dialect words between Finnish and Swedish participants (see Figure 2 and Table 3), we fitted the same model as for German L1 listeners. The final model with the best fit included all factors but dialect word (old, new), which was not a significant predictor of endorsement rates ($\chi^2 = 7.8$, $p > .44$).
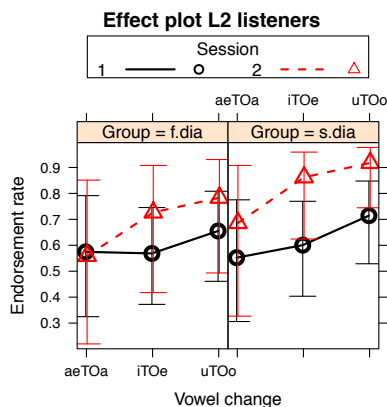

Effect plot L2 listeners

Figure 2: *Endorsement rates for dialect words in sessions 1 and 2 for the Swedish group (s.dia) and the Finnish group (f.dia) plotted as effect estimates. The error bars represent 95% confidence intervals.*

There was a main effect of session ($\chi^2 = 7.45$, $p = .006$), confirming that both L2 groups – just like the German dialect group – accepted more dialect words in session 2 compared to session 1. There was also a significant interaction between vowel shift and session ($\chi^2 = 6.56$, $p = .04$), suggesting that type of vowel shift affected the endorsement rate differently across sessions. No significant interactions emerged between group and session or group and vowel shift.

To evaluate how both L2 groups adjusted to vowel shifts across both sessions, planned separate models were run for each group. There were no significant effects for the Finnish group (all p's > .25). For the Swedish group, there was a main effect of session ($\chi^2 = 6.56$, $p = .04$), and no significant interaction between session and vowel shift ($\chi^2 = 3.95$, $p = .14$), confirming an adaptation effect for all vowel shifts.

4. Discussion and Conclusion

We familiarized German listeners and two groups of L2 listeners (Swedish and Finnish) with a novel accent of German to examine the role of native language background in lexical adaptation. For German listeners, results were as predicted: the exposure phase affected participants' performance in the lexical decision task. After 15 min of accent exposure, German participants showed systematic changes in the mapping of acoustic-phonetic input to lexical representations, consistent with previously reported results [1, 4, 5, 6]. Furthermore, adaptation generalized to dialect words that had not been presented in the dialect story but that contained the same shifted vowels. Adaptation did not generalize to lowered vowels with which participants had not been familiarized in the dialect story. However, in contrast to [6], German listeners exposed to the dialect adjusted reliably only to some vowel shifts. This could be due to the nature of the vowel shifts, some of which may be acoustically more similar (e.g., *u* to *o*) and activate more lexical candidates than others, or due to differences in the design between [6] and the present study. While we lowered front and back vowels, [6] lowered only front vowels. Future studies would need to show how type of vowel shift might affect adaptation. In addition, the exposure phase in [6] was 5 min longer than in the present study. A longer exposure phase may strengthen adaptation to and interpretation of altered phonetic forms. Finally, [6] tested 15 participants in a within-subject design, such that each participant heard both standard and dialect stories on separate days, while we tested 21 participants in a between-subject design. More participants could thus add statistical power.

Importantly, all groups showed a descriptively similar pattern of adaptation to the accented speech. Across both L2 groups, an increase in endorsement rate for dialect words from session 1 to session 2 was observed, suggesting that both L2 groups adjusted to the accented speech. This adds further support to the notion of flexibility of the L2 perceptual system [5, 8], extending the evidence to vowels. Although no interactions between L2 group and session or vowel shift emerged, separate models showed that – as predicted – adaptation was significant in the Swedish group only. In addition, Swedish participants adjusted to all familiarized vowels and generalized to other vowels that were shifted in the same direction as the familiarized vowels. A possible explanation for this could be lexical and phonological similarities between Swedish and L2 German. For example, some vowel shifts resulted in words that were more similar to Swedish than to Finnish: the German word *Mut* 'courage' shifted to /mot/ sounds similar to the Swedish equivalent *mod* /mo:d/. Similarly, *Spiel* 'game' shifted to /spe:l/ sounds similar to the Swedish counterpart /spe:l/. Such similarities as well as L2 learners' phonological confusions could have contributed to the overall high endorsement rates prior to the dialect exposure (57.3% and 59.7% versus 27.3% for L1 listeners).

Similarities between Swedish and German items, however, cannot fully account for these results, because the German dialect group did not show an overall larger adaptation effect than the Swedish L2 group. In addition to the advantage of listening to their native language, German participants could have benefited from knowledge of several south German dialects, in which various vowels are lowered, for example vowels in nasal contexts such as *Kind* 'child' pronounced as [kend], and Hund pronounced as [hond] [31]). While this knowledge might have played a certain role, it does not explain why German participants did not outperform the Swedish group in the overall endorsement rate. It is therefore reasonable to assume that German listeners applied a more normative approach to word endorsements, which may be less likely to occur in L2 groups.

Future studies would need to control cross-linguistic similarity between items to better model the adaptation effect for different groups. In addition, it would be of interest to see whether differences between L2 groups would emerge after exposure to the standard story. Taken together, these findings indicate that non-native speakers are able to make use of top-down L2 lexical knowledge to adjust to a novel accent in a L2, but also that mastering the task is modulated by native language background and similarity between L1-L2 lexicon and phonology, in line with [15,16,17].

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