

PHONOLOGICAL PRIMING AND PHONETIC CARRY-OVER IN TWO DANISH-ENGLISH BILINGUALS

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ABSTRACT

In this study we investigate whether the phonetic carry-over effects (or gestural drift) reported in the literature as occurring in the speech of bilinguals after long-term phonological priming (i.e., several months), also occur after short-term priming of less than an hour. Two bilingual Danish-English speakers were asked to read word lists after being primed for some time in one or other of their languages. In the Danish mode, a number of switches into English occurred in the word-list, and in the English mode switches into Danish were included. The switches allowed the examination of three possible carry-over effects: two with vowels and one with consonants. The results demonstrated no effect with the switches that would require the greatest phonetic change. They also showed that some potential carry-over effects were more likely long-term interference patterns. Acoustic analysis did suggest that with one of the vowel switches carry-over effects going both ways between Danish and English and English and Danish did occur, although this was clearer with one subject than the other.

1. INTRODUCTION

Bilingual speakers who have control over two different phonologies have to be able to switch between these when moving from one language to another. (We realise that in some instances of long-term societal bilingualism, such as Welsh-English, the two languages may have very similar phonologies: we are excluding such cases from our discussion here.) When, during reading, the bilingual switches from one language to another, they further have to switch grapheme-phoneme correspondence rules in many instances. Differences in these correspondences may be slight (for example, a small difference in tongue height for a particular vowel symbol), or more marked (e.g., a symbol representing a front rounded vowel in one language where the other language lacks such sounds and the symbol represents an unrounded front vowel).

In this preliminary study we wish to investigate whether priming a bilingual in one language will cause phonetic carry-over in a reading task when the speaker is suddenly forced to switch to their other language.

Lexical priming has often been used in psycholinguistic research to investigate, for example, speed of access to the lexicon (see Frenck-Mestrie & Bueno 1999, and references therein for background to this area). It has also been applied to bilinguals to examine the effect of priming in one language on lexical access bilingually (see, for example, Kirsner et al. 1984, Schwanenflugel & Rey 1986, Chen & Ng 1989).

Priming in phonological research, however, is comparatively uncommon. Nevertheless, bilinguals with (potentially) control over two phonologies appear to us as interesting subjects for phonological priming. We can hypothesize that balanced bilinguals are able to distinguish in production similar, but phonetically different, phonological units of their two languages. One way of testing this is to investigate the acoustic characteristics of the units and then see whether there is any phonetic carry-over between the languages following on from phonological priming. An investigation of long-term phonological priming effects with a bilingual speaker is reported in Sancier & Fowler (1997). This study reports three experiments with a Brazilian Portuguese-English bilingual, but only the third is of direct interest here. Sancier & Fowler measured the voice onset times (VOTs) of their subject's production of Brazilian Portuguese unaspirated [p] and [t], and her production of American English aspirated [p^h] and [t^h]. These measurements were taken after a stay of several months in the US, several months in Brazil, and again after several months in the US. The results showed that long-term priming caused what Sancier & Fowler term 'gestural drift'. By this they mean that the subject's Portuguese VOTs drifted towards those of American English when she was in the US, and her English VOTs drifted towards those of Portuguese when she was in Brazil. The authors note similar results in Flege (1987) for bilingual English-French speakers, whose VOTs for English lessened after living in France for extended periods, and in Major (1992) for English-Portuguese bilinguals, whose VOTs also reduced after living in Brazil.

The authors explain this gestural drift through appealing to a general disposition to imitate, found in a variety of human behaviors. It could perhaps also be seen as a phonetic level reflex of accommodation theory as explored in the sociolinguistic literature (see, for example, Giles et al. 1987). However, whatever the underlying explanation, it is of interest to study whether this phonetic carry-over is a result only of long-term priming, or whether it can occur when the priming effects are much shorter. In other words, can we find phonetic carry-over in the kind of code-switching that is common in bilingual speech?

2. THE STUDY

In this study, then, we wished to investigate the effect of short-term phonological priming on phonetic carry-over, as opposed to the long-term priming of Sancier & Fowler's (1997) study. In order to obtain strictly controlled and comparable data from our two subjects, we had to eliminate as much as possible extraneous linguistic and non-linguistic variables. Therefore, we drew up a structured data collection protocol (see below), and chose subjects with similar backgrounds apart from their language dominance category.

It was decided that data collection should be via a reading task. While this naturally does not directly reflect normal linguistic usage, it does have the advantage that we can control precisely the amount of priming in one language before the other language is introduced. We can also control the timing, number, and phonological make-up of the language-switch items. This allows us to concentrate on specific possible phonetic carry-over effects. However, we also have to recognize that the results obtained may be accounted for not only in strictly phonological terms, but could also be a reflection of grapheme-phoneme encoding abilities in the two languages. To avoid this reading effect being dominant it is important that subjects are made aware visually when a word in the second language of the test session is introduced (through color-coding the print, for example). This will avoid any pauses or false starts due to surprise at the appearance of a language-switched item.

For reasons noted below, VOTs were not a suitable area of investigation with the Danish-English bilingual subjects of this study. We decided to choose phonetic features that differed in degree of difference between the languages to see whether this had an effect on possible carry-over. We also decided to use subjects with different language dominance patterns to investigate whether carry-over (if it occurred) might be one way only and reflect this dominance feature. Our experimental hypotheses can be noted as follows:

- phonetic carry-over after short-term phonological priming will affect only small differences between the languages;
- phonetic carry-over after short-term phonological priming will reflect the dominant language of the subject in terms of the direction of that carry-over (based on experience of L1 to L2 interference patterns).

3. METHOD

3.1 Subjects

In this preliminary study we recruited two English-Danish female bilingual subjects. Both subjects were in their thirties, and from similar socio-economic classes (educated professionals). Neither subject was phonetically trained, and both were unaware of the nature of the investigation. Subject A was originally from Copenhagen, the capital of Denmark, but had lived in the United Kingdom for many years and considered herself English-dominant. Subject A had had one first-language Danish parent, and one first-language English. Subject B was also from Copenhagen, and currently lived in Sweden. She considered herself Danish-dominant. Danish was her first language, but she had acquired bilingual control of English through schooling, and considered herself fluent in English.

3.2 Materials

Two sets of materials were prepared: an English set and a Danish set. Each set consisted of an extended passage written in the relevant language (the fable of the North Wind and the Sun in each case), followed by a list of 20 words. The word list was in the relevant language except that items 10, 13, 15, 18, and 20 were in the second language. All items were checked to ensure they were frequently occurring words in the relevant language, and that the orthography represented unambiguously either an English or a Danish word (e.g., *let*, or *male* would be excluded, as these spellings represent both English and Danish words).

The purpose of the reading passage was to provide a preliminary priming of the subject to the phonology of the relevant language. Further, prior to reading the passage, subjects were to recite the numbers 1 to 20 in the relevant language. This priming is reinforced by the fact that the first half of the word list is also in this language. Subjects were warned that the word list would contain both Danish and English words so that the occurrence of words from the other language would not simply cause them to stop reading. The subjects were also informed that the words in the L2 would be printed in red as opposed to black, again to minimize any effect from surprise at the language shift. These L2 words would then be investigated to see whether any phonetic carry-over effects could be detected when specific graphemes were realised in speech.

The three graphemes chosen for the study were <y> (the greatest phonetic difference between the languages), <e> (less difference), and <t> (least

difference). <y> is realized in Danish as a retracted high front rounded vowel, represented by [y]. This vowel can be both long or short (tense or lax according to Haugen 1987). In English, <y>, when representing a vowel, is normally either [i] or [ai]. To ensure relatively common and phonologically simple English items, words with the [ai] pronunciation were chosen (e.g., *try*). To be similar, we had to choose words in Danish with final <y>, resulting in the long form of the vowel for that language.

Short <e> in Danish is realised as a vowel close to cardinal vowel 2. Unlike Grønnum (1998) we shall use the symbol [e] (Grønnum, following normal Danish phonetic usage, used [ɛ] to distinguish this vowel from an even higher mid front unit). This same grapheme in English is realised in most varieties of British English today as close to cardinal 3 (some varieties may have a slightly raised version of this, other slightly lowered). We will use the symbol [ɛ]. This grapheme was chosen because of the relatively slight difference in realization between the languages: a matter of tongue height. To avoid effects of formant transitions, both the L1 and L2 <e> words were matched in syllable shape, with all ending in an alveolar consonant.

Both vowel graphemes were tested in L1 at the beginning of the list in five words (2 for <y>, 3 for <e>), and in L2 at the end; distractor words of L1 were also included which contained neither grapheme to avoid prompting the subjects as to the nature of the investigation. For each language the L2 words were as follows: 10 <y>, 13 <e>, 15 <e>, 18 <y>, 20 <e>. The word lists used are included in the Appendix. Clearly, in a fuller study, a greater number of tokens, and several repetitions of tokens, would be desirable.

As we noted earlier, other studies have investigated VOT differences in voiceless plosives. Both English and Danish have aspirated voiceless plosives (though Garde 1991 claims that Danish plosives have less aspiration, and Grønnum 1998 notes that Danish voiceless plosives are lenis) so, even though VOT was likely to be somewhat different between the two languages, this was not felt to be a fruitful area of investigation. Grønnum (1998) does, however, note that the voiceless alveolar plosive is characterised by an affricated release. Most varieties of English (including Southern British—the model for both subjects in this investigation) do not have an affricated release to /t/. The grapheme <t>, therefore, was included as our third test item. It occurred on several items in both the L1 and L2 words in both lists (see Appendix). The aspirated variant was transcribed [tʰ], with [tʰ] for the affricated variant. As an unreleased variant of /t/ ([t̚]) is commonly found in this position, we included this variant also in our transcriptions.

3.3 Procedure

The subjects were tested in one language on one day, and the second language two days later. This was to avoid undue effects from familiarity with the task. Subject A was tested English, Danish, and Subject B Danish, English. This ordering reflected the language dominance of each subject, as we expected carry-over to occur potentially more often from the dominant language to the second language.

The subjects were recorded onto an Aiwa AM-F70 Minidisc recorder via a Sony ECM-MS907 external microphone in the Phonetics Laboratory of the University of Ulster. They were first asked to recite the numbers 1 to 20, and then to read the North Wind and the Sun passage at a normal reading rate. Almost immediately after finishing the passage they were presented with the word list in the form of individual flash cards shown at a fairly rapid rate. They were instructed to avoid any pauses if at all possible. They were also told that words from both languages were likely to occur, and that words in L2 would be printed in red.

The five L2 test words and their equivalent L1 words from the early part of the list were phonetically transcribed by the authors for both subjects. The transcription was fairly broad, in that it was simply into the two or three variants per grapheme described earlier. There was 100% agreement between the transcribers for all items.

The vowels used for <e> were subjected to acoustic analysis via the Kay Elemetrics Computer Speech Lab (CSL™) 4300. LPC (linear predictive coding) analysis was undertaken at the mid point of each vowel, and values for F1, F2 and F3 recorded.

The release portions of the <t> test items were also analyzed via the CSL. In this case, wideband spectrograms were made, and the frequency range of the release was measured, and compared to 'model' productions of aspirated and affricated [t] recorded by the second author. In the results below, productions of the <t> test items are classified simply as either 'aspirated' or 'affricated' derived from this analysis. We included one pair in this category with <t> in final position. The unreleased variant of /t/ ([t̚]) was to be assigned when no release portion was visible on the spectrograms.

The productions of the <y> test items were clearly one or other of the widely differing variants: [y] and [aɪ]. We did not detect any signs of gestural drift between these values, so acoustic analysis was not undertaken on these vowels, and the results record only the IPA transcriptions.

4. RESULTS

The results for the <e> tokens are given in Table 1, with both the IPA transcription, and the formant values. Typical formant frequencies for female speakers for RP English / ϵ /, as given in Cruttenden (1994, quoting Deterding 1990) are: F1 645 Hz, F2 2287 Hz. Typical values for female speakers for Danish / ϵ / are: F1 390 Hz, F2 2400 Hz, (Fischer-Jørgensen 1971). It should be noted that the Danish values are estimated, as they are derived from a formant chart (for the long version of this vowel), and no formant values are given. Further, Fischer-Jørgensen uses data analysed in 1952; Grønnum (personal communication) confirms that no more recent figures are available.

From this table, it is clear that impressionistic transcription suggests that there has been no carry-over from L1 to L2. However, the formant values do show differences between the L1 and L2 versions of the test items, and we return to this in the next section.

Table 1: Results for <e> tokens

Token	Subject A: English dominant				Subject B: Danish dominant			
	as L1:English		as L2:Danish		as L1:Danish		as L2:English	
	IPA	F1-F3 (Hz)	IPA	F1-F3 (Hz)	IPA	F1-F3 (Hz)	IPA	F1-F3 (Hz)
wet	ϵ	574	ϵ	561	ϵ	674	ϵ	478
		1959		1807		1659		1063
		2596		2627		2563		2589
ten	ϵ	558	ϵ	539	ϵ	593	ϵ	276
		1940		2022		1839		1888
		2805		3061		2962		3070
tell	ϵ	537	ϵ	662	ϵ	602	ϵ	601
		1538		1630		1854		1765
		3002		2946		2979		2943
slet	e	408	e	475	e	419	e	535
		2325		2030		2173		2122
		3158		3005		3155		3099
sten	e	426	e	424	e	390	e	489
		2506		2599		2469		2426
		3353		3121		2954		3092
telt	e	406	e	482	e	511	e	509
		2019		1888		2037		2124
		2724		2796		3142		3082

The results for the <y> tokens are given in Table 2; as noted above, these are in IPA transcription only. This table demonstrates that there has been no carry-over between L1 and L2 for the <y> grapheme.

Table 2: Results for <y> tokens

Token	Subject A: English dominant as L1:English as L2:Danish		Subject B: Danish dominant as L1:Danish as L2:English	
	IPA	IPA	IPA	IPA
try	aɪ	aɪ	aɪ	aɪ
why	aɪ	aɪ	aɪ	aɪ
ny	y	y	y	y
ly	y	y	y	y

The results for the <t> tokens are given in Table 3. Again, as noted above, these are divided solely into aspirated or affricated examples. It should also be noted that the *take* and *tak* tokens are included to check normal pronunciations, and were not used as L1-L2 switch items. No examples of unreleased-t were found. This table shows some carry-over effects: for Subject A one example of affricated changed to aspirated, for Subject B three examples of aspirated changed to affricated. These effects are discussed more fully in the next section.

Table 3: Results for <t> tokens

Token	Subject A: English dominant as L1:English as L2:Danish		Subject B: Danish dominant as L1:Danish as L2:English	
	IPA	IPA	IPA	IPA
tell	tʰ	tʰ	tˢ	tʰ
wet	tʰ	tʰ	tˢ	tˢ
take	tʰ		tʰ	
telt	tˢ	tˢ	tˢ	tˢ
slet	tˢ	tˢ	tˢ	tˢ
tak	tʰ		tˢ	

5. DISCUSSION

These results seem at first sight to support aspects of our initial hypotheses. First, the only carry-over effects that are recorded by impressionistic transcript on are with <t>. This supports our hypothesis that only small differences between the languages will be affected. Also, all the carry-over effects are from the subject's dominant language to their less strong language. Interestingly, however, the carry-over effects do not appear to be due to priming, as Subject A's sole example occurs on Danish

tak during her L1 Danish session, and two of Subject B's three examples occur on English words during her L1 English session. We feel, therefore, that these examples might best be portrayed as pervasive and fairly stable two-way interference patterns between the languages, and this study does not support any claim that short-term phonological priming increases the likelihood of this interference.

The phonetic transcriptions of the <e> vowels suggests, as we noted above, that there is no phonetic carry-over here. However, an examination of the acoustic data allows a more fine-grained analysis. We recognize, of course, that the small amount of data involved means we cannot make any firm claims here; nevertheless, comparing L1 and L2 productions of the same tokens reveals interesting findings. For Subject A, L2 productions of [e] words (*slet, sten, telt*) mostly show a higher F1 and lower F2 (thus making them somewhat more [ɛ]-like); while with L2 productions of [ɛ] words (*wet, tell, ten*), two show a higher F2 and one of these shows also a lower F1 (thus making them more [e]-like). These findings are similar to the gestural drift reported by Sancier & Fowler (1997), and so do not support our hypothesis that carry-over will only be from the dominant to the weaker language.

Subject B presents a more complicated pattern. With [e] words, two examples show a rise in F1 between L1 and L2 productions, but stable F2. This still means that they become more [ɛ]-like. The very low F2 for *telt* as an L1 production was not reflected in the IPA transcription, and suggests a possible problem in the acoustic analysis of this token. Subject B operates a different strategy with [ɛ] words. L1 pronunciations all have similar F1-F2 values. *Tell* displays comparatively little variation between L1 and L2 realizations (slight fall in F2). On the other hand, *ten* shows a marked fall in F1, while *wet* shows a fall in both F1 and F2. The fall in F1 alone does demonstrate a move towards [e] (indeed even beyond it), although this move lacks a rise in F2. The fall in both F1 and F2 for *wet*, however, gives a more central vowel quality. It is indeed possible that these changes are the result of phonetic carry-over, but without more examples they could also be accounted for in terms of performance errors brought on by the language switch.

6. CONCLUSION

This preliminary study has shown that fine-grained phonetic carry-over effects (or gestural drift) may occur after short-term phonological priming as well as after the long-term priming described in the literature. It has

also shown the need to distinguish carefully between quasi-permanent interference patterns in individual bilinguals (such as the aspirated/affricated-t), which seem to bear no particular relation to phonological priming, and changes that do seem to derive from language-switching. We have also noted the importance of instrumental analysis when looking for such slight changes. Clearly, these tentative findings need to be supported by wider studies, looking at a range of phonetic features, different bilingual situations, and using a larger number of subjects. Nevertheless, this investigation has supported the claim that bilinguals do utilize separate, if similar, phonetic units, and that phonetic carry-over between these units may occur, and that this may be due to phonological priming in one of their languages.

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APPENDIX

Danish Reading Passage (from Grønnum 1998)

Nordenvinden og solen kom engang i strid om, hvem af dem der var den stærkeste. Da så de en vandringsmand, der kom gående, svøbt i en varm kappe. Og de enedes om, at den der først kunne få kappen af ham skulle anses for den stærkeste. Først tog nordenvinden fat, og han blæste og blæste, men jo mere han blæste, des tættere holdt manden kappen sammen om sig. Til sidst måtte nordenvinden give fortabt. Så tog solen fat. Og han skinnede og skinnede, og til sidst fik manden det for varmt og måtte tage kappen af. Da måtte nordenvinden indrømme, at solen var den stærkeste af de to.

English Reading Passage (from IPA 1949*)

The North Wind and the Sun were disputing which was the stronger, when a traveller came along wrapped in a warm cloak. They agreed that the one who first succeeded in making the traveller take his cloak off should be considered stronger than the other. Then the North Wind blew as hard as he could, but the more he blew the more closely did the traveller fold his cloak around him; and at last the North Wind gave up the attempt. Then the sun shone out warmly, and immediately the traveller took off his cloak. And so the North Wind was obliged to confess that the Sun was the stronger of the two.

* N.B. The current IPA Handbook (IPA 1999) uses US spellings and verb forms unsuitable for the linguistic background of the subjects.

Word Lists

	Danish Word List		English Word List
1.	tak	(thanks)	take
2.	ny	(new)	try
3.	sjov	(fun)	shove
4.	slet	(bad)	wet
5.	jul	(Christmas)	yell
6.	telt	(tent)	tell
7.	ly	(shelter)	why
8.	hvil	(rest <i>n.</i>)	hill
9.	sten	(stone)	ten
10.	try*		ny*
11.	flest	(most)	flock
12.	bøg	(beech)	beak
13.	wet*		slet*
14.	præg	(look <i>n.</i>)	pray
15.	ten*		sten*
16.	stål	(steel)	stall
17.	rask	(healthy)	risk
18.	why*		ly*
19.	mæt	(full)	mate
20.	telt*		telt*
	*English words		*Danish words

Comparison Word Pairs

	Danish	English
<e>	slet	wet
	sten	ten
	telt	tell
<y>	ny	try
	ly	why
<t>	telt	tell
	slet	wet
	tak*	take*

*These were for comparison of norms only, as they were not involved in switches.