

## THE INTERRELATIONSHIP BETWEEN VOT AND VOICE ASSIMILATION

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### ABSTRACT

The main aim of this contribution is to enlighten the phenomenon of regressive assimilation of voicing (RVA), referring especially to Afrikaans and Tswana Afrikaans. The strong interrelationship between negative VOT values on the one hand, and RVA on the other hand is being pointed out, using production experiments. In conclusion, we speculate on the possible explanations of the results and the theoretical implications thereof. We suggest a clear interrelationship between hard core phonetic and abstract phonological considerations.

### INTRODUCTION

The phenomenon of assimilation of voicing has been researched extensively in the case of the Germanic languages Dutch [1, 2] and Afrikaans [3,4]. Few cross-linguistic studies (with the exception of Van Dommelen [5] and Elshout [6] in the case of Dutch and German) has been done, and not much is known about the possible phonetic causes either. Van Dommelen [5] implies a causal role of negative voice onset time (-VOT) in the case of regressive voicing assimilation (RVA) in Dutch. In this contribution we will test this hypothesis cross-linguistically, and present preliminary results which could serve as a starting point to fill this gap in our knowledge. We will concentrate on Afrikaans L1 as well as Afrikaans L2 (of Tswana speaking persons, 'n Bantu language of Southern Africa). We will also refer to a variety of (mainly) European languages.

Assimilation of the type given in (1) is very common in many languages:

(1) Type 1 languages:

Afrikaans: o/pd/aag → [bd]aag

Dutch: a/sb/ak → a[zb]ak

Other languages include, Hungarian, Russian, French, and Spanish.<sup>2</sup>

When an underlying voiceless consonant precedes a voiced consonant,

the first (C<sub>1</sub>) assimilates as to voicedness to the second (C<sub>2</sub>). This is called regressive assimilation of voice, or regressive voicing assimilation (henceforth RVA). Both English and German are absent from this list of languages (cf. Roach [7] for English, and Elshout [6] for German). Instead, these languages both prefer progressive voicing assimilation (PVA)<sup>3</sup>, as in (2):

(2) Type 2 languages:

English: it i/z/ → it[s]

German: au/f d/em → au[f]em

It is a puzzling fact that languages such as Afrikaans and Dutch are being characterized by the existence of RVA of Type 1, but that this type of assimilation is absent in the related English and German. In Figure 1 we present some measurements of VOT in a variety of languages, serving as a starting point for discussing the possible relationship between the presence of negative VOT values and RVA in any given language. RVA is known to exist in the cases of Afrikaans, Dutch, Russian, Spanish, but not in German or English. It was tested in this study for Tswana Afrikaans.

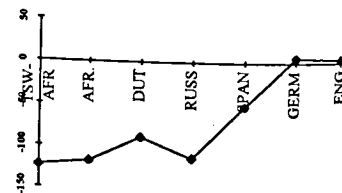


Figure 1. Comparison of VOT values (neg. and pos. - indicated on Y-axis) for voiced plosives in languages exhibiting RVA, i.e. Tswana Afrikaans, Afrikaans, Dutch, Russian and Spanish. In English and German RVA is absent. The precise values are (from left to right): -123ms, -117ms, -88ms, -112ms, -51ms, and German +6ms, English +4ms. Measurements are of one L1 speaker per language. (n=10+).

The voiced consonants of German [5] and English [7] are strictly speaking not voiced, but rather lenis (tense), in contrast with voiceless consonants, which are fortis (lax), e.g. [p t k].

In Afrikaans, RVA and PVA (progressive voicing assimilation), sometimes alternate in a given word (e.g. se[zd]e / se[st]e - "sesde" (sixth)). Voice assimilation thus is an optional process in Afrikaans, unlike the situation in Russian, where it is an obliga-

tory process. This, together with the above-mentioned hypothesis, leads to the expectation that, even in the case of Type 1 languages, the -VOT has to be of a certain minimum value in order to enforce RVA, otherwise either no assimilation at all will take place, or C<sub>2</sub> would be weakened with respect to voicedness to such an extent that RVA would be impossible. This was tested in the following experiments.

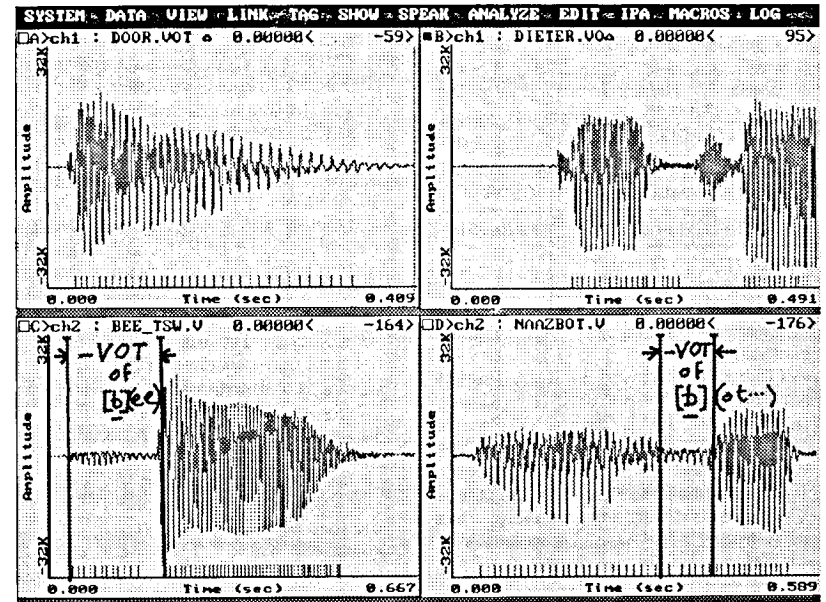


Figure 1: Waveforms of typical examples of initial voiced (lenis) consonants of British English ("door" in Window A) and German ("Dieter" in B) with no negative VOT values, compared to languages with large -VOT values: Tswana Afrikaans ("bee" in C) and L1 Afrikaans ("Naa[zb]otha" in D).

### THE CASE OF AFRIKAANS

One speaker of Afrikaans, known from a previous experiment [3] to exhibit RVA, was used. The phrase *Naas Botha* (name and surname) was read 50 times at a fast but comfortable rate. The words *sesde*, *elfde* and *liefde* were read ten times each. In all of these words both RVA and PVA are possible, though PVA would be expected to occur rarely in *Naas Botha*, and more readily in the former three derivatives [3]. All instances of the two types of

assimilation were registered. *Naas Botha* were pronounced either as *Naa[zb]otha* (RVA) or as *Naa[sb]otha* (no assimilation), but never as *Naa[sp]otha* (PVA). See Figure 2 (D) for an example of RVA. The words *sesde*, *elfde* and *liefde* exhibited either PVA or RVA, or no assimilation at all. C<sub>2</sub> consonants were isolated and their -VOT durations measured, using the CSL speech editing system of KAY.

## Results

Table 2. Values in milliseconds (ms) of negative VOT (-VOT) of C<sub>2</sub> ([b]) in the Afrikaans phrase Naas Botha. Ranges of values are also mentioned in brackets.

(One L1 Afrikaans speaker)	C <sub>2</sub> (-VOT)
RVA (C <sub>1</sub> = [z]) (33 cases)	80 (40-122)
No ass. (C <sub>1</sub> = [s]) (17 cases)	48 (15-83)

There is a statistically highly significant difference ( $p = 0,000003$ ) between the -VOT values involved in RVA (80 ms) and those of C<sub>2</sub>'s not involved (48ms).

Table 3. Values in ms of negative VOT of C<sub>2</sub> ([d]) in Afrikaans sesde, elfde and liefde. Ranges of values are also mentioned in brackets.

(One L1 Afrikaans speaker)	C <sub>2</sub> (-VOT)
RVA (C <sub>1</sub> = [z]) (14 cases)	52 (0-75)
No ass. (C <sub>1</sub> = [s]) (2 cases)	33 (16-49)
PVA (C <sub>2</sub> = [t]) (10 cases)	7 (0-65)

There is a statistically highly significant difference ( $p = 0.007$ ) between the -VOT values involved in RVA (60ms) and those of C<sub>2</sub>'s not involved (33ms). In two of the RVA cases a VOT value of 0 was found, the rest alternated between 45 and 75ms (see Discussion). There is a definite tendency for the -VOT's to shorten progressively from PVA through No Assimilation to RVA. This also goes for the durations of C<sub>1</sub>, but in reversed order: ([s] in PVA = 63ms and in No Assimilation = 60ms; in RVA [z] = 51ms). Both these tendencies are consistent with results of experiments on RVA so far [3]. For the significance of the results in broader perspective, see Discussion.

### THE CASE OF TSWANA AFRIKAANS

Four male Tswana speakers, all of whom were competent speakers of Afrikaans (their second or third language), were asked to repeatedly read a few sentences, among others, containing the phrases *ek dink* ("I think") and *mos dat* ("certainly that"), at a comfortable rate. Out of the 320 possible instances of RVA, the subjects assimilated 247 times (either *e[gd]ink* or *mo[zd]at*). 42 phrases were not taken into account,

due to mispronunciations, yielding only 31 instances which were in fact not assimilated regressively (i.e. a mean of 89% RVA's, ranging from 77% to 95% for the four subjects). When taking into account the fact that Tswana is characterized by strong -VOT values (123ms in the case of the above-mentioned subject - see also Figure 1 (C) for a waveform example), these results clearly support the hypothesis postulated. (See next section for discussion)

## DISCUSSION

It is quite clear that there is a direct relation between the presence of negative VOT's in C<sub>2</sub> consonants and the appearance of regressive voicing assimilation in the languages studied or referred to in this contribution. The question is, however, what kind of a relationship this is. More specifically: are large -VOT values a prerequisite for RVA to surface in any given language? The strong presence of RVA in Tswana Afrikaans certainly is an indication that this is the case, especially when taking into consideration the fact that RVA is not a possibility in Tswana itself, because of the total non-existence of the relevant of C<sub>1</sub>+C<sub>2</sub> combinations - Tswana has mainly a CVCV syllable structure. The statistically significant difference between the -VOT values in the case of "Naas Botha" involved in RVA (52ms) and those of C<sub>2</sub>'s not involved (33ms) in the case of the first experiment on Afrikaans (see Table 2) strongly supports this hypothesis. The same goes for the second Afrikaans experiment (Table 3). The magnitude of -VOT's in the latter instance (52ms for RVA, 33ms for No Assimilation, and 7ms for PVA) surely highlights the plausibility of the hypothesis that the low-level phonetic VOT values does indeed interrelate with the presence or absence of voice assimilation in the languages under consideration (and perhaps in any given language). On the other hand, the presence of two 0ms values involved in RVA (see Table 3 and accompanying text) suggests that this explanation cannot be absolute. A possible explanation lies on a mental level. Speakers of languages characterized by large negative VOT values sometimes might not actually produce voiced plosives distinguished

by -VOT's large enough to further RVA, but such speakers might nevertheless be directed by the tacit knowledge of, in this case, the presence such large negative VOT's typically of their language, be it actualized in particular instances or not. Such an explication implies a clear interrelationship between hard core phonetic and abstract phonological considerations. This, however, is merely a suggestion, which has to be followed up. The optionality of this phonological process in languages such as Dutch and Afrikaans, as well as the fact that males are more inclined to assimilate regressively than females [1] have to be accounted for in subsequent studies of this nature.

As to the presence of RVA in Tswana Afrikaans, this cannot be explained in terms of Natural Phonology (as was suggested by some e-mail reactions per Linguist List). According to Stampe [8] processes such as voicing assimilation are found in the speech of children universally and have to be unlearned for those languages which violate them. More in particular, Natural Phonology (NP) posits a set of innate, vocal tract physiology-driven phonological natural processes, of which RVA would be one. However, vocal tract physiology has to be (very much) the same for all humans, so that it is highly unlikely that the vocal tracts of German and Dutch speakers, for instance, would differ to such an extent that RVA will be present in the latter language but absent in the former.

Neither can NP explain the alternation of RVA and PVS (and, in fact, no assimilation) as is the case in the Afrikaans words *sesde*, *elfde* and *liefde* (see Table 3).

According to Universal Grammar [9], each language may fix the VOT parameter differently. UG, however, was, up till now, restricted to syntax. Another possibility is that large negative VOT values simply evolve in certain languages but not in others, due to unknown factors.

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<sup>2</sup> Confirmed by different e-mail users of Linguist List.

<sup>3</sup> But see Van Dommelen [5], who argues in favour of the term fortition instead of devoicing of C<sub>2</sub>