



**UvA-DARE (Digital Academic Repository)**

**Identification of deleted plosives: the effect of adding noise or applying a time window: a reply to Ohde and Sharf**

Pols, L.C.W.; Schouten, M.E.H.

*Published in:*  
The Journal of the Acoustical Society of America

*DOI:*  
[10.1121/1.385312](https://doi.org/10.1121/1.385312)

[Link to publication](#)

*Citation for published version (APA):*  
Pols, L. C. W., & Schouten, M. E. H. (1981). Identification of deleted plosives: the effect of adding noise or applying a time window: a reply to Ohde and Sharf. *The Journal of the Acoustical Society of America*, 69(1), 301-304. <https://doi.org/10.1121/1.385312>

**General rights**

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

**Disclaimer/Complaints regulations**

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

# Identification of deleted plosives: The effect of adding noise or applying a time window (A reply to Ohde and Sharf)

L. C. W. Pols and M. E. H. Schouten

*Institute for Perception TNO, Soesterberg, The Netherlands*

(Received 5 June 1980; accepted for publication 8 September 1980)

A Letter in this *Journal* [Ohde, R. N. and Sharf, D. J., *J. Acoust. Soc. Am.* 69, 297–300 (1981)] deals with the identification of voiced and voiceless stops from vocalic transition + vowel stimuli edited from CV and VC syllables. The segmentation points were smoothed by applying a time window. With respect to an earlier study, in which straightforward segmentation without time window was applied, final plosives were still identified better than initial plosives. The present Letter shows that there is, however, one major difference between the with-window and the no-window condition, namely a substantial improvement in identification for initial voiced plosives. This improvement is similar to that found by the present authors in identification experiments with a noise burst adjacent to the segmentation point versus no-noise listening conditions. Instead of a controversy reported by Ohde and Sharf, this Letter suggests a unifying interpretation.

PACS numbers: 43.70.Dn, 43.70.Ve, 43.66.Dc

## INTRODUCTION

Several recent papers (Sharf and Hemeyer, 1972; Sharf and Beiter, 1974; LaRiviere *et al.*, 1975; Ohde and Sharf, 1977; Pols and Schouten, 1978; Pols, 1979; Ohde and Sharf, 1980) deal with the identification of initial and/or final plosives in monosyllables from which the initial or final plosive burst + aspiration has been deleted. The stimuli for plosive identification, particularly identification of place of consonant articulation, then consist only of the consonant–vowel (CV) vocalic transition + vowel segment for initial plosives, or of the vowel segment + vowel–consonant (VC) vocalic transition for final plosives. Ohde and Sharf (1977) and LaRiviere *et al.* (1975) also studied the vocalic transition alone. Pols and Schouten (1978) and Pols (1979) used various segmentation points.

The two discussion points we want to focus on in this Letter are:

- (1) Is there a substantial difference between initial and final plosive identification?
- (2) Does the deletion procedure itself introduce artifacts or lower the correct score, and if so are there ways of overcoming this?

In Pols and Schouten (1978) we, somewhat provocatively, claimed that there is no inherent difference in information content between CV and VC transitions. We contended that any such differences found (Sharf and Hemeyer, 1972; Ohde and Sharf, 1977) were due to the abrupt onset of the CV transitions after deletion of the initial burst + aspiration. As a result, deleted initial stop consonants were identified much worse than deleted final consonants. We demonstrated that for Dutch plosives the advantage of final over initial consonant identification could be reduced considerably by replacing the deleted consonants with noise, thus smoothing the abrupt onsets. As a result, identification of initial consonants improved, whereas that of final consonants remained unchanged.

In their recent Letter to the Editor, Ohde and Sharf (1980) set out to counter our claim that there is no inherent difference in information content between consonant–vowel (CV) and vowel–consonant (VC) transitions. They describe a new experiment, in which they eliminate a possible “click sensation” by smoothing the onsets of CV transitions and the offsets of VC transitions by means of an amplitude-smoothing time window. They claim that, although there are now no abrupt onsets anymore, the original advantage of final over initial transitions remains, and that the difference between the two is consequently an inherent one. The purpose of our present reply is, firstly, to indicate that we think that Ohde and Sharf’s (1980) data do not differ essentially from ours, and secondly, to discuss some considerations they raise in their discussion.

## I. INTERPRETATION OF THE DATA

In Table I, we present a summary of the figures on which Ohde and Sharf (1980) base their claim, and on which we base ours. We include the results of an experiment on American English plosives, recently conducted by one of us and described in Pols (1979).

A few things should first be said about differences between stimuli, experimental designs, and languages. Ohde and Sharf (1980) used CV-type syllables and separate subsets for voiced /b, d, g/ and voiceless /p, t, k/ stimuli, whereas we used CVC syllables and mixed voiced–voiceless presentations and response sets. Moreover, Dutch differs from English in that Dutch plosives are unaspirated and do not have initial /g/ or final voiced plosives. Dutch voiced plosives are usually prevoiced, and it is not uncommon for a Dutch /t/ to be mistaken for a /d/ by a native speaker of English. So identification results will only be comparable in a relative sense.

Ohde and Sharf (1980) conclude from their new identification experiment with a time window that “the reliability and direction of the results . . . ,” with respect

TABLE I. This table contains the identification scores for deleted plosive consonants from all the studies mentioned in this Letter. The deletion procedure resulted in stimuli consisting of vocalic transition + vowel for initial plosive identification or vowel + vocalic transition for final plosive identification. The first five columns specify the experimental conditions, namely: Segmentation procedure; whether voiced or voiceless subsets were used, or a full set; the syllable type (CV and VC or CVC); the language used (AE = American English, D = Dutch); and whether or not a time window or noise were applied. The next four columns give the detailed scores; the last two columns give combined scores.

Study	Segment procedure	Stimulus response	Syllable	Language	Window noise	Initial (CV)		Final (VC)		CV	VC
						/b, d, g/	/p, t, k/	/b, d, g/	/p, t, k/		
Sharf and Beiter (1974)	splicing	subset	Cə	AE	...	64	39	79	83	52	81
Sharf and Hemeyer (1972)	splicing	subset	Cə	AE	...	66	26	91	91	46	91
Ohde and Sharf (1977)	erasure	subset	CV	AE	...	44	35	73	58	39	65
Ohde and Sharf (1980)	digital	subset	CV	AE	window	72	40	78	57	56	67
Pol's (1979)	digital	full set	CVC	AE	...	54	17	63	82	35	73
Pol's (1979)	digital	full set	CVC	AE	noise	82	26	67	69	54	68
Pol's and Schouten (1978)	digital	full set	CVC	D	...	/b, d/					
						noise	74	34	...	77	...
						73	66	...	77	...	...

to earlier studies (where other deletion techniques without time window were employed) "... were similar." In other words, final stop identification is still superior to initial stop identification. They, furthermore, reject our noise paradigm because of the "risk of not being able to explain the effect obtained."

Table I shows that for the new experiments with a time window (Ohde and Sharf, 1980), the VC score (67%) is indeed still higher than the CV score (56%). The difference, however, is substantially reduced with respect to the no-window condition (Ohde and Sharf, 1977), where the VC and CV scores are 65% and 39%, respectively. Moreover, if one looks more carefully at the data, it is clear that there is a major difference between the no-window versus window conditions, namely for the initial voiced plosives (44% versus 72%). Interestingly enough, this improvement is comparable to that found by Pol's (1979) for initial American English voiced plosives in the no-noise versus noise conditions (54% versus 82%), and to that found by Pol's and Schouten (1978) for initial Dutch voiceless plosives in the no-noise versus noise conditions (34% versus 66%). In English, the vocalic transitions of the voiced stops are more consonant-specific than those of the voiceless stops, where most coarticulation takes place during aspiration. Dutch voiceless stops are unaspirated, which makes their vocalic transitions more consonant-specific.

Apparently, for those situations where a lot of consonant-specific information is present in the vocalic transition directly following the segmentation point, the abrupt vocalic onset ("click sensation") produces conflicting information and reduces the identification score. The perceptual effect of this abrupt onset can be avoided by applying a time window to smooth the segmentation, or by a noise burst preceding the segmentation point; both procedures cause a considerable improvement in identification of deleted plosives, especially initial American English voiced ones.

We find it difficult to include in this discussion the data from similar experiments by Sharf and Hemeyer (1972) and Sharf and Beiter (1974). As can be seen in the first three rows of Table I, there is considerable inconsistency among these scores and those found by Ohde and Sharf (1977), whereas the experimental conditions were quite similar. There were two differences, however, which may have influenced the results: (1) Sharf and Hemeyer (1972) and Sharf and Beiter (1974) used only the vowel /ə/, whereas Ohde and Sharf (1977) used a larger vowel set; (2) the segmentation procedure used in the two earlier papers was tape splicing, replaced in 1977 by tape erasure. We consider the more recent data of Ohde and Sharf (1977) to be the more reliable ones; moreover, in that study, the set of vowels is more similar to the one used by Ohde and Sharf (1980).

## II. IMPLICATIONS

In our 1978 paper, we used the term "click sensation" for want of a better term. What we meant by it was the effect produced by the inevitable spectral consequences of an abrupt onset. We felt that this effect differed only in degree, but not in principle, from the clearly audible click produced by cutting and splicing at a high amplitude point on a waveform. Combining Ohde and Sharf's (1980) and our own results, we think it may be said that the addition of noise or of a time window reduces, perhaps even cancels, the unwanted onset spectrum. Such an effect is to be expected if a time window is used, provided not too much information is smoothed away. With noise, however, the effects are perhaps less predictable, although the net results appear to be at least as effective. In addition to supplying the required spectral continuity, added noise could also (1) serve as an alerting signal to subjects (this could be investigated by having noise bursts of various durations); (2) mask the no-signal situation, with unpredictable effects. If no noise is applied there is silence instead, with the con-

sequence that no information is present at all; (3) allow subjects to suppose that the original information could be present but has been made inaudible ("hear through the noise") (Plomp, 1980).

The third possibility is the one we briefly hinted at in our paper, where we said that this "possibility must not be excluded." The truth is, however, that we do not really know exactly what happens when noise is added to a signal; how, for example, would it provide "spectral continuity?" The fact that Ohde and Sharf's (1980) and our results are of the same magnitude could indicate that the effects caused by a time window or noise are the same, but it is too early to say that.

LaRiviere, C., Winitz, H., and Herriman, E. (1975). "Vocalic transitions in the perception of voiceless initial stops," *J. Acoust. Soc. Am.* 57, 470-475.

Ohde, R. N., and Sharf, D. J. (1977). "Order effect of acous-

tic segments of VC and CV syllables on stop and vowel identification," *J. Speech Hear. Res.* 20, 543-554.

Ohde, R. N., and Sharf, D. J. (1981). "Stop identification from vocalic transition plus vowel segments of CV and VC syllables: A follow-up study," *J. Acoust. Soc. Am.* 69, 297-300.

Plomp, R. (1980). "Perception of sound signals at low signal-to-noise ratios," in *Proceedings of Symposium on the Recognition and Classification of Aural Signals*, June 1978, Cambridge, MA.

Pols, L. C. W. (1979). "Coarticulation and the identification of initial and final plosives," *ASA 50 Speech Communication Papers*, edited by J. J. Wolff and D. H. Klatt (Acoustical Society of America, New York), pp. 459-562.

Pols, L. C. W., and Schouten, M. E. H. (1978). "Identification of deleted consonants," *J. Acoust. Soc. Am.* 64, 1333-1337.

Sharf, D. J., and Beiter, R. C. (1974). "Identification of consonants from formant transitions presented forward and backward," *Lang. Speech* 17, 110-118.

Sharf, D. J., and Hemeyer, T. (1972). "Identification of place of consonant articulation from vowel formant transitions," *J. Acoust. Soc. Am.* 51, 652-658.

## Absorption of acoustic energy by plant leaves

Maurice J. M. Martens

*Section Experimental Ecology, Department of Botany, Catholic University, 6525 ED Nijmegen, The Netherlands*

Axel Michelsen

*Institute of Biology, Odense University, DK 5230 Odense M, Denmark*  
(Received 6 May 1980; accepted for publication 22 July 1980)

We investigated the vibration of leaves of four plant species in a sound field using a laser-Doppler-vibrometer system. All leaves behave as linear mechanical systems when driven by sound and noise at sound pressure levels (SPL) of up to 100 dB *re* 20  $\mu$ Pa. The modes of vibration are complex in the investigated frequencies (0.5-5.5 kHz), and change with the orientation of the leaf in the sound field. The vibration velocities of the leaves varied between  $10^{-5}$  and  $3 \times 10^{-4}$  m/s, while the vibration velocity of the air particles is  $5 \times 10^{-3}$  m/s at 100 dB SPL. Although the amount of sound energy absorbed in this way by a single leaf is very small, this mechanism may anyhow contribute to sound attenuation by plants and plant communities, since the number of leaves of one fullgrown tree equals  $2 \times 10^5$ .

PACS numbers: 43.80.Gx, 43.28.Hr

### INTRODUCTION

The acoustic properties of the environment are important with regard to noise pollution problems and noise abatement,<sup>1-8</sup> and for the understanding of sound communication by animals.<sup>9-12</sup> Vegetation is a complex medium consisting of air, soil, and the stems, trunks, branches, and foliage of herbs, shrubs, and trees. Despite both theoretical<sup>13,14</sup> and experimental work,<sup>1-8,14-16</sup> the mechanisms of sound attenuation in various types of plant communities remain obscure. Among the mechanisms which have been suggested are the ground effect, the thermoviscous absorption of sound at the soil and in the boundary layer of air at the surface of the leaves, scattering from trunks, branches,

and leaves, and the vibration of thin branches and leaves. The aim of this paper is to investigate the vibration of plant leaves in a sound field using a laser-Doppler-vibrometer system.<sup>17</sup>

The acoustic force acting upon a leaf is determined by the vectorial difference between the sound pressures at its two surfaces, cf. a ribbon microphone and other pressure gradient receivers.<sup>18</sup> A part of the sound energy received by a leaf may be lost by friction and thus absorbed, and some of the energy may be re-emitted. At low frequencies the force acting on the leaf is small, and the re-emission of sound is likely to be inefficient.<sup>19</sup> At higher frequencies the driving force is larger, and a considerable part of the energy received