

EAR CANAL SPEECH LEVELS PRODUCED USING THE VIOLA I/O-BASED PRESCRIPTION PROCEDURE

Robyn M. Cox,^{1,2} and Gregory A Flamme²

Department of Veterans Affairs Medical Center¹ and The University of Memphis²

Presented at the American Academy of Audiology National Convention, Salt Lake City, UT, April 1996

Introduction:

The Visual Input/Output Locator Algorithm (VIOLA) is a software-assisted method for prescribing and selecting a hearing aid. The approach incorporates loudness perception data from the Contour test and is suitable for either linear or non-linear instruments (Cox RM., *Hearing Journal*, 47(2): 10, 39-42, 1995).

Using VIOLA, hearing aid selection follows a two-dimensional strategy, considering gain as a simultaneous function of frequency and input level. VIOLA facilitates the selection process by providing input/output functions for two frequencies, each showing the target levels at that frequency for the 1/3-octave band of speech at three input levels.

The purpose of this study was to evaluate the assumption inherent in the VIOLA procedure that a hearing aid fitted using a prescribed pure tone input/output function would produce amplified speech having a predicted long-term 1/3-octave band spectrum in the ear canal.

Each figure shows the result for a different hearing aid condition with soft, average, and loud speech level inputs.

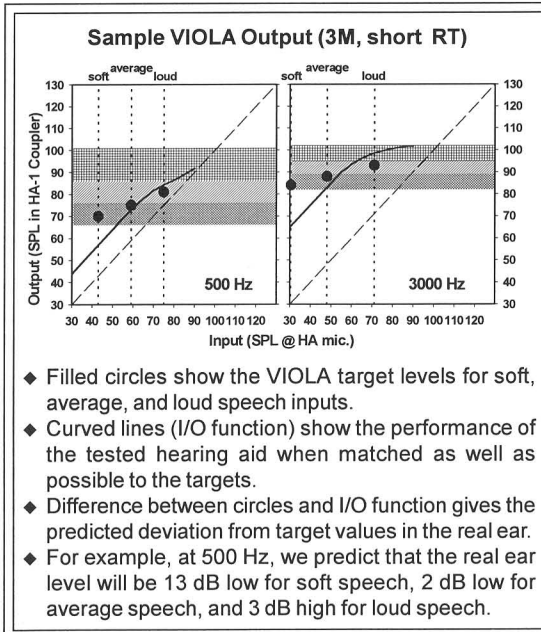
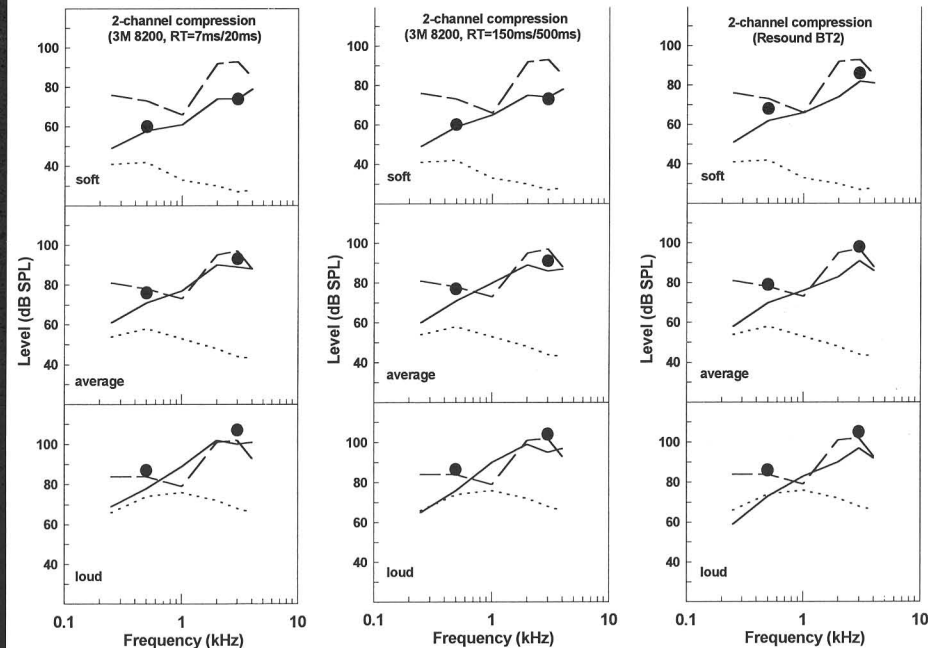
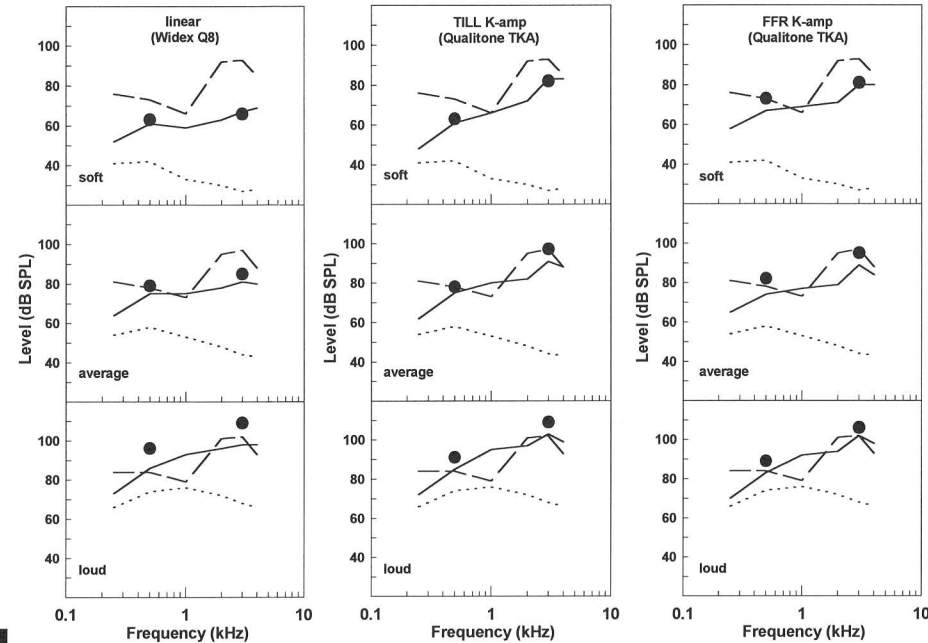
Dashed line = the 1/3-octave band ear canal target levels for soft, average, or loud speech, after amplification.

Filled circles = the predicted ear canal level of amplified speech based on the closeness of the match between the VIOLA targets and the tested hearing aid's pure tone I/O function (see sample VIOLA output below).

Solid line = the 1/3-octave band levels of amplified speech actually measured in the ear canal.

Dotted line = unamplified speech levels in the sound field.

If the measured ear canal speech levels (solid line) coincide with the predicted levels (filled circles), the assumptions of the VIOLA method have been shown to be valid.

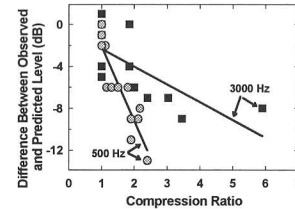


Conclusions

◆ When the hearing aid was operating linearly and well below limiting, the ear canal target was met, eg., Widex soft, 3M soft, TILL K-amp soft.

◆ When the hearing aid was operating non-linearly, output was lower than the ear canal target level and the amount of error was proportional to the compression ratio.

◆ The figure (right) shows the relationship between error and compression ratio in non-linear instruments for 500 and 3000 Hz. From these data, we could predict the difference between VIOLA target and observed levels as follows:



Frequency = 500 Hz
Diff (dB) = 5 - 7.1(CR)

Frequency = 3000 Hz
Diff (dB) = -0.6 - 1.7(CR)

(Where CR= compression ratio computed from pure tone I/O function at the corresponding input level)

◆ The VIOLA procedure could be modified to account for the error expected with any compression ratio so that adjustments could be made to provide a better match to target level in the ear canal.

◆ Long release time did not produce more or less error than short release time, eg., compare 3M short RT with 3M long RT.

◆ Errors between observed and predicted levels were not less for 2-channel compression systems than for single channel compression (K-amp) systems. However, note that 2-channel compression processing might permit a closer match to VIOLA targets.

◆ When the hearing aid was operating linearly and input speech level was higher than soft, output levels were lower than ear canal target levels, eg., Widex average and loud.

◆ We speculate that the discrepancy between observed and predicted levels in the linear-average and linear-loud conditions was related to headroom. However, these differences were larger than expected. Further data are needed with additional hearing aids to explore this finding.

Subject: KEMAR manikin

Hearing Loss: Sensorineural, moderate, sloping

Contour Data: Typical for hearing loss

Procedure:

- Six hearing aid conditions - linear, K-amp, and 2-band compression.
- Hearing aid configured to match the VIOLA program target levels as well as possible.
- Amplified speech measured at KEMAR's eardrum while wearing hearing aid.
- Observed amplified speech levels compared to those predicted by the VIOLA rationale.

Acknowledgement: Supported by funding from the Department of Veterans Affairs, RR&D Service.

