THE CONTOUR TEST: NORMATIVE DATA

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Abstract: The Contour test is used to measure loudness perceptions for seven categories of loudness from "very soft" to "uncomfortably loud". The data can be displayed as (1) level-by-frequency contours, or (2) growth-of-loudness curves. When results on the Contour test for a hearing-impaired person are compared to those obtained with normal-hearing listeners, the differences can be used as the basis for postulating appropriate charactistics of a linear or non-linear hearing aid. In this poster we describe methodological aspects of the test and provide normative data for six warble tone test frequencies and a broad-band speech signal. Implications for hearing aid fittings are discussed. (Supported by the Department of Veterans Affairs, RR&D Service).

Clinical Test parameters:

- Stimuli: (a) Frequency-specific pulsed (e.g., warble tones), (b) 5-second samples of broad-band (whole) speech.
- An ascending presentation mode.
- Intensity increments that vary from 2 to 5 dB.
- ER-3A insert earphones calibrated in an HA-1 coupler.
- One practice run per session.
- Four consecutive runs per stimulus.
- Manual or computer-controlled administration.

Each loudness category = the median sound pressure level of responses using that category across the 4 runs.

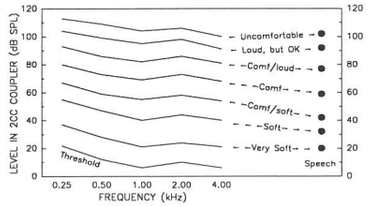
Instructions for Contour Test

"The purpose of this test is to find your judgements of the loudness of different sounds.
You will hear sounds that increase and decrease in volume.
You must make a judgement about how loud the sounds are.
Pretend you are listening to the radio at that volume. How loud would it be?
After each sound, tell me which of these categories best describes the loudness.
Keep in mind that an uncomfortably loud sound is louder than you would ever choose on your radio no matter what mood you are in."

Categories of Loudness

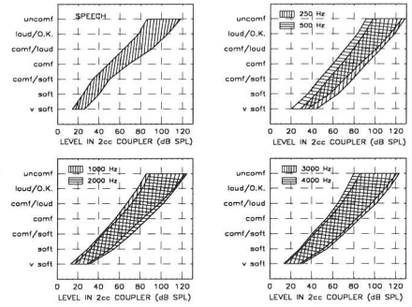
7. uncomfortably loud
6. loud, but O.K.
5. comfortable, but slightly loud
4. comfortable
3. comfortable, but slightly soft
2. soft
1. very soft

How do Normal Hearers Perform?



This Figure depicts average loudness contours for warble tones and loudness category values for whole speech.

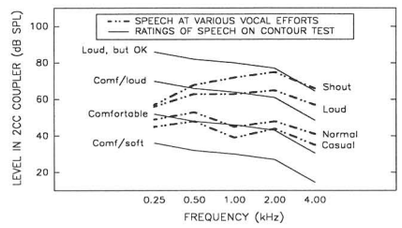
- All the warble tone contours parallel the threshold line.
- The contours become closer together as loudness increases.
- The loudness categories for speech are similar in level to the high-frequency warble tone contours in the same category.



This Figure shows growth-of-loudness functions for speech and for six frequencies tested with warble tones.

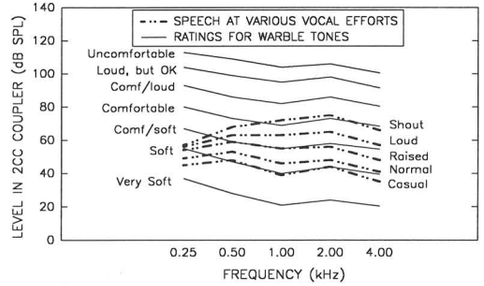
- All the stimuli have a smaller range of levels in the "soft" categories than in the "loud" categories. That is, listeners were more consistent with each other in judging "soft" than in judging "loud".
- The speech stimulus produced more narrowly defined loudness categories than the warble tones. Apparently listeners agreed more with each other about loudness judgements for speech than they did about loudness judgements of warble tones.
- When speech was the stimulus, loudness grew quickly through the soft categories, more slowly through the comfortable categories, and quickly again through the loud categories.
- The loudness growth of warble tone stimuli did not seem to show the rapid increase through the soft categories that we saw with speech.

How Do Contour Data Relate To Other Data About Speech Levels?



This Figure depicts : (a) Speech spectra for various Contour ratings, and (b) spectra of speech produced by talkers instructed to use different vocal efforts.

- As vocal effort increases, the tilt of the speech spectrum changes from low-frequency emphasis to high-frequency emphasis. This change was not reflected in the Contour test because speech produced with normal vocal effort was amplified to produce all levels.
- Speech that was rated "comfortable" in the Contour test corresponds closely to speech produced with casual and normal vocal efforts.
- Speech rated "Comfortable but slightly loud" in the Contour test was fairly close to speech produced with loud vocal effort.
- Speech produced with shouted vocal effort corresponds in the high frequencies with "Loud, but O.K.".



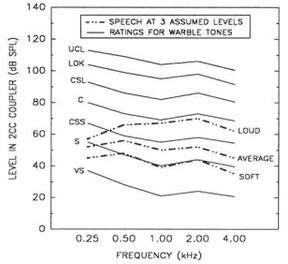
This Figure allows comparison of speech at various vocal efforts with loudness ratings of warble tones in the Contour test.

- Overall, warble tones are rated much lower in loudness than the corresponding level and frequency in broad-band speech.
- For example, the levels present in casual speech are rated "soft" when presented as warble tones.
- Also, the levels present in speech produced with shouted vocal effort are only rated "comfortable" when presented as warble tones.

How Can Contour Data Be Used To Fit Hearing Aids?

One thing we can NOT do is assume that there is a direct correspondence between the loudness of warble tones (or other narrow-band stimulus) and the loudness of the corresponding band of speech. If we amplify the 1/3-octave speech spectrum to match the warble tone "comfortable" contour, the speech will be MUCH TOO LOUD! (check the Figure below if you don't believe this)

There are ways that Contour data might be used:



1. By comparing the warble tone Contour map for normal-hearers with input levels of soft, average, and loud speech, we can develop rules that specify the relationships between Contour data and speech levels at different frequecies. Using these rules and a hearing-impaired individual's Contour data, we can determine input/output functions that should restore these relationships. For example, look at 2000 Hz in this Figure. We can see that soft speech should fall at the "soft" contour, average speech should be about midway between "soft" and "comfortable, but slightly soft", and loud speech should be slightly below the "comfortable" contour.

2. By comparing Contour maps with Preferred Listening Levels for speech for hearing aid wearers, we can identify the warble tone contour that is typically preferred for amplified speech (usually between "soft" and "comfortable, but slightly soft").

3. The dynamic range of compressed speech can be compared to the dynamic range of the wearer.

4. Loudness growth curves of a hearing aid candidate can be compared to those of typical normal hearers at several frequencies. This suggests the input levels and frequencies where gain is needed to restore loudness growth to within the normal range.

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