Derivation of the NAL-NL2 prescription procedure

Gitte Keidser, Harvey Dillon, Teresa Ching, Matthew Flax, Scott Brewer

The National Acoustic Laboratories and The HEARing Cooperative Research Centre

Background
The first procedure from NAL for prescribing nonlinear gain (NAL-NL1) was introduced in 1999. Recently, NAL-NL2 was introduced. NAL-NL2 maintains the same aim as NAL-NL1, which is to make speech intelligible and overall loudness comfortable. The theoretical component of NAL-NL2 is further derived using the same adaptive process that was used to derive NAL-NL1. The revisions leading to NAL-NL2 were largely directed by empirical data collected during the past decade with NAL-NL1 (see full line path below).

Optimization procedure
The adaptive process used to determine the optimum gain-frequency response for different audiograms and speech input is outlined below. Two modifications were made to this process before deriving NAL-NL2.

Adjustments
Empirical data suggested that different populations preferred different amount of gain. Consequently, the NAL-NL2 formula was adjusted to prescribe gain dependent on:

- Hearing aid experience
- Age
- Gender
- Fitting configuration

Resulting prescription
Supported by empirical data, NAL-NL2 tends to prescribe relatively more gain across low and high frequencies and less gain across mid frequencies than NAL-NL1 (see example for a moderate, gently sloping hearing loss to the right). NAL-NL2 further takes the profile of the hearing aid user, language, and compressor speed into consideration.

Multi-dimensional equation
A neural network, with one hidden layer, used HTLs and speech level as input and the optimized gain values as output to derive the theoretical NAL-NL2 formula.