# Preliminary Hearing Aid Selection: A Structured Approach

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Preliminary hearing aid selection involves the review of multiple hearing aid characteristics across all available hearing aids. The manual search of characteristics to meet a specific client's needs is of limited efficiency and tends to be unstructured. Computers offer an effective and structured search technique. This paper describes a microcomputer system (PHASS) for preliminary hearing aid selection and includes an overview of the problem, a description of the program logic, and its implementation on a microcomputer.

In most audiology-aural rehabilitation practice, preliminary hearing aid selection precedes formal on-the-ear hearing aid evaluation with clients. Preliminary hearing aid selection involves the choice from among all hearing aids available, a limited number of hearing aids appropriate for evaluation with a given client. The number of hearing aids that can be tested on a given client is limited by constraints of time, client cooperation, and fatigue. Because of these limitations, the adequacy of formal hearing aid evaluation is enhanced by improvement in the preliminary hearing aid selection process. In order for a hearing aid to be considered, it must be in the group of hearing aids accessible to the audiologist. These aids may be in a clinic's inventory or may be available by order from a hearing aid manufacturer.

Considering the numerous brands and models of hearing aids in the marketplace, the number of hearing aids available to an audiologist is very large. A large number may be beneficial because as the number of available aids increases the potential for a closer matching of hearing aid characteristics

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to the specific needs of a client also increases. However, this potential may not be realized with casual or unstructured methods of preliminary selection.

A common practice in preliminary hearing aid selection is a manual search through hearing aid specification sheets. Although the group of aids considered in a manual search may be large, the matching accuracy is limited by the audiologist's time constraints, memory, and processing capability. The manual search requires a rigorous mental review of multiple hearing aid characteristics across all available hearing aids while keeping in mind the needs of a specific client. The review may be subject to biases, may be influenced by the format of hearing aid specification sheets, and may be done in an unstructured or unsystematic manner.

In order to receive maximum benefit from a large number of available hearing aids, a more objective, structured process is required. This process should incorporate several basic considerations, including identification of characteristics that can be represented in terms of hearing aid parameters and each client's specific hearing aid requirements.

The choice of hearing aid characteristics and their parameter specifications should relate to needs of clients. For example, maximum power output can be represented both in terms of a specific client's need and a specific hearing aid's characteristic. The specification of parameters of hearing aid characteristics can be categorical (i.e., low, medium, or high) or numerical (i.e., a specific value or range of values). Once the parameters have been described for the hearing aid characteristics and the client's requirements have been specified, a systematic matching of characteristic to requirement is possible.

The matching procedure should be flexible because hearing aid characteristics may not have equal importance for all clients. Therefore, based on the specific needs of a client, a level of priority or relative importance for each hearing aid characteristic should be incorporated into the matching process. After adjusting for the priority of each hearing aid characteristic, it is possible to rank available hearing aids according to their overall potential to satisfy the client's needs.

Although a structured approach to preliminary hearing aid selection neutralizes many of the problems associated with an unstructured manual search through hearing aid specification sheets, it does not eliminate the problems associated with the audiologist's time constraints and capacity to review mentally and process a large mass of hearing aid information. It is appropriate that a computer be employed as a tool in a structured selection procedure. The use of a computer to store and process hearing aid information enhances the reliability and efficiency of the selection procedure. It also increases the audiologist's capacity to review large numbers of potential hearing aid selections in a relatively short time. With the advent of increased computer use for audiologic and otologic applications, computer facilities are available to many audiologists.

A microcomputer application for structured preliminary hearing aid selection called PHASS (Preliminary Hearing Aid Selection System) has been developed at the Pennsylvania State University.[1] It has been implemented on a Zenith/Heath H-89 microcomputer in Micro-Soft Basic with the Heathkit H-14 printer to produce hard copy output.

PHASS uses ten characteristics to match available hearing aids to a client's requirements. These include three acoustic characteristics: full-on gain, reference test gain, and SSPL 90. Each is specified according to the high frequency averaging procedures described in the 1976 ANSI S3.22 Standard for Specification of Hearing Aid Characteristics. These three characteristics are entered into PHASS as a range of values to allow for the plus or minus 4 dB variability recommended in the ANSI standard S3.22 and for the changes in acoustic response of the hearing aid due to variable gain or output settings. A fourth acoustic characteristic is frequency emphasis, specified according to combinations of low, medium, medium-high, and high. These categories indicate the locations of the primary and secondary peaks of the hearing aid's frequency response curve. The other six characteristics are type of hearing aid (body, behind-the-ear, etc.) and five optional features (variable gain, variable tone, compression, directional microphone, and telephone coil). The last six characteristics are specified as present in an aid (or needed by the client) or absent in an aid (or not needed by the client). PHASS allows the user to store, edit, delete, sort, or list the characteristic information.

The hearing aid characteristics and parameters can be obtained from hearing aid manufacturers' specification sheets or by electroacoustic analysis of the hearing aids in stock. The information on each available hearing aid is stored in PHASS.

The audiologist enters the hearing aid needs of a specific client into PHASS and requests a match with the available hearing aids based on the ten hearing aid characteristics and their parameters. The matching procedure includes a priority consideration where the PHASS user may assign different weightings of importance to client needs. The weight categories are high, medium, low, mandatory, or indifferent. Mandatory means that any aid that does not completely satisfy the client's need is removed from further consideration, and indifferent means that the hearing aid characteristic is not considered in the matching process.

The PHASS matching procedure involves four steps: (a) calculate the percentage that each client requirement is matched by its respective hearing aid characteristic for each available hearing aid; (b) multiply each percentage by the appropriate weighting of importance (1000 for mandatory, 100 for high, 10 for medium, 1 for low, and 0 for indifferent); (c) sum the resulting values for all ten characteristics for each available aid; and (d) rank the aids according to their summed values. The hearing aid ranking represents each

[1]The PHASS software and manuals have been copyrighted by the Pennsylvania State University.

available hearing aid's relative overall potential to satisfy the specific needs of a client.

A list of preliminary hearing aid selections ranked in order is displayed on the screen or in hard copy form. Given the ranked list of preliminary selections, the audiologist proceeds with a more detailed review of specification sheet information, electroacoustic analysis of individual hearing aids, or the formal hearing aid evaluation with the hearing aids ranked by PHASS.

In conclusion, the PHASS approach to preliminary hearing aid selection has been developed to provide a systematic and efficient method for ranking available hearing aids based on the audiologist's judgment of the needs and priorities of a specific hearing-impaired client. The PHASS software will be available in the form of floppy disk and user manual for distribution in the near future.

## REFERENCES

American national standard for specification of hearing aid characteristics, ASA STD7-1976 (ANSI S3.22-1976). New York, N.Y.: American National Standards Institute, 1976.