Choosing Aural Rehabilitative Directions: Suggestions from a Model of Information Processing

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A model of normal information processing developed by Massaro (1975) is presented and adapted for clinical application. Assessment is suggested in specific areas of processing so that therapy may logically follow. An advantage of this model is that the communication needs of auditorily impaired clients may be specified according to their information processing needs, rather than by some arbitrary criterion such as degree of deficit or presumed site of lesion. Finally, it is suggested that the hierarchy of importance of behavioral treatment priorities be world experience, semantic aspects of language, syntax and phonology, and bottom-up processes.

Providing aural rehabilitative services requires making several difficult choices. Among these are what direction therapy should take initially, and what goals should subsequently be set. We also need to decide on goals for assessment in order to clarify rehabilitative needs. Such decisions could be made more easily with a framework or model for consistent application of decision criteria.

It is the purpose of this paper to present a conceptual framework for many of the activities in rehabilitative audiology referred to by Schultz (1972) as perceptual therapy. The framework is based on a model of information processing developed by Massaro (1975). Figure 1 shows the model as first proposed with the addition of letters and numbers to identify the components in this paper.

MODEL OF NORMAL INFORMATION PROCESSING

Massaro's model was chosen for a number of reasons. First, it delineates and defines the processes involved. Some assessment procedures, for example the Flowers-Costello Tests of Central Auditory Abilities (Flowers, Costello,

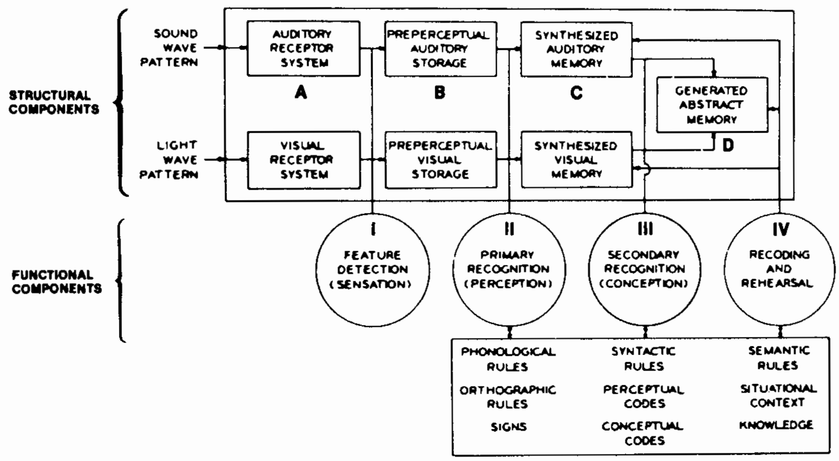

Figure 1. A model of the course of normal information processing after Massaro (1975). Reprinted by permission.

& Small, 1973) merely indicate the presence or absence of central auditory processing deficit. Procedures or models that do not define specific processes do not lead easily to therapeutic goals and, thus, have limited clinical usefulness (Dempsey, 1983).

Second, Massaro's model accounts for all known stages of information processing. Some models, for example the one proposed by Selfridge (1959), do not account for an initial brief storage before categorization of stimuli.

Lastly, Massaro's model is comprehensive. It is based specifically on "results and theory from a number of different approaches to the study of language processing" (Massaro, 1975, p. 5).

In the Massaro (1975) model, processing includes two types of components, structural and functional. Structural components, identified by letters in the large rectangles in Figure 1, are memories where information is stored for various lengths of time. Functional components, shown in the circles in Figure 1, are processes that transform the information held in one memory into a different form in the next memory.

Processing includes both bottom-up and top-down aspects (Duchan & Katz, 1983). Bottom-up processes are activated by specific properties of the physical stimulus and serve to transport some of the available information. These processes include the various detections and discriminations necessary for speech recognition. Top-down processes synthesize percepts by using previously stored information such as knowledge of linguistic structures, the rules for generating them, and the rules for constraining them, based on context, situation, or any experience that might be in long-term memory (LTM).

Processing begins as the acoustic signal impinges on the auditory periphery (part A in Figure 1). The neural mechanism at this level creates a code of the signal for further processing. The neural code will contain features which will activate detectors in the central auditory pathway (component I in Figure 1) (Abbs & Sussman, 1971). In the original conception of the model (Massaro, 1975), feature detection referred to the neural processing necessary for determining whether a feature is present in the signal. Later research (Massaro & Oden, 1980; Oden & Massaro, 1978) indicated that features are evaluated in a graded fashion, feature detectors indicating the degree to which a feature is present.

Not all acoustic characteristics are features. In order to qualify as a feature, an acoustic characteristic must be critical to the recognition process (Massaro, 1975). Some examples of features are steady-state formant frequencies (for vowel recognition), voice onset time (for plosive voicing), and F_2 transition (for place of articulation).

The result of feature detection is the transformation of sound waves into acoustic features held in preperceptual auditory storage (PAS, part B in Figure 1). A brief (about 250 msec) preperceptual storage is not a feature of all information processing models (e.g., Selfridge, 1959) but its existence is well supported by experimental evidence (Crowder & Morton, 1969; Massaro, 1970, 1972). It is also logically necessary because many speech sounds, especially consonants, can be recognized only in vowel context, requiring information to be held for some duration.

The next process, primary recognition (component II in Figure 1), is the "transformation of the features held in preperceptual auditory storage into a percept in synthesized auditory memory" (Massaro, 1975, p. 10; see Figure 1, part C). The recognition is of perceptual units, or sound patterns that are uniquely represented in LTM by a list of acoustic features. Perceptual units generally correspond to syllables.

Primary recognition is the first process to make use of information in LTM. During recognition the process may make use of phonological rules to (a) limit the choices for recognition, or (b) synthesize percepts in the absence of complete acoustic information.

The output of primary recognition is held in synthesized auditory memory (SAM; part C in Figure 1). This is analogous to echoic memory of other models (Cole, Coltheart, & Allard, 1974; Neisser, 1967). Besides perceptual units, many suprasegmental characteristics of speech are held in SAM. Its holding strength is a few seconds, and it is during this time that we have the phenomenological experience of hearing.

Secondary recognition (Figure 1, component III) begins the search for meaning. Through this process the perceptual units in SAM are transformed into meaningful units (i.e., words or familiar phrases) to be stored in generated abstract memory (GAM; part D in Figure 1). Secondary recognition makes use of semantic, syntactic, and situational constraints, and suprasegmental patterns, to recognize or access words held in the lexicon in LTM.

GAM is the structure we usually think of as short-term memory (STM) with a capacity of roughly seven chunks of information, and a duration of about 15 seconds. The representation in GAM is not modality specific; a representation there may be due to processing through any sensory system.

Because the capacity of GAM is finite, it is efficient to increase the size of the chunks of information there. This is accomplished by the processes of recoding and rehearsal (Figure 1, component IV). Recoding acts on strings of words in GAM to transform them into larger meaningful segments, for example, phrases. Rehearsal keeps the strings in GAM until the recoding is completed. The recoding process has access to all the information in LTM which may constrain the recoded sequences. This includes not only linguistic information and generational rules, but any knowledge and experience represented in LTM.

After recoding and rehearsal, processing may proceed in a right-to-left direction. For example, recoding on the basis of a situational constraint can feed back to SAM so that secondary recognition can occur. This is the common experience of apparently hearing a word that does not seem to fit and recognizing it later when we have information about the entire sentence.

EFFECTS OF HEARING LOSS ON INFORMATION PROCESSING

As a basis for clinical application of the Massaro model of normal information processing, it becomes important to discuss the effects of hearing loss on these processes. Since empirical evidence is not available regarding all aspects of the following discussion, some statements are conjecture.

Pathology at the cochlea (A) may result in a neural code which is likely to be inaccurate and/or incomplete. Thus, the rest of the processes would act upon faulty information.

Much is known regarding future detection ability (I), at least in moderately hearing-impaired adults. For example, from the work of Walden and colleagues (Walden, 1984; Walden & Montgomery, 1975; Walden, Prosek, & Worthington, 1975) we have information regarding the efficiency with which hearing-impaired adults transmit information available about various phonetic features.

If we can assume that the neural structure for PAS (B) is in the central nervous system, then those individuals with central auditory disabilities would be especially vulnerable to a reduction of information that is held in PAS. However, we cannot necessarily assume, then, that those with peripheral hearing loss have normal PAS. For example, Webster (1983) has published evidence that peripheral hearing loss, especially of early onset, pathologically affects the central pathway.

Primary recognition (II) depends in large measure upon the completeness of the phonological rule system. Although even profoundly hearing-impaired persons can generate rules (Odom & Blanton, 1967) and linguistic hypotheses

(McNeill, 1966), hearing-impaired children may develop phonological rule systems which are incomplete (Dodd, 1976; Monsen, 1974). Therefore, primary recognition may be based on both a degraded signal and insufficient information for synthesis.

SAM (C) is, as with PAS, an area we know little about in the auditorily impaired. Again, clinicians may assume that these central processes are normal in cases of peripheral hearing impairment. Such an assumption is not justified and is very often untrue.

Secondary recognition (III) is likely to be impaired in many clients with auditory deficit. Because secondary recognition depends so heavily upon an established vocabulary, the impoverished vocabulary often found in hearing-impaired persons makes secondary recognition difficult.

GAM (D), like other memories, may be normal in the peripherally hearing impaired (though, again, not necessarily). However, an incomplete syntactic system may make recoding difficult and would, thus, bring the amount of information held in GAM to a minimum, for example seven words rather than seven phrases. In addition, some deaf children have been shown to use inefficient rehearsal strategies at best (Belmont, Karchmer, & Pilkonis, 1976). This decreases the likelihood that word strings can be held long enough for recoding to proceed.

We can see that the effects of deficits of processing at the various stages may be cumulative and interactive. An inaccurate neural code makes feature detection difficult. Faulty feature detection makes development of phonological rules difficult, which impairs both primary recognition and the development of vocabulary, impairing secondary recognition. Lack of vocabulary and lack of access to acoustic information impair the development of a syntactic rule system, which increases the load on GAM, and further impairs secondary recognition. Reduced vocabulary, incomplete syntactic rules, and increased load on GAM would make recoding and, therefore, the comprehension of sentences, very difficult.

PRE-INTERVENTION ASSESSMENT OF INFORMATION PROCESSING

There is considerable divergence of opinion regarding what should be assessed prior to intervention and if it is possible to assess the functioning of isolated skills. Many authors feel that isolation of skills is possible. Dempsey (1983) indicates that testers "must be able to define auditory skills" (p. 204); a typical list of skills is provided by Matkin and Hook (1983). Rees (1973, 1981), on the other hand, raises doubts about the wisdom of trying to identify and assess separate skills. Sanders (1977, p. 230) agrees with the latter view, concluding that therapies based on attempts to improve isolated detection and discrimination skills are largely ineffective.

The view is taken here that assessment of isolated skills is both possible and important for designing subsequent intervention. However, it is suggested that the assessment is of aspects of information processing rather than of bottom-up skills as suggested by Dempsey (1983). Massaro's model can provide a framework for assessment as well as for processing. The assessment procedures, though of isolated components, do not need to rely on enumeration of bottom-up skills. This is advantageous because the relationship of bottom-up skills to any given processing task required for a given test may be less than clear.

The following are suggestions and examples for assessing stages of information processing. They consist of both conventional and experimental procedures. Since these are suggestions only, it should be noted that there may well be other ways to assess any of the aspects of processing.

To assess feature detection (I) we can use same/different tasks with dichotic presentation of comparison stimuli (Cole & Scott, 1972) or similarity ratings (Singh & Woods, 1971). Neither of these procedures requires recognition and, because feature detection precedes recognition in processing, this is an advantage. If the response includes recognition, an answer may be given which is correct because of top-down processing, rather than accurate feature detection. This may be the case in such tests as the Word Intelligibility by Picture Identification (Ross & Lerman, 1971).

The California Consonant Test (Owens & Schubert, 1977) might also be used. Even though it is, strictly speaking, a recognition task, the closed-set format and minimally varying foils neutralize top-down effects such that recognition can be primarily based on differences in acoustic features.

Memory strength of PAS (B) can be assessed using backward recognition masking tasks (Massaro, 1970, 1972). Primary recognition (II) could be assessed by a task of having a client repeat syllables. A resulting confusion matrix could then be analyzed to indicate strengths and weaknesses in feature detection. Also valuable for acquiring information at the primary recognition stage is an assessment of the client's phonological rule system (e.g., Ingram, 1981; or Weiner, 1979).

Hellige (1975) noted, "the important feature of the information in synthesized auditory memory is that it retains many of the acoustic characteristics of the stimulus" (p. 392). An assessment of SAM (C, in Figure 1), then, must determine the period of time acoustic characteristics of perceptual units are held. Paap (1975) noted that the information in SAM should be susceptible to both intervening processing and stimulus interference effects (p. 190). It should be possible to accomplish that assessment by backward recognition masking of perceptual units (Pisoni, 1972), rather than simple brief tones as had been used by Massaro (1970) to measure PAS.

Secondary recognition (III) relies primarily on accessing meaningful units in LTM. Therefore, an appropriate assessment is any valid vocabulary test.

A number of paradigms have been used by psychologists to measure the strength of short-term memory, or GAM (D). Two are described by Weisberg

(1980, pp. 4-6). In the first, a subject is presented with a verbal stimulus, such as a three-word sequence. After presentation of the stimulus the subject must perform some cognitive task, for example counting backward by threes. The purpose of the intervening task is to prevent rehearsal. After some variable delay the subject must recall the original stimulus. The measure of interest is the length of delay before the subject cannot recall the stimulus correctly.

The second paradigm is known as release from proactive interference. When a series of similar stimuli is presented (e.g., a series of three color-names) with an intervening task after each three-word stimulus, recall will be poorer for later stimuli if the delay before recall is of sufficient duration; the degree of this proactive interference is less with shorter intervals. The response delay producing proactive interference could be considered the duration of short-term memory. If the item to be recalled late in the series is made significantly different from earlier items (e.g., a change from color names to foods), then proactive interference is no longer seen. The release from proactive interference is confirmation of the duration of short-term memory. In clinical application of these paradigms, stimuli and intervening tasks could be adapted to capabilities of individual clients.

Since recoding relies so heavily on use of syntactic information, assessment of recoding is essentially assessment of the syntactic rule system. This might be done with a spontaneous sample of speech or with any of several prepared tests that include an evaluation of sentence comprehension strategies. Informal procedures should make use of information about the way hearing-impaired people comprehend sentences. For example, it is well-known that some hearing-impaired clients often comprehend sentences using a subject-verb-object strategy (Davis & Blasdell, 1975) or a first mentioned-first occurred strategy (Jarvella & Lubinsky, 1975). Assessment of recoding should also include recall of sentences of increasing complexity (Nation & Aram, 1977, p. 266) and processing of several different sentence types such as is found in the Test of Syntactic Abilities (Quigley, Steinkamp, Power, & Jones, 1978).

An excellent procedure which manipulates several of the variables involved in recoding and rehearsal is the $M_0N_0Sn_0C_0$ of Garstecki (1984). In this procedure the variables of message type (M), noise type (N), signal-to-noise ratio (Sn), and competition (C) are varied in ordinal steps from easy to difficult. The desired end level of each is given a subscript of zero, and individual subjects begin at levels greater than zero. Increasing the difficulty of the variables places a processing strain on the system, and the client must make more and more efficient use of recoding and rehearsal.

APPLICATION OF THE INFORMATION PROCESSING MODEL TO AURAL REHABILITATION THERAPY

Inadequacies of Some Other Approaches to Therapy

Aural rehabilitation therapy is often designed for clients of a particular age.

There is an undoubted correlation between age at onset of hearing loss and the likelihood of certain information processing needs. For example, it is likely that clients who develop hearing loss as adults will have problems primarily with neural coding and feature detection. Those affected earlier in life are likely to show the interactive and cumulative effects described earlier. However, there is also considerable variation in clinical populations, and designing therapy for age categories per se may not meet the therapeutic needs of many clients in those categories.

Basing therapy approach on degree of hearing loss also may not lead to effective strategies. Fiedler (1969) reported that many moderately hearing-impaired children act communicatively like deaf children and vice versa. There are many factors which impact on communicative competence. Assumptions regarding therapy needs cannot be made based on degree of deficit.

We also make assumptions regarding supposed differences in rehabilitative needs of peripherally versus centrally impaired clients, especially those whose information processing is more globally affected by early onset of disability. Sanders (1977) stated, "The difference between the problems of the hearing-impaired child and the child with central processing difficulties is primarily that, given sufficient auditory information early enough, the hearing-impaired child has the capacity to process it" (pp. 182-183). There are several untested assumptions in such a statement. For example, there is the assumption that preperceptual and echoic memories are unaffected by peripheral hearing impairment but are doubtlessly impaired in cases of central auditory dysfunction. There is evidence to indicate difficulty in sequencing among peripherally hearing-impaired children (Ling, 1975) and adults (Lubinsky, 1977), difficulty recalling visually presented digit strings attributed to faulty auditory storage (Blair, 1957), and difficulty recalling verbal as opposed to nonverbal material (Ling, 1975). These are difficulties usually ascribed to populations with central auditory processing problems.

Evidence regarding the effect of peripheral hearing loss on central pathways has been cited earlier. Webster (1983) also presented evidence to show that, in human subjects, early hearing loss was correlated positively with inattention, poor localization, learning difficulties, impaired verbal development, and impaired auditory decoding. These, again, are characteristics ordinarily considered to be part of central auditory deficit.

The assumption that site of lesion is an appropriate basis for determining the conduct of therapy is further challenged by the fact that both centrally impaired and peripherally impaired populations have been described in similar terms. Calabrese (1984), describing centrally impaired children, and Moeller (1986), describing peripherally impaired children, both noted that difficulties become most apparent in the third or fourth grade, and the greatest rehabilitative needs are in vocabulary and verbal reasoning.

Finally, there are, in fact, similarities in intervention strategies advocated for centrally and peripherally impaired populations. McCroskey and Thompson (1973) and Peck (1977) showed improved performance of learning disabled children when rate of speech was slowed. Picheny, Durlach, and Braida (1985) found significantly increased comprehension by peripherally hearing-impaired subjects when speech was "clear," including a rate about twice normal rate. Dempsey (1983), describing therapy for children with central processing disorders, said flatly, "Treat this child as if he or she were hard of hearing" (p. 219).

It can be seen from the foregoing that the categories used for planning aural rehabilitation therapy are often not sufficient or accurate. Rather than using some arbitrary criterion such as age of onset, degree of deficit, or presumed site of lesion, the clinician may specify the communication needs of auditorily impaired clients according to their information processing needs. That is, the auditorily impaired may be viewed as a unified population. They can be viewed as clients with auditory processing problems, presenting difficulty at one or more stages of information processing.

DESIGNING THERAPY FROM ASSESSMENT OF INFORMATION PROCESSING

Use of an information processing framework presents suggestions for goals to work for in therapy. Use of information processing models has been advocated previously for some aspects of aural rehabilitation therapy. For example, Butler (1981), using Massaro's model and other models (Butler, 1983), presented suggestions for general conditions of assessment and remediation, essentially concerned with the interaction of language, memory, and attention.

Besides the general conditions described by Butler, Massaro's model suggests specific therapy goals which may be derived from results of the assessment procedures described previously. If difficulty is found, for example, in feature detection, therapists may initiate a program of discrimination training focusing on the acoustic aspects of the misperceived features. An example of this approach was presented by Bennett (1977) who trained deaf children to improve their perception of voicing by training discrimination of voice onset times.

If the memories PAS (B in Figure 1), SAM (C), and GAM (D) are found to be less than normal in storage capacity, and if these are assumed to be neurologically fixed, we will not be able to expand their capacities per se. However, length of therapy material can be adjusted to fall within the limitations imposed by reduced memories. In the case of GAM, at least, therapists can work to increase the size of the chunks of information held so that, even with reduced duration, more information is held overall.

Information regarding deficits in phonological rule structure, vocabulary and other semantic codes, and syntactic rule structure can lead directly to therapy which enhances those aspects of linguistic functioning. That enhancement will increase efficiency of primary and secondary recognition and recoding. Recall that primary recognition synthesizes information based on phonological rules, and secondary recognition is dependent upon vocabulary, while recoding makes use of a combination of semantic and syntactic structures. Likewise, deficits in knowledge in LTM which support linguistic functioning, such as general world knowledge and experience, indicate that such knowledge must be augmented. Increase of general information in LTM increases the efficiency of secondary recognition and recoding by adding conceptual bases for semantic codes.

Order of Priorities for Intervention

Although the information processing model presents suggestions for therapy, the model must be extended to answer the clinician's question, "What do I work on first?" It would make good clinical sense to concentrate first on problem areas which have the most impact on language processing.

Massaro has not specified a hierarchy of skills and, at the present time, we do not have sufficient knowledge to indicate surely in which order aspects of information processing lend most to language comprehension. However, certain lines of reasoning lead to an order of importance in language comprehension and, therefore, by extension, to an order of importance in remediation. The following is offered as a hypothesis for prioritizing therapy based on information processing needs.

It seems that information processing leading to language comprehension is based most heavily upon synthesis by reference to information stored in LTM. It is suggested here that the most vital aspect of that information is general experience and that information processing must be based on the widest possible variety of world experience. We may view language as a way of encoding what we know about the world and, without general knowledge, there is nothing for language to represent. Furth (1966) repeatedly pointed out the correlation between impaired cognitive skills and limited world experience in both deaf and hearing populations. Furth (1966, pp. 151-154) pointed to general world experience as a prime determinant of cognitive ability. Although the correlation between cognition and language is not quite perfect, the comprehension and use of language is supported to a very great extent by more general cognitive abilities (Rice, 1983).

Furthermore, experience does not need to be through any one sense modality. In a normal functioning person at least, a representation of "chair" in LTM might be accessed by the sound of the word, the chair's physical features, how it feels to sit on, or its manual sign.

Second to experience in importance are semantic aspects of language. Moeller (1986) noted that vocabulary development is one of the most important needs of hearing-impaired children. We are familiar with examples indicating the primacy of semantics in language, such as telegraphic speech and anomalous sentences which are well-formed syntactically but incomprehensible. Solberg (1975) in a thorough review of semantics and syntax in information processing noted, "Any performance model of language must assume that the end result of linguistic analysis is a semantic structure" (p. 340).

Massaro (1975, p. 12) pointed out that vocabulary items are multidimensional. Therefore, therapists should attempt to allow a client to have as much experience as possible with an item, and through as many modalities as possible. The more experience a client has with all these representations, the more possibilities exist to access the item during secondary recognition.

Following close behind semantics in importance are syntax and phonology. Syntax serves to constrain the use of conceptual codes, and aids in the synthesis of information into GAM. Phonology also serves a constraining role. It facilitates the synthesis of perceptual units in SAM and also constrains the number of words which may be sought in LTM during secondary recognition.

Bottom-up processing, the detections and discriminations necessary for sensory processing of the stimuli, is integrated with all other processing. Therapists need to give clients every opportunity for sensory processing, including appropriate amplification, corrected vision, and environmental modification. Therapists also need to choose the most appropriate sense modality for language input.

It is suggested, however, that behavioral therapy for training detection responses and discriminations be undertaken only after consideration of needs in experience, semantics, syntax, and phonology. In Massaro's model all functional components after feature detection proceed by synthesis of information with reference to information in LTM. It appears then, that the major portion of language comprehension is reliant on such aspects as phonological rules, vocabulary, and syntax. Furthermore, attempts at using training in bottom-up skills to enhance language comprehension have met with equivocal results (Lasky & Cox, 1983, p. 256).

Application of the Hierarchy

The proposed hierarchy is intended as an order of goals, not necessarily as isolated steps in therapy. Application of the hierarchy could proceed as follows.

First, the client's information processing needs are determined through thorough assessment. Clinicians should also take steps to provide optimal sensory processing of language stimuli: appropriate amplification, corrected vision, environmental modification, and appropriate input modality and language system. If diagnosis indicates a lack of world experience and knowledge, the first goal of therapy would be to provide that. In the course of acquiring experience as a basis for language comprehension, the client should also be receiving a rich language input.

If assessment indicates that a client is not deficient in world experience, the clinician would next determine if the client is deficient in semantic aspects of language. If so, then remediation of semantic aspects becomes the primary focus of therapy. During development of semantics the client would likely be exposed to syntactic and phonological aspects of language, and even to additional world knowledge. The primary focus of therapy would remain in the realm of semantics, however.

If assessment indicates that world knowledge/experience and semantic bases of language are adequately developed, clinicians applying the proposed hierarchy would next determine if deficits exist in phonology and/or syntax. These then become the focus of therapy.

Following determination that deficits do not exist in language, therapists would focus on training those bottom-up skills found to be deficient during evaluation. This training is not the same as provision of amplification or modification of the environment; those steps are prerequisite to therapy.

DISCUSSION

It should be noted that different models of information processing may lead to different assumptions or processes of assessment and remediation. Weisberg (1980, p. vii), for example, describes two basic approaches to information processing. The first, of which Massaro's is representative, focuses on information as it moves through stages, is transformed, and, ultimately, permanently stored. The second approach attempts to describe how information already stored is put to use in various situations. These are two very different aspects of information processing. Their clinical applications would likely be very different.

Differences occur even within the models accounting for initial transformation of physical signals. For example, Butler (1983, pp. 303-305) presented two models of information processing with some adaptation for clinical use. Her multistore model is similar to the one presented here, but places more emphasis on bottom-up processes. The depth-of-processing model puts greater stress on the coding of information in LTM and the processes used in recall.

Models of information processing give us suggestions for dealing with many of our clinical problems in rehabilitative audiology. The Massaro (1975) model suggests areas of skill assessment so that difficulties can be specified in terms of particular information processing needs, rather than in broad terms such as moderate hearing impairment, central auditory processing deficit, or adventitious hearing loss. This model also allows us to view auditorily impaired clients as a unified population with needs that can be described within a single, connected framework. This view allows us to avoid assumptions about the kinds of problems a client might have due to age of onset, severity of deficit, or etiology.

It is suggested that extension of the model can indicate a hierarchy of skills and needs so that a clinician might choose rehabilitative directions, both for initial and subsequent goals. A client's information processing needs may be matched to the proposed hierarchy. Goals for therapy would begin at the highest level at which the client is deficient.

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