DOCUMENT RESUME

ED 146 726 EC 102 708

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TITLE Proceedings: Basic Assessment and Intervention Techniques for Deaf-Blind and Multihandicapped Children.
INSTITUTION California State Dept. of Education, Sacramento.
SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
PUB DATE 77
NOTE 39p.
AVAILABLE FROM Southwestern Region Deaf-Blind Center, California State Department of Education, 721 Capitol Mall, Sacramento, California 95814 (Free)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Auditory Evaluation; *Deaf Blind; Elementary Secondary Education; Evaluation Methods; Intervention; *Multiply Handicapped; Neurology; Perceptual Motor Coordination; *Psychological Evaluation; *Sensory Integration; *Student Evaluation

ABSTRACT

Presented are proceedings of a conference which focused on basic assessment and intervention techniques for use in the education and habilitation of lower functioning deaf blind and multihandicapped children. Following an introduction by D. Overbeck are papers with the following titles and authors: "Considerations in the Psychological Assessment of Deaf-Blind Children" (L. Stewart); "Audiological Assessment of the Deaf-Blind and Multihandicapped Child" (B. Franklin); "Essential Pretesting Information from Teachers" (M. Leathers); "Audiological Assessment of Deaf-Blind Children (Alternative Instrumentation)" (F. Harris); "Neurological Basis for Ayres' Theories of Sensory Integration" (M. Brown); "Sensorimotor Development--Normal and Abnormal" (H. Kaplan); "Developing a Sensory Integrative Team Approach" (M. Zimmerman); and "Sensory Integration Therapy" (S. Golubock). (SBH)

Proceedings

Basic Assessment and Intervention Techniques for Deaf-Blind and Multihandicapped Children

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This publication, which was funded under the provisions of Public Law 91-230, Title VI, Education of the Handicapped Act, Part C, Section 622, was published by the California State Department of Education, 721 Capitol Mall, Sacramento, CA 95814 The activity that is the subject of this publication was supported in whole or in part by the U.S Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not necessarily reflect the position or policy of the U.S Office of Education, and no official endorsement by the U S. Office of Education should be inferred.

Printed by the Office of State Printing
and distributed under the provisions of the
Library Distribution Act

1977

Preface

Assessing the deaf-blind has, for a number of years, been a source of much frustration for educators of deaf-blind children. No specific tests to measure the intelligence or functioning level of the deaf-blind have been developed, and testing instruments that have been adapted for use with the handicapped have not, in many cases, been studied for reliability nor validated, particularly for use with the deaf-blind. Thus, the question of what will help the deaf-blind child to learn is almost as perplexing today as it was when the regional deaf-blind centers were instituted. Educators of the deaf-blind are, for example, still groping for information about how the cortex assimilates, processes, and synthesizes what the deaf-blind child perceives auditorily, visually, and tactually.

Educators of the deaf-blind and others interested in helping deaf-blind children must begin to question the applicability of basic assessment and testing techniques to these children. We must look for new ways of determining how the deaf-blind child learns and functions.

This proceedings contains discussions about steps that classroom teachers can take, or might consider taking, in their attempts to document what can help a deaf-blind child to learn. We hope that some part of its content might serve as the basis for research that will ultimately lead to improved procedures for educating the deaf-blind.

WILLIAM A. BLEA
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Contents

5

Introduction

Presented by Daniel B Overbeck,
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This publication presents the proceedings of a three-day conference, "Basic Assessment and Intervention Techniques for Deaf-Blind and Multihandicapped Children," which was held on April 7, 8, and 9 at Arizona State University, Tempe, Arizona. The focus of the conference was on basic assessment and intervention techniques for use in the education and habilitation of lower-functioning deaf-blind and multihandicapped children. We could not, in the three days allotted, cover all of the basic assessment or training techniques that are relevant, therefore, in this workshop, the topics were limited to psychological and audiological assessments plus a brief overview of a powerful approach in habilitation sensory integration

Assessment

Providing psychological assessments is not the job of only the psychologist Whether psychological services are effective with a particular deaf-blind multihandicapped child depends on the quality of the relationship among the educational specialist, the psychologist, and, of course, the child.

In clinical assessment the procedures of data collection are dependent upon and secondary to the goals and purposes of the investigation Children are evaluated and tested not merely to see what the test shows but also to determine qualitatively and, if need be, quantitatively, their level and variation of development This means that the key to the usefulness of any assessment is the nature of the referral, that is, the questions that the person who requests the assessment has with respect to the child and that the psychologist is expected to investigate.

Certain basic procedural considerations should be part of a referral for psychological or behavioral assessment

1. The child's full name (legal) and preferred name should be determined
2. The legal guardian of the child should be identified.
3. Information about the child's school should be obtained. Such data are always valuable but become of primary importance when the child has originally been referred by the school or is presenting difficulties in school. Similarly, in many cases knowledge of who is responsible for medical care and permission to seek any needed care are vital. Not infrequently, persons other than the parents, school personnel, or a physician are also involved in the referral. These may include close relatives, ministers, attorneys, or personnel from agencies other than the one making the referral. Their names, addresses, telephone numbers, and relationships to the child should also be recorded
4. Information regarding previous assessments of the child should be made available. If a study has been completed recently, the psychologist may need to know why another one is necessary What were the purposes of the prior assessment? Was the assessment made with the child directly or on the basis of reports by parents, teachers, or others? Have changes occurred in the child's performance since the last assessment? If the child was present, how did he or she react to the procedures used? Given the number of problems fr quently exhibited in normal development . the deaf-blind or multihandicapped child, prior measures, if valid, are invaluable information on which to base estimates of the child's trend of progress or regress, developmental rate, and continuing strengths or weaknesses in development In a determination of the validity of prior assessments, this portion of the referral should include the background of the person(s) completing the study, the kinds of measures used, and the procedures employed (e g., direct testing, observation, or review of records).
5. The central and most important part of a referral is the reason(s) for the referral. The

psychologist should receive a concise but definitive statement of the child's problems, the referrer's view of them, and the questions that the referrer poses for the assessment How did the child come to the attention of the referrer, and for what reasons? What kinds of problems did the referrer discover, and what were his or her findings and impressions about them? What decisions have to be made about the child concerning care, training, treatment, or possible disposition? None of these questions need to be posed in psychological terms.

6. The practical limitations of the assessment as a result of the physical disabilities of the child should be determined. Knowing which impairments (vision, hearing, or motor) might affect the results of the planned assessment is vital. Information from audiologists and ophthalmologists is particularly relevant for the psychologist to be able to provide a fair and realistic appraisal of the child's abilities or potentials. The psychologist will have to be prepared to observe the effectiveness with which the child uses and integrates, or perhaps even resists, input from the impaired and the unimpaired sense modalities.

   Also, with the widespread use of psychopharmacological agents, the psychologist needs to know which medications, if any, are being given, the dosages, and the intervals at which they are given. The psychologist should know how long the child has been on this particular drug regimen and what the possible side effects of the drug may be. In institutional or hospital settings, especially, the psychologist should learn to check thoroughly on what medical, surgical, or other procedures the child has recently undergone or is scheduled to undergo.

7. In some settings, especially institutional or other residential settings, certain facts should be brought to the attention of the psychologist. For example, if the child has been punished recently for some infraction, has been in a fight with other children, or has been feeling very dejected because parents have failed to visit, the information should be made known to the psychologist.

8. Information regarding the language that the child speaks or is used to speaking in the home and information about the degree to which he or she understands it are crucial to the validity of the assessment. This is especially true in the case of the deaf-blind or multihandicapped child, with whom manual forms of communication may be used for either receptive or expressive purposes.

9. The final question to be answered with regard to the referral concerns the distribution of the psychologist's final report. Sometimes only the referrer needs a copy of the report. In other instances several persons may want copies, or they may want to be apprised of the findings.

With the information just described, the assessor begins to construct some beginning hypotheses about the case to help determine procedures and techniques to be used

A psychologist is bound by ethics not to accept a referral that is beyond his or her competencies. Thus, a psychologist who has never dealt with deaf-blind or multihandicapped persons, before accepting such a referral, should obtain consultation or even supervision from a colleague who is knowledgeable about the specific problem. Similarly, the psychologist is ethically bound to use only those techniques that he or she has been trained to use and only those that he or she has reason to believe will contribute answers to the referral questions.

When assessing the deaf-blind or multihandicapped child, the psychologist is obliged to do so in an environment that provides the greatest chances for the child to demonstrate his or her full capacity or potential. In some cases an office or clinic setting will be sufficient. In the greatest number of cases, however, when the client is a lower-functioning sensory impaired or multihandicapped child, the psychologist should conduct the evaluation in the child's natural setting (i.e., in the home or classroom) The problems that result in a referral for assessment typically arise from behaviors in the home or classroom setting; and conducting the evaluation in such a setting will enable the psychologist to (1) understand the "topography of the problems" more completely, (2) identify in the environment the relevant variables that stimulate, sustain, or reinforce the problem behavior, and (3) discern possible options, in the manipulation or alteration of the variables, that might result in improved performances by the child.

In the classroom the teacher can work closely with the psychologist to identify the specific, behaviorally referenced concerns that can be measured in terms of their frequency of occurrence, their intensity, or their duration. The teacher's observation of the child and the resulting data, or baselines, generally tend to be more relevant information than the information that is available from direct manipulation by the psychologist The child must deal most frequently with his or her teacher or parents, interactions with those individuals thus yield more relevant data that pertain to the assessment concerns.

In the home the adaptive demands upon the child usually are more pronounced. The five-year-old child is expected to be toilet-trained; to feed himself or herself efficiently and neatly with a minimum of assistance, to communicate basic needs and wants in a socially acceptable fashion, and to interact with peers and adults in a socialized manner. When the child does not, or will not, comply with adaptive expectations of the parents or family members, the data most significant for the psychologist to deal with are those resulting from family interactions This is not to exclude or ignore the fact that at times the psychologist can, in the clinic setting, gain a perspective of the child that is not available in the home setting. The deaf-blind child and the child with multiple physical disabilities is more often preoccupied with the novelty – or anxiety of the new setting, and the psychologist in that case is left with only the opportunity to observe and interpret behaviors that are actually representative of the child's attempts to make contact with, understand, and cope with the new environment For this reason the diagnostic classroom and the structured residential setting can frequently be the optimal site for discovering the child's latent capacities as well as latent and manifest anxieties and fears

Standardized test scores are sometimes needed to establish a child's eligibility for services through a particular service provider In those cases the psychologist is obliged to present as fair and non-prejudicial a picture of the child as is possible through current test methods Test scores may be those of intelligence tests, personality tests, behavioral tests, or developmental tests. Scores become irrelevant, however, when the teacher or other educational specialist must develop a clear understanding of the child's developmental status prior to the design of an individualized, prescriptive intervention program Two children may both score a "17" on a developmental measure of independent feeding skills. For one child the score may mean that the child eats with a fork and spoon, but not a knife; spills little is able to pour milk from a pitcher; and uses acceptable table manners. For the other child the score may mean that he or she eats very neatly with a spoon; drinks unassisted from a glass; uses a napkin appropriately, with verbal prompting, but chews noisily with his or her mouth open.

The teacher or the parent is concerned with improving the behavior, not the score, and the psychologist must therefore respond to the behavioral dimensions of the child's performance rather than to the quantitative measures. If the behavior improves, the score will increase.

In the diagnostic setting, then, relevant dimensions of performance may include such items as following signed or spoken instructions, assuming responsibility for cleaning up after specific activities, indicating toileting needs, searching independently for the water fountain, or displaying other skills that are indications of the child's continuing progress toward greater self-reliance.

Being able to make a plaster-of-paris hand cast may have only minimal relevance to the child's habilitation, even though his or her mother may visibly swell with pride at the child's creation. But is it the child's creation? If the teacher sets out the materials, mixes the plaster, pours it into a mold, pushes the child's hand into the wet substance, cleans the child's hand, sets the mold aside to dry, removes the dry cast from the mold, and paints and decorates the cast handprint, what improvement has been made in the child's behavioral skills? The diagnostic classroom has helped to illustrate that time cannot be wasted. With respect to priorities within available time and resources, arts and crafts should make way for prescriptive habilitative services. This is not to deny that the child can learn valuable language and social concepts within the context of the arts and crafts experience. With the tendency of many deaf-blind children to become stimulus-fixed, more importance may be placed on the child's learning those same language and social concepts within a more typical living situation – one that will make the child's life, and that of his or her parents, more nearly "normal" and self-sufficient.

The diagnostic classroom or diagnostic residential setting and the structured play setting or living setting prepared by the psychologist within a clinic environment should reflect those activities that provide an opportunity to evaluate the child on the basis of his or her adaptive behavior. Self-help skills, language skills, socialization behaviors, and other "nonpsychological" behaviors actually provide to the psychologist a relevant opportunity to assess the child's capacity to reflect efficiency in such intellectual functions as long- and short-term memory, problem-solving, evaluation and discrimination, cognition, visual and auditory reception, and discrimination and closure For the psychologist to discern these operations in the behavior of the deaf-blind or multihandicapped child is not enough. The observations together with suggestions regarding what the teacher might do either to accelerate, intensify, or decelerate the behaviors observed, must be communicated to the teacher or other educational specialists in language that is clear and concise. If possible, the report should include not only the recommendations of what should be done but also illustrative options for the teacher to consider in implementing the recommendations.

In many cases the psychologist may be predisposed to prepare a relatively brief summary of the full findings of the assessment on the premise that (1) the teacher is not sufficiently prepared to understand the "magical" jargon, or (2) even if the teacher could understand, he or she would not read the full report anyway If the probability is great that the child will be seen only very infrequently for evaluation or intervention, the brief report may suffice

If repeated assessments are to be made to monitor the child's developmental status, a more expanded report form is needed. In institutional settings, for example, the child who is fourteen years of age and who has been in the facility since age five may have had four or five psychologists assigned to his or her case. If only brief summary reports are available, the current psychologist may be denied the opportunity to identify subtle variations in the extent or quality of performance of the child This could result in the child's being denied full credit for marginal, but tangible, improvements It may also mean that a slow, but steady, regress on the part of the child will not be noticed until the deterioration becomes extremely great. Psychologists should be prepared to take a little more time and prepare a more detailed, behaviorally specific report of interaction with the child And teachers, if the reports are sketchy or too brief, should meet with the psychologist for a conference and should incorporate the key points from the discussion into their own notes for the record.

The potential value of any psychological or behavioral assessment is a function of how fully the educational specialist is able to design and implement program strategies that reflect the essence of the report's recommendations Without implementation, the whole process of the assessment becomes meaningless, futile, and wasted

Don't be surprised if the recommendations do not work immediately nor annoyed if they should fail to work at all. Rather than filing the report in the back of the file cabinet with a snort of disdain for those ivory-tower psychologists, march over to the psychologist's bailiwick, or call him or her on the phone and say, 'Look here! I tried this recommendation and it didn't work, so I tried it with such-and-such variation and it still didn't work! What now?"

Give the psychologist feedback regarding the effectiveness of the methods. Plan with the psychologist what variations can be made in the recommendations to render them more feasible. Keep the dialogue going. Remember that the quality of the relationship between the educator and the psychologist is the key determinant to the effectiveness of the intervention. The sharpest psychologist in the world and the sharpest teacher in the world may be completely ineffective if they cannot – or will not communicate easily and understandably with each other.

Sensory Integration

Many people have never had an opportunity to observe sensory integrative approaches in action. For many people the popular form of intervention for nonambulatory, severely or profoundly retarded, sensory impaired, or multihandicapped children has been what is called sensory stimulation. Unfortunately, sensory stimulation has never been clearly defined as a therapeutic intervention. Everyone thinks that he or she knows what sensory stimulation is, but visits to different programs will disclose many different people doing many different things to many different children for many different reasons.

One of the hopes for this conference was that it would encourage a reduction in the use of "sensory stimulation" programs and their replacement with "sensory integration" services.

The two methods differ in more than just the names. Using the research basis of sensory integration as described by Jean Ayres, using the proprioceptive emphasis of Bobath physical therapy, and understanding not only what to do but also why to do it and how, one can make legitimate variations upon specific recommendations.

Appropriately implemented sensory integration training is therapeutic, not prosthetic. That is, an effective use of the technique removes the need for further applications. Once the child has developed or acquired the desired response, an opportunity to practice the skill is usually the only prerequisite to sustain the behavior in the child's repertoire.

Sensory integrative approaches are designed to relate to more than just the peripheral sensory receptors. The impact of the method is directed to, the brain stem level of the central nervous system. The developmental sequences of the intact infant are used as the yardstick against which to measure both the impaired child's status and his or her rate and direction of progress. The training itself can be carried out by almost anyone who has had training and who receives supervision in using the correct methods of helping children through the sensory integrative activities.

Considerations in the Psychological Assessment of Deaf-Blind Children

Presented by Larry G. Stewart
Psychologist, University of Arizona, Tucson

I am not an authority on the deaf-blind. However, I have worked with deaf people for 14 years, in counseling and psychological assessment; and I have had some experience serving disabled deaf persons. I will try to share some of what I have learned about working with deaf people, and I will try to draw some parallels with serving deaf-blind persons.

The most basic question we can ask ourselves about testing is, "Why test?" One may consider this to be an unnecessary question, but, often, psychological testing is performed apparently without clear goals having been determined. Often, too, a psychological assessment report is filed and never referred to again. Perhaps as a beginning we can go back to the basics of why we test.

Several reasons can be given for testing.

1. To predict future performance
2. To determine placement
3. To diagnose problems
4. To plan educational approaches or treatment approaches, or both
5. To assess growth over a period of time
6. To describe behavior

Testing is also done for research purposes, of course; and sometimes testing is done just because it is the thing that is commonly done.

Regardless of the reason for testing, the reason should be understood by the examiner and by the person who is using the test results. Whenever a psychological report is written, usually only that one report is written up, and that one report serves many different readers. We who do the testing tend too often to use our own dialect to such an extent that others do not understand what we are saying in the reports. In the interpretation of the results of an examination, the viewpoint of the user of the results is of great importance. Writing for that viewpoint, however, is not an easy matter since professionals from various disciplines usually read one report. Ideally, then, more psychological reports should be written in language that most people can understand.

Another aspect of testing that bears scrutiny is the use of specific tests for specific individuals. An assumption underlying the use of any test is that the individual being tested is comparable to those individuals upon whom the test was standardized. If the individual has limitations different from those of the standardization population, the particular test may not be valid for use with that individual. The following are examples of such instances:

1. Blind individuals should not be tested with tests that have been standardized on sighted individuals, for whom vision is important in test performance. Examples are the *Wechsler Adult Intelligence Scale (WAIS)* (performance) and the *Revised Beta Examination.*
2. Deaf individuals should not be tested with instruments that have been standardized on a nondeaf person, for whom hearing is important in test performance. Examples are the *Stanford-Binet Intelligence Scale* and the *WAIS* (verbal).

The tests cited above are not always invalid when used in the ways described, and some of their subtests are useful. The danger is in using the tests and results with the assumption that the scores for handicapped individuals may be compared with the standardization norms.

We need to be aware of the impact of a disability on a person's development. We might, for instance, be able to administer the verbal portion of the *Wechsler Adult Intelligence Scale* to a deaf person by using sign language. However, we would most likely find that the deaf person scores at a level far below that of his or her performance score. What we are dealing with, then, is not deafness per se but the impact of deafness on the person's development, specifically in the area of language and concept formation. I am sure that parallels exist in some areas with some blind individuals and other handicapped persons.

Listed below are some of the factors I consider when I test a deaf person and some reasons that I consider those factors important for a valid interpretation of results.

1. *The age of the individual when he or she became deaf.* A child who is born deaf or who becomes deaf prior to the age of two or three years may be expected to have a serious language deficit. The older the child is when he or she loses hearing, the less the impact of deafness on language development will be. In practical terms, we can see the significance of a reading achievement level of 2.0 in a person age eighteen with a *Wechsler Adult Intelligence* PIQ of 120 who was born deaf, and the significance of these same scores for an eighteen year old who became deaf at the age of fifteen. Obviously, different factors would be present in each case.
2. *The cause of deafness.* We may expect quite different factors to be affecting an individual who is inherently deaf and one who became deaf as a result of maternal rubella. We are now aware that some of the causes of deafness also cause other disabilities some of which are not easily discernible. Knowledge of the etiology of deafness may help us differentiate physical limitations from personality deviations.
3. *The degree of hearing loss.* The more usable hearing a person has, the more auditory input he or she will receive. The significance of residual hearing emerges in terms of speech, language, sound orientation, and, to some extent, knowledge. We may expect language skills, at least, to be more advanced in an individual who has a 50 dB loss than in a person who has a 95 dB loss.
4. *Family circumstances.* How do the parents communicate with the child? How does the child feel about his or her mother, father, and brothers and sisters? We may expect overall adjustment to be better in cases in which communication is good between parent and child and between child and siblings. If communication is poor, the deaf child almost invariably has serious language and communication problems. The most linguistically accomplished deaf man I ever knew was born deaf, of deaf parents, and his parents communicated with him with sign language and fingerspelling from earliest infancy. Although family circumstances alone are not predictors of problems, they do give indications of probable difficulties and account at least in part for certain problems in the child.
5. *Educational history.* The previous education of a child who is deaf has some bearing on current adjustment, needs, and problems. The earlier a deaf child receives some schooling, the better his or her chances are for a more normal development in some areas. This is not always true since many deaf children who will never have good oral skills have an early education marked by oral-only instruction. When a child enters school at age eight or nine, or later, educational retardation takes on a new meaning.
6. *Other disabilities.* Clearly, if other disabilities are present, then the deaf child's deafness will not be the only causative factor for behavioral limitations. A perceptual-motor problem caused by a birth injury or other factors may significantly affect learning and development. Countless other combinations of disabilities may complicate the child's adjustment and growth. If we are unaware of these disabilities, or at least the possibility of their presence, we may attribute particular problems to incorrect causes.

The following are two hypothetical cases. Read them, and try to imagine the testing results.

In Case A Joe was referred for a comprehensive psychological assessment to assist his teachers in planning an appropriate instructional program. Joe was born deaf, apparently, and his mother reports that she had rubella when she was eight weeks pregnant. Joe seemed to develop slowly and walked much later than his older brother. He did not seem to be too alert, but he could not sit still and was constantly moving around. His parents, who learned of Joe's deafness when he was two years old, did not know what to do with him. Both parents worked, and Joe was kept at a nursery school during the day. His parents were not too well adjusted in their marriage, so his father spent much of his time working or being outside the home. Neither could communicate well with Joe, although the mother was protective of him and took special pains to see that he was well taken care of. Joe's hearing loss was set at 95 dB when he entered the school for the deaf at age eight (his mother couldn't let him go away to school earlier). Joe received instruction by means of total communication but made little progress. Referral for testing was made midway through his second month at school.

In Case B Bob was referred for a routine psychological examination upon his first enrollment at the school for the deaf at age six years. Bob was born deaf, and his parents as well as several other relatives were deaf. His mother experienced no illnesses during pregnancy, the course of the pregnancy was normal, and Bob had no birth problems or subsequent serious childhood illnesses. Both parents used sign language and communicated with Bob in this manner from the time he was a baby. The parents were very close to one another, and the home was a happy, bright place. Relatives visited often, and everyone in the family used sign language. Bob began communicating through signs when he was very young, and he continued to do so at the school for the deaf. His development was normal in all ways; he was close to his parents; and he communicated very well through sign language, although he had a 100 dB loss.

One can see from these two contrasting cases the influences exerted by several of the variables previously mentioned. To understand these two children, we must look at these variables. The *Wechsler Intelligence Scale for Children* could yield a performance IQ of 100 for both children, but knowledge of each child's case history would lead us to a quite different diagnosis of their problems and needs and to a different prognosis.

Suppose that oral work is emphasized in Bob's school and that he is denied the use of sign languag in the classroom. Imagine that signing is taboo and that the use of signs leads to a frown from the teacher and a slapping of hands. Bob is required, instead, to watch his teacher's face for several hours a day and to learn speech sounds and imitate them. Because he must live at school, he is removed from his parents' presence and understanding. After two or three years of this, how would Bob test out?

Suppose that Joe, on the other hand, is enrolled in a school in which the best available techniques for dealing with learning disabilities are used by warm, supportive teachers. His parents receive counseli.., learn sign language, and begin to help Joe at home. After three years, how will Joe test out?

With the background variables we have considered, we can look at some of the tests that we might use with a Joe or a Bob. In doing so, we can support our choice of tests.

Let's start with Joe. An examiner, aware of the etiology of his deafness and family circumstances, should recognize that an effective diagnosis will be demanding of his or her skills and resources. Before the examiner even considers testing, he or she will want to have the following:

1. General medical examination results
2. Detailed information about development, both as a neonate and during infancy and childhood
3. A detailed report from Joe's teachers, including observations of Joe's behavior, his response to the lear ing environment, and his response to oth [illegible] and the teachers
4. The results of [illegible] examination
5. The results of a neurological examination
6. The results of an otological examination and of a following audiological examination

Given the information listed above, the examiner can use these tests:

1. *Leiter International Performance Scale.* This is an excellent test for children ages four through twelve. It has good interest appeal and requires no verbal instructions.
2. *Hiskey-Nebraska Test of Learning Aptitude.* This test is excellent for use with deaf children ages four through twelve. It has good interest appeal.
3. *Bender-Gestalt Test.* This test provides a good measure of gross neurological impairment and is easy to administer.
4. *Callier-Azusa Scale.* This is a new, potentially useful development scale that permits assessment of a child's behavior and related instruction possibilities.
5. *Vineland Social Maturity Scale.* This instrument is to be completed by the parents and the teachers. It will yield useful information about the child's development level.

A battery such as the foregoing will yield information that will be helpful not only for diagnostic purposes but also for planning of an instructional program for Joe. Of importance is the fact that all these tests make allowances for Joe's deafness but will still yield useful information about him.

What about Bob? Frankly, I don't think Bob needs a psychological examination. Not if he goes to the right school. Of course, we will need an extensive personality assessment if he gets into the wrong school. I am not being facetious. As long as Bob is able to handle his school work and is happy, testing would be pointless at his age. Later, if problems develop in the learning process or if his achievement lags, an assessment would be in order. Otherwise, why test?

Joe is another matter completely. We do not have a ghost of a chance of helping him unless we understand what his problems are. We need the very best assessment we can get for Joe, and we need a team approach to achieve an effective diagnosis and to determine a treatment program. Moreover, our assessment must be an ongoing one in which we follow progress and modify the treatment approach as needed.

In regard to testing deaf children and youths, my opinion is that we have a good variety of tests for almost every purpose except self-reporting. Self-reporting is a problem because of the language problems of a large number of deaf people, but even tests like the *Thematic Apperception Test* and the *Rorschach* can be administered if the examiner and student know sign language.

Making predictions from test results is another area of concern. An ancient Chinese saying admonishes us to "distrust all predictions, especially those about tomorrow." Unfortunately, we do need to make predictions. In regard to testing deaf people I have been called upon to make predictions primarily with respect to postsecondary training placement and vocational career selection. I have found that we must consider not only the abilities of the deaf person but also the nature of the environment that we are considering for the deaf person. A good example is the young deaf adult who has an IQ of 125 but a reading level of 6.5. Suppose this person wants to attend college. My prediction for his or her success at a university would be pessimistic, even with the aid of an interpreter. However, my prediction for the individual's success at Gallaudet College would be favorable, provided that he or she has evidenced slow but steady progress in reading achievement over the years. This latter prediction is based upon my knowledge that (1) Gallaudet has a preparatory year to assist academically weak students who exhibit good promise, and (2) research shows that the achievement of deaf youths plateaus from approximately age sixteen to eighteen, then slowly rises again.

The main point is that in making predictions we must be knowledgeable about environmental variables. This point is reinforced when we make predictions regarding vocational success. Although we hear that equality of opportunity exists, the evidence is somewhat to the contrary. We do find deaf people in all levels of work, but the majority are in skilled trades. Attitudinal barriers most certainly do exist in the world of work, and all too often a deaf worker may find himself or herself unemployable in the career of his or her choice, even though he or she possesses the required skills. I know of a highly skilled chemist in New York City who has been bypassed time and again for promotion simply because he is deaf. He has trained all the chemists who now supervise his work. This man has told me that the one and only reason he is not the superintendent of his plant is that he is deaf and, theoretically, cannot use the phone or participate in staff conferences. Apparently, his bosses have not heard of interpreters. The fact remains that our predictions could be completely amiss if we do not consider the environment that a person may live in.

We test blind people by using oral tests. Obviously, blind people cannot be tested with an instrument requiring vision. By the same token, deaf people cannot be validly tested with an instrument that requires hearing. With deaf people we need to use a performance test, or, if the person has good language skills, we need to use sign language to administer a verbal test. If deaf people cannot take tests requiring hearing and blind people cannot take tests requiring sight, what can be used with the deaf-blind person? I have read about various light devices that are used with partly sighted deaf persons and about various sound devices that are used with hearing-impaired blind persons, apparently, these devices are useful for diagnostic and training purposes. However, I have reservations about the usefulness of these devices as predictors of intelligence or other abilities. I am bound to traditional concepts of reliability and validity, and perhaps a good job is being done in the assessment of deaf-blind persons. However, I question the feasibility of assessing deaf-blind persons in any way comparable to those used with persons who have either vision or hearing. With individuals who, for practical purposes, lack both vision and hearing, the basic concepts of psychological assessment are useless. We are faced with the task of not only reaching the deaf-blind person, especially the child, through tactile channels, but also with understanding the world of that child. What happens to the development of the child? What may we expect of the deaf-blind child, especially when other disabilities may be present?

Piaget's theories, the *Callier-Azusa Scale*, and the *Denver Developmental Screening Test* are helpful for establishing baseline behaviors and providing directions for treatment and training programs for the deaf-blind. I suggest that the best course now is to describe behavior; attempt to facilitate the greatest possible growth of an individual deaf-blind child; and strive to increase our understanding of how we may better assess behavior and subsequently increase our skills in making predictions.

Just thinking about the world of deaf-blind persons is a new experience for me. I can never fully comprehend what this world might be like, especially for those who are born deaf and blind. We need to ask ourselves many questions about developmental stages for the deaf-blind child. We need to determine how we may best facilitate the progress of the individual child and what environments we may expect the deaf-blind adult to be able to cope with. Further, we need to be concerned with how the environment will receive the deaf-blind person. All these considerations affect the issue of psychological assessment of the deaf-blind person.

Certain requirements are common to assessing deaf persons and deaf-blind persons. For both, we should learn all we can from a medical point of view. We need to know about the individual's general physical status, vision, hearing, neurological functioning, family circumstances, and developmental history. Any therapeutic or treatment activities that may help the child to function better should be carried out. Then, through the impressive teaching methods and equally impressive personalities of successful teachers of the deaf-blind, we can begin to understand better the capabilities of these children and how we can help them realize their full potential.

As Albert Szent-Gyorgi says (Torrey, 1972):

> The human brain is not an organ of thinking but an organ of survival, like claw and fangs. It is made in such a way as to make us accept as truth that which is only advantage.

We must find, through experience, that which is advantageous for deaf-blind persons. As we become better able to do this, I believe the learning process will become more clear-cut. We should learn from deaf-blind persons and should not impose our own world view on them.

Dr. James Heriot, Director, Arizona Diagnostic Treatment and Education Center, offered the following summary of the issues dealt with by Dr. Stewart in his presentation.

1. Standard psychometric test *batteries* are inappropriate for use with the deaf-blind.
2. Standard test administration procedures are neither realistic nor feasible. Therefore, it is necessary to "optimise" or "limit-test." A record of the procedures used should be kept.
3. Diagnostic instruments should be used to conduct differential diagnoses rather than to assign specific IQ equivalences. Thus, they should be used to (1) rule in or rule out strength and weaknesses, and (2) determine etiologic factors.
4. Because of their lack of precision when used with the deaf-blind, psychometric instruments lead to "ball park" estimates of general intelligence (e.g., "educable," "slow," "average," or "bright").
5. Because of the unknown statistical variance in psychometric findings with the deaf-blind, the "bands" used to determine "cut-offs" for establishment of significant differences (or strengths and weaknesses) should be much broader than those used in the decision-making processes with normal children. In other words, decisions about the measuring of psychometric profile variations in the deaf-blind should be conservative.
6. If specific data points are reported, mental age estimates are more useful educationally than are IQ or percentiles.
7. *All* children, regardless of handicaps or age, can be assessed psychometrically. At times, however, the examiner may have to utilize measures that are used with normal children of lower mental age, such as newborns. For example, to assess language readiness in a young, severely handicapped child, he or she may have to use measures of auditory alerting, discrimination, and habituation; touch; pain; smell; reflexes; and the like. For every higher function there are prerequisite lower functions that *can* be measured. The data yielded at the very low level ranges is of a "yes-no" type, but it should yield "ball park" developmental age ranges.
8. Psychometric assessments should be *dimensional;* that is, they should measure identifiable functions.
9. Psychometric assessments should be channel-specific. The diagnostician should know what sensory channels and what combinations of sensory channels are being assessed.
10. Psychometric assessments of deaf-blind persons should be repeated or reviewed at least every six months.

11. Psychometric assessments must yield prescriptive ideas if they are to be more than just package labeling.
12. Regardless of the norms, administrative procedures, and instruments used, functional capabilities in the real world, not in the testing room, are the primary concern. Heavy emphasis must therefore be placed on assessing the child's capabilities in activities of daily living.
13. The use of paraprofessionals as data generators in the building of a functional "picture" must be refined and encouraged for both manpower and cost-benefit considerations.
14. Extended observation of the child in a natural setting by all persons concerned with the child can be invaluable. Observation of the child while he or she is eating would be an appropriate extended observation.

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Audiological Assessment of the Deaf-Blind and Multihandicapped Child

Presented by Barbara Franklin
Clinical Audiologist; and Coordinator, Deaf-Blind Program, Department of Special Education, San Francisco State University

On the subject of audiometric testing of children, Rita Eisenberg (1976) offered the following views:

> If too few audiologists have progressed from asking *whether* infants hear to asking *how* they hear, a good many psychologists and linguists have begun to question long accepted ideas about the determinants of verbal communication These changing patterns of research have yielded a body of new information bearing upon the organization of auditory mechanisms.
>
> The recent explosion of neurophysiologic data on hearing has had few repercussions at the clinical level, mainly because scientists concerned with behavior and scientists concerned with the mechanisms underlying the behavior seem unable to communicate adequately with each other.
>
> There has been no systematic attempt to design a battery of tests specific to infancy. Somehow or other threshold measurements alone, and more frequently, only threshold approximations, have become accepted as a reasonable index of eighth nerve integrity, and "screening" of newborn infants has become stylish
>
> Perhaps the time has come for thoughtful clinicians to take a long, hard look at what passes for "pediatric audiology." Standardized procedures almost uniformly involve the use of abstract input signals such as clicks, pure tones, and band-limited noises, and the associated output measures reflect relatively low level activity in the nervous system.
>
> It is neither realistic nor productive ascribe limitations in current clinical practice to difficulties inherent in dealing with the pediatric aged or to lack of information. The problems, although they have historical roots, stem mainly from inertia For the moment, pediatric audiology is a myth, and differential diagnosis of the pediatric aged is too often an exercise in futility.
>
> We badly need new ideas that are pertinent to these disorders. We need normative information in order to define which functions are affected and in what ways. We need new clinical measures that refer quantitatively to specific coding operations. Most of all, we must attack these needs in rational order and ask critical questions about current priorities. Do we need to use pure tones or other abstract signals when speech and speech-like sounds are more effective elicitors of response?

As one who has been involved in audiometric testing of children for 21 years, I am in total agreement with Dr. Eisenberg that audiometric testing of children, sometimes referred to as paedo-audiology, has been adapted from techniques originally developed for testing adults. The majority of hearing-impaired adults have adventitious hearing losses; that is, hearing losses that they "acquired" *after* learning language. For these adults routine hearing tests using speech and pure tones are generally effective. However, the typical tests using speech usually cannot be used with children who have congenital hearing losses; that is, hearing losses that they acquired *before* learning language. In addition, most children under four years of age and low-functioning children of all ages usually find pure tones meaningless. Therefore, tests using these techniques are unsuitable for hearing-impaired children and are particularly unsuitable for the deaf-blind child. These children, however, will often respond to more conventional auditory stimuli, such as environmental sounds and speech. These sounds may have acquired meaning for the children.

I would like to review the *Auditory Behavior Index*, developed by Marion Downs, which deals with the level of response for infants from birth through age two, to a variety of stimuli – noisemakers, including bells, squeeze toys, and rattles, warbled pure tones, and speech. I will also coordinate her information regarding auditory stimuli and intensity levels with expected responses as reported by Dr. Kevin Murphy, a pediatric audiologist from Redding, England.

Table 1 is a modification by me of a chart that appears in *Hearing in Children* (Northern and Downs, 1974). It represents some of the findings of Downs.

For the age range of zero to six weeks, the response to noisemakers is at 50 to 70 dB, to warbled pure tones at 78 dB, and to speech at 40 to 60 dB.

Table 1

Level of Response to Sounds in Infants

Age	Noise-makers	Warbled pure tones	Speech
0-6 wk.	50-70 dB	78 dB	40-60 dB
6 wk.-4 mo.	50-60 dB	70 dB	47 dB
4-7 mo.	40-50 dB	51 dB	21 dB
7-9 mo.	30-40 dB	45 dB	15 dB
9-13 mo.	25-35 dB	38 dB	8 dB
13-16 mo.	25-30 dB	32 dB	5 dB
16-21 mo.	25 dB	25 dB	5 dB
21-24 mo.	25 dB	25 dB	3 dB

The difference between the response to noisemakers and speech at this age range is negligible since the noisemaker level is in terms of sound pressure level (SPL) and the speech and warbled pure tones are based on audiometric zero. This means that 13 dB must be added to the speech levels The responses of the infant to the stimuli at this stage include:

1. Reflexive
   a. Moro response (stiffening of extremities)
   b. Auropalpebral (eye blink)
2. Change in ongoing behavior – either increase or decrease of activity
3. Tensing of entire body

From age six weeks to four months, the response to noisemakers is at 50 to 60 dB; to warbled pure tones, at 70 dB, and to speech, at 47 dB. Again, the level for the tones is different, but the level for the speech and noisemakers is still somewhat comparable. The responses to the stimuli are essentially the same as for the zero to six-week age level, except for a new response that occurs at this stage – an orienting response, which is a searching for sound.

From four to seven months of age, infants respond more readily to speech than they do to noisemakers or tones. They respond to speech at 21 dB, to noisemakers at 40 to 50 dB, and to tones at 51 dB. The response is a 90 degree turn of the head to either side – the first sign of the ability to localize.

The findings cited above are somewhat similar to those published by the Ewings (1944). The Ewings found that (1) for infants from birth to age two months, percussion, such as bells, drums, and triangles, elicit the most response, and (2) high intensities are required. They found, too, that voice elicits a response more readily than percussion does with infants who have reached the age of three months; and they indicated that soft voice is better than loud voice.

Eisenberg (1976) reported that with infants eleven to twelve weeks of age voice elicits response more readily than noisemakers do. Eisenberg also found that infants twelve to fourteen weeks of age prefer the maternal voice to the voices of strangers. Murphy (1962) also found that the mother's voice is best for eliciting response in infants three to six months of age.

Turnure (1969) reported that by age three months babies attend better to their mother's voice than to the voices of strangers, even when the mother's voice is filtered.

Irwin (1952) reported that by age three months infants of highly verbal parents vocalize more and better than do infants of parents who are not particularly verbal.

Downs found that children between the ages of four months and two years respond to speech much more readily than they do to noisemakers and tones. From seven to nine months, they respond to noisemakers at 30 to 40 dB, to tones at 45 dB, and to speech at only 15 dB. At this age the infant localizes first to the side and then down. At nine to thirteen months, the levels for noisemakers and warbled tones drop slightly, to 25 to 35 dB for noisemakers and to 38 dB for tones. However, at this age the infant responds to speech at 8 dB and can immediately localize down. With infants up to the age of seven months, the speech stimulus used by Downs is "buh, buh, buh." After this age she uses meaningful speech, such as "bye bye" plus the child's name. By the time a child reaches age two years, she introduces "no, no"; "oh, oh"; and verbal commands.

The Ewings (1944) found that, in addition to the human voice, common household sounds, such as bottles clinking, a spoon tinkling in a cup, and the click of a door handle, are effective in eliciting responses during the seven-to-twelve-month period. In fact, the softest environmental sound might elicit a response when no response is made to a loud tone from a pitchpipe.

Downs presents the following levels for the second year of life in her *Auditory Behavior Index*. thirteen to sixteen months - noisemakers, 25 to 30 dB, tones 32 dB, and speech 5 dB, sixteen to twenty-one months noisemakers 25 dB, tones 25 dB, and speech 5 dB, and twenty-one to twenty-four months – noisemakers 25 dB, tones 25 dB, and speech 3 dB. The responses for these three age levels are: thirteen to sixteen months, indirectly above, sixteen to twenty-one months, directly above, and twenty-one to twenty-four months, direct localization at any angle. Considerably lower levels of intensity are required for the responses to speech, and the responses to speech are significantly more consistent.

The response levels described so far indicate awareness levels; that is, detection levels. However, a growing body of evidence indicates that a feedback system is present at birth and that the neonate is capable of more than just the stimulus-response type of behavior.

Condon and Sander (1974) reported that as early as the first day of life, the human neonate moves in precise and sustained segments of movements that are in synchrony with the articulated structure of adult speech. The neonate is a participant in the rhythm of many repetitious speech structures long before he or she uses them for communication. These rhythms comprise a prelinguistic activity of the human infant even at birth. The data that Condon and Sander reported were obtained by examination of films of adult-neonate interaction.

Butterfield (1968) reported that one day olds, using sucking, can control the onset and offset of recorded music. He also reported (1972) that infants can differentiate music from noise bands.

Eimas (1971) reported that one-month-old infants can differentiate /p/ from /b/, which would indicate the ability to make a voicing distinction (synthetic speech).

McCaffrey (1971) reported heart rate changes in infants as young as four weeks old when vowels and consonants were changed to contrasting vowels or consonants (live voice).

Shriner and others (1973) reported that infants between six and fourteen weeks of age can differentiate /^/ from a pure tone (synthetic speech).

Cutting and Eimas (1975) reported that two month olds are able to differentiate /bae/ and /dae/, which would indicate a place-of-articulation distinction (synthetic speech).

Morse (1972) reported that infants forty to fifty-four days old are capable of place-of-articulation distinction as well as intonation differentiation (synthetic speech).

Lewis and others (1964) reported that the spoken voice elicits more utterances in the infant at twenty-four weeks than music or tonal signals elicit (live voice).

Weir (1966) reported that infants are able to monitor suprasegmental features by age four to five months. He found that five-month-old Chinese children can produce intonations of the Chinese language and that the babbling of five-month-old Polish infants can be distinguished from the babbling of English infants.

I am skeptical of the use of pure tones for children at any age, since I assume a hearing test is supposed to predict an individual's ability to *use* his or her residual hearing. I have some reservations about the predictive value of information obtained from electrodes placed at the brain stem or higher levels. Goldstein and others (1972) reported that they knew of no clinical instance in which a confirmed central nervous system lesion, even bilaterally, at any level, in the presence of a normal peripheral auditory mechanism had led to a reliable measured impairment of auditory sensitivity. In other words, a normal audiogram with current techniques that place electrodes at the brain stem level is possible even if the child has no cortex. I challenge that these tests are tests of "hearing." Moe Berman, involved in a large research project studying the hearing of geriatric patients, reported case after case of individuals with normal pure-tone audiograms whose speech discrimination scores were significantly reduced. Normal response to pure tones with a greatly reduced number of neurons in the auditory pathway seems possible, but the reception and processing of speech is far more complex and demanding of the auditory system.

Research has established that in almost all individuals the left hemisphere of the brain is specialized for speech, both for reception and expression and that the right hemisphere is specialized for all other types of auditory stimuli, including music and environmental sounds (Millikan and Darley, 1967). If the right hemisphere is specialized for nonspeech stimuli, the possibility exists that pure tones are processed predominantly by the right hemisphere. This is pure speculation on my part, but the available evidence of hemispheric specialization adds to my concern that a child's ability to respond to pure tones may be generalized to his or her ability to respond to the spoken word. The audiometric screening tests that I was given in grade school, in which I had to repeat numbers, may actually have been able to detect more problems than the current screening methods, which use pure tones. A screening test in which speech is used might detect children with reduced acuity as well as impaired ability in speech discrimination and reception – such as those children who have "learning disabilities."

I have been conducting audiometric evaluations of deaf-blind children for a number of years. To obtain audiological information for those children who could not be tested by means of conventional procedures, I developed other techniques I recorded a variety of auditory stimuli – speech, music, a trumpet playing simple nursery rhymes, and sound toys. The tape is played through an audiometer, and the intensity can be regulated by the attenuator The speech, music, and trumpet are used to determine awareness thresholds, and in some instances, the ability to discriminate different auditory stimuli. The sound toys are used to obtain a crude audiogram, since the frequency range of the toys was established through spectrographic analysis. For example, the tape includes a bell with no visible energy below 1,500 Hz and another bell with no visible energy below 2,500 Hz If a child responds to one or both of these bells, a crude audiogram can be obtained

I intend to develop a standardized tape that can be used to test children. It will contain recorded auditory stimuli, including music, speech, sound toys, and environmental sounds, which will be passed through a series of high-pass filters with various low-frequency cutoff points. Each set of stimuli will be cut off at 250 cps, 500 cps, 1,000 cps, 2,000 cps, and 4,000 cps. For example, if a child responds to a bell that has been cut off at 1,000 cps, this means that no energy exists below 1,000 cps. If the child responds at 80 dB, one could assume that the child has residual hearing at 1,000 cps at 80 dB.

Difficult-to-test children tend to adapt readily to auditory stimuli and to cease responding once the signal loses its novelty. Through the use of a different auditory stimulus for each frequency to be tested, adaptation might be reduced or eliminated. Several factors must be considered in the selection of the auditory stimuli. First, both speech and nonspeech stimuli must be used. The nature of the nonspeech stimuli is also critical. The Ewings have used common household sounds to test the hearing of infants. I, too, have found familiar sounds to be effective auditory stimuli. Eisenberg (1976) and others recommend using auditory stimuli with a wide spectrum of frequencies, such as white noise and onionskin. Like them, I have found that those sound toys that have acoustic energy distributed over a wide range, such as shakers and a cowbell, are most effective in eliciting responses. Eisenberg (1976) reported that a drum beat and wooden sticks striking together are less effective than onionskin and concluded that duration might well be a critical factor in the neonate's processing of auditory stimuli. Similarly, I found that those sound toys of very short duration, such as clackers and crickets, elicit far fewer responses than do the shakers and cowbells that are sustained in time.

In conclusion, let me say that an audiogram indicates what an individual does not hear What I have discussed are audiometric tests of *what*, and possibly *how*, one hears.

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Essential Pretesting Information from Teachers

Presented by Maxine Leathers
Teacher, Washington School District, Phoenix, Arizona

How a child learns and why he or she learns in a particular manner is of interest to all educators but is an obsession to teachers of deaf-blind students. We are constantly looking for reasons why we so often see bizarre behaviors We therefore seek the help of the audiologist, among others, to gather information to help us function in the classroom. Teachers want to know how a child hears, what he or she hears, and what, if any, amplification will help. We ask a lot; and, to be fair, we must offer as much help as possible in a child's diagnosis.

A complete diagnosis requires a history of the child, an observation, and an examination The main role of the teacher is that of an observer, however, he or she could be the one to compile the history. In addition, the teacher should play a supportive role in the examination phase.

To gather data about the child, the teacher may utilize any or all of the following, a questionnaire, an interview, or records. Each offers advantages and disadvantages. Ideally, all three should be used

During the observation phase, the teacher must make notes on his or her observations Numerous formats can be used, including checklists, narratives, and developmental scales Use the one with which you are most comfortable.

One of the first observations that a teacher makes will establish his or her reason for referral. The student is obviously doing something to make the teacher feel that the student is not using his or her hearing effectively The teacher may observe the fo' wing no response or inconsistent response to gross sounds, no response or inconsistent response to speech sounds, favoring of one ear, excessive activity, listlessness, or no sound being made and/or drainage or pulling at the ears.

When reporting the reason for referral, narrow it down. For example, if the child responds to some sounds, determine what those sounds have in common. Volume level? Frequency? Are they foreground sounds or background sounds? Such information may be difficult to obtain through observation of general classroom behavior, but it can be obtained through a structured auditory training program.

At the most informal level, when a gross sound is presented, do you note a startle reflex, such as an eye blink, vocalization, cessation of activity, Moro reflex, or change in respiration? Do you note an orienting response, such as reaching for or looking at the object? Does the child exhibit an observable localization response? Does the child search for or turn toward the source of the sound? The presence or absence of these responses can be noted during play with sound toys. At first in the visual field and then when the child has developed a good listening attitude, move the toys around. By playing hide and seek with sounds, you can informally draw the child's attention to just an auditory cue. The same activities can be performed with amplified babbling and environmental sounds An approximate auditory field can be established by slowly moving the sound source away from the child until no response is noted. Remember that the child may respond quite differently when the sound is out of the visual field.

Having established sound awareness and a listening attitude, you can begin to work on auditory discrimination. You can begin to provide simple games to teach the child to make deliberate responses to a sound stimulus. Is the child able to match sounds? Does the child show an on-off awareness of sound? Present related activities visually, tactually, and auditorily before progressing to only an auditory presentation. Other high-level activities are discrimination between two or three familiar sounds, discrimination of environmental sounds, and discrimination of speech sounds.

All the activities mentioned above should be part of an ongoing auditory training program. Therefore, when a child is referred for an auditory evaluation, the teacher should have much helpful information to give to the audiologist. This information should include family history, records, and the auditory information gathered from classroom observations The audiologist will need to know what responses occurred, how they were elicited, and what rewards, if any, are effective. He or she will also need to know of the child's willingness or unwillingness to wear earphones, something about the child's general behavior, other handicapping conditions, and the medications, if any, that the child takes. All this information should be sent in advance. Any format that is brief and concise is satisfactory. (See Appendix A.) The teacher should also be available for a conference if necessary before the evaluation.

Once the teacher has referred the child and has passed on information to the audiologist, the examination phase begins. During this phase the teacher should play a supportive role by attending the session with the child and by scheduling the appointment to meet the needs of the individual child. Scheduling is easier if the audiologist is a staff member rather than a consulting audiologist.

The audiologist can help the teacher by (1) sending reports written in behavioral terms, (2) allowing for flexible scheduling, (3) observing the child in the classroom, (4) being available for several testing sessions, (5) scheduling time for conferences; and (6) attending staff meetings.

After the examination is completed, what can a teacher do if he or she does not agree with the audiological report? The teacher should first check his or her information again. If the teacher feels that it is correct, then he or she should ask the audiologist to observe the child in the classroom and to retest.

On the basis of the three phases mentioned earlier, the diagnosis is complete after the evaluation phase. Most teachers will argue, however, that diagnosis goes on continually in the classroom.

Appendix A

Sample Referral

September 17, 1970

Mrs. Marcia Simpson, Audiologist
Emory University Clinic
Otolaryngology
Atlanta, GA 30322

Dear Mrs. Simpson.

Gloria ______________ (BD 12-13-64) is being referred for an audiological evaluation at your earliest convenience.

This totally blind, non-verbal child responds to sounds presented in the classroom by smiling, hyperventilating, and ceasing activity. When given a music box, she consistently holds it to her right ear and when wearing earphones holds the right side of her head. Gloria has not been conditioned for play audiometry, however, she does make noticeable informal responses to sound. Gloria is a passive child who responds well to affection and should present no behavior problem during the testing session.

If you need further information before testing, please contact me.

Sincerely,

Mrs. Linda Gray
Teacher
Deaf-Blind Unit
Emory University Medical Center

LG/rml
encl.

Audiological Assessment of Deaf-Blind Children (Alternative Instrumentation)

Presented by Fran Harris
Audiologist, Thomas Davis Clinic, Tucson, Arizona

The audiological assessment of deaf-blind children presents several unique problems. The purpose of this presentation will be to analyze the responsibilities of the audiologist in the assessment of such children and to present some suggestions for the use of alternative instrumentation to alleviate some of the more obvious problems.

Audiological assessment should include (1) identification of the existence of auditory impairment, including definition of loss, magnitude, type, educational implications, appropriate amplification, and guidelines for training in use of amplification, (2) counseling of parents and other involved resource personnel, and (3) ongoing follow-up.

Techniques available for assessment include conventional audiometric techniques (or appropriate adaptations), impedance audiometry, and electrocochleography (ECoG). The three techniques are outlined below.

Conventional Audiometric Battery

Use of the conventional audiometric battery should provide some preliminary information about the child's auditory sensitivity.

The audiologist can utilize earphones to assess the following.

1. Conditioned response pattern (pure-tone and awareness thresholds)
2. Response to meaningful unfiltered and filtered speech
3. Response to music and nonmeaningful verbal/vocal stimuli
4. Reflexive response

Sound field techniques are useful for assessing the child in the following areas

1. Condition response pattern (pure-tone and awareness thresholds)
2. Localization

Some supplementary instruments and procedures that can be used are the following:

1. Desk-type auditory trainer or body-type hearing aid that the child can manipulate (if possible)
2. Noisemakers — observation of manipulation
3. Portable audiometer — observation of manipulation

Impedance Audiometry

Impedance audiometry is an objective technique for determining certain aspects of the auditory system. More specifically, the usual test battery consists of the following.

1. Tympanometry — Tympanometry is an objective method for evaluating the mobility of the tympanic membrane and the functional condition of the middle ear (Liden, Peterson, and Bjorkman, 1970).
2. Static compliance — Static compliance involves measurement of aspects of the middle ear in its resting state.
3. Acoustic reflex — The stapedius muscle will contract reflexively in response to sound of sufficient loudness. The "softest" sound level that will elicit the reflex is the level of the reflex threshold.

Certain problems may be encountered in the use of the technique of impedance audiometry, especially if the child being assessed is uncooperative. The audiologist should therefore keep in mind the following.

1. Testing should be tried on each child who is seen.
2. The child should be prepared by touching his or her ears and by letting the child manipulate the headset.
3. Assistance may be necessary, and as much as is required should be used.
4. Sedation may be required.

The integrity of the reflex may be questionable, especially when nonauditory stimuli, such as tactile stimulation, air jet directed at the eyes, and lifting of upper eyelids, are used.

Electrocochleography (ECoG)

Electrocochleography is the electrophysiological approach to the study of hearing. The electrical activity that originates within the cochlea or the auditory nerve is recorded and evaluated (Glattke, 1976).

Although cortical auditory-evoked response audiometry seemed to be a promising technique, results were found to be influenced by the physiological state of the individual being tested. The literature suggests that measurement of brain stem potentials is less influenced by these variables and is therefore more applicable to deaf-blind persons.

Crowley, Davis, and Beagley (1975) reported the results of a survey of 26 facilities (3,696 cases) using ECoG. Their findings indicated that ECoG added significant information to the diagnoses of 87.8 percent of the children and 34.2 percent of the adults examined. They also indicated that for 48.2 percent of the children and 2 percent of the adults this information was a primary factor in the hearing evaluation and the decision on management. Significantly, the cases in which ECoG was most helpful were predominantly those involving children and neonates with complex neurological or psychiatric problems that interfered with reliable testing by other methods.

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Neurological Basis for Ayres' Theories of Sensory Integration

Presented by Michael Brown
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Jean Ayres, in *Sensory Integration and Learning Disorders* (1972), had the following to say about dysfunction:

> Before we can treat dysfunction, we need to have some organized ideas about it. We have to build for ourselves some kind of theory about the nature of perception and its development. Theories are temporary explanations, they are expected to change. They are modified as we acquire more facts and have to make fewer guesses. Please remember that theories are heuristic devices and must be considered provisional. We have to oversimplify concepts in order to grasp them and gain some kind of perspective of the whole.

Since this presentation is a gross simplification of Ayres' theories, please keep in mind that. (1) Ayres' theories are more complex than those presented herein; (2) current and previous neurophysiological research do support the sensory integrative theory; and (3) Ayres' approach was developed for children with learning disabilities, but it is applicable to a wide range of disabilities.

Neurological Overview

In discussing neural development, Ayres (1972) offered the following:

> As the nervous system of the vertebrates evolved, growth at the cephalic end added structures which increased the organisms' adaptive capacity, including the capacity for sensory interpretation and effective motor response. At each stage of phylogenesis, regardless of the size and complexity of the nervous system, the animal had a well integrated although simplified repertoire of neural structure with which to interpret the environment and to react to it.

Each level of the brain was at one time the highest level of neural function and had the capability of integrating sensory impulses and of producing adaptive motor responses. This integrative capability is not lost when higher neural centers develop. Each successively higher level of the brain refines and modifies but does not diminish the capabilities of lower centers.

The higher level or newer structures tend to duplicate older structures and functions and to improve upon them so that the same functions are performed at several levels of the brain.

Although higher levels modify, they are dependent on information supplied by lower centers and vice versa. All levels of the central nervous system are interdependent.

This view of neural development is also indicative of the maturation that takes place in the nervous system of the child. As such, it can be a guide for remediation of learning disorders.

Even though we "assign" certain functions to different areas of the brain, no area is sufficiently developed to function alone. All areas of the brain are functionally interdependent.

Ayres and others frequently use the term *brain mechanisms*. This term is used to describe the process whereby information (often sensory) is used to determine an act (usually motor). Mechanisms involve feedback systems that are constantly supplying information or sensory input concerning the effectiveness of the motor response or act. Ayres also states that "the concept of a mechanism provides a rather convenient means of dealing verbally with that which cannot be well explained structurally."

The phrase *plasticity of neural function* refers to the ability of a structure and the resultant function that will be influenced even when a dysfunction is present.

The neural synapse is the point at which individual neurons make contact for the transmission of impulses. The neural synapse is important to the discussion of sensory integration because structural as well as biochemical changes occur at this connection. Research has indicated that (1) use of the neural synapse increases the ease with which the fundamental connection will be made, and (2) disuse reduces the probability that the nnection will be made. Dendritic growth represents part of the plasticity of the brain. To assume that this growth is influenced by the early environment is not unreasonable. Thus, the more the synapse is used, the greater the chances for dendritic growth, which results in greater learning capacity in the organism.

Organism-environment interaction, that process whereby the environment acts on the organism and the organism reacts to the environment, is central to the concept of brain function. The primary function of the brain is to translate sensory input into an appropriate motor response. One must keep in mind that the central nervous system selects the kind of sensory input (afferent flow) that it will accept and that the major criterion for selection is its survival value. Many of the activities used in sensory integrative therapy are chosen for their elementary survival value. An example of this would be working on equilibrium reactions.

The term *intermodality association* refers to the possible methods by which the brain associates the impulses from various modalities. Convergent or polysensory neurons are thought to receive stimuli from several different sensory modalities and to serve an integrative function. Stimuli from different sources, but all relevant to the same aspect of the environment, may produce a response that would not be elicited by one source of stimuli alone. Some neurons require convergence of many impulses for discharge. Evidence indicates that multisensory convergence on single neurons occurs in all parts of the cortex as well as in subcortical centers. The most commonly reported modalities showing convergence are the visual, auditory, olfactory, somesthetic, and vestibular modalities

Centrifugal influence is a "mechanism" whereby the brain regulates its own sensory input through influences operating away from the cortex toward the periphery. Without such regulation sensory overload can occur. A related hypothesis is that disorders, such as hyperactivity, can be related to malfunctioning of the centrifugal mechanisms.

Adaptive response is dependent on continual sensory feedback and on adequate integration or interpretation of sensations.

Understanding the role of inhibition in the sensory integration process is easy, for that role seems closely related to the observable behavior of the dysfunctioning child. Employing the principle of enhancing inhibition through sensory integration in a therapeutic setting is considerably more difficult. The fact that inhibition is an active process, a result of sensory stimulation and normal brain activity, and not a result of sensory deprivation, provides the key for therapeutic intervention

Finally, movement that is adaptive to the organism is one of the most powerful organizers of sensory input. Research has indicated that the motor component of a visual-motor skill act is more important than the visual component for establishment of a memory trace.

Levels of Central Nervous System Function

The material in this section deals with the functions of the spinal cord, brain stem, cerebellum, basal ganglia, old cortex and/or limbic system, and neocortex.

Spinal Cord

Sensory impulses arising from tactile, kinesthetic, bone, tendon, and muscle receptors make connections that influence motor output. Brain function is manifested in part through the spinal cord, and for that reason activity mediated by the spinal cord is pertinent to sensory integrative problems.

Brain Stem

When discussing the brain stem, Ayres focuses mainly on the reticular formation. For this reason she includes the thalamus, which is not generally considered to be a part of the brain stem but which functions as the rostral, or head end, of the reticular formation. The reticular formation is composed of most of the brain stem mass. This structure is nonspecific in terms of function; that is, it is not exclusively a motor center, visual center, or auditory center. The reticular formation receives impulses from every sensory modality as well as descending impulses from higher brain centers. Any major neural structure that receives input from many sources is likely to have widespread influence over the rest of the brain.

As a major center of integration, the reticular formation performs several important functions. One of its major roles is that of promoting general alertness and attention, which tends to enhance the discriminatory power of the organism. In other words, the reticular formation serves an arousal or alerting function. Keep in mind, however, that this alerting potential may vary from moment to moment

The second function of the reticular formation is that of promoting inhibition, which is directed by centrifugal impulses from the cortex and possibly the cerebellum.

Research has indicated that activity of the reticular formation increases cortical response to specific stimuli, such as visual, auditory, and somatosensory (vestibular, proprioceptive, and kinesthetic) stimuli.

From a clinical point of view, the majority of learning-disordered children show some dysfunction that can be linked to brain stem disorders of the arousal state. These dysfunctions include hyperactivity, distractibility, abnormal muscle tone, abnormal postural mechanisms, abnormal extraocular muscle responses, and an unusually low sensory threshold.

The Cerebellum

The primary functions of the cerebellum are those of integration and regulation. Its action has been most frequently described as acting on descending motor impulses to smooth and coordinate movements and to influence muscle tone. A person who is familiar with cerebral palsied children can easily relate the jerky, uncoordinated movements that result from ataxic cerebral palsy to the damaged cerebellum. The cerebellum is closely connected with and influenced by the vestibular system, and, when Ayres speaks of the cerebellum, she includes its interrelationship with the vestibular system, even though she does not expressly state that fact. In addition to the input from vestibular nuclei, the cerebellum receives input from much of the cortex and from all the sensory modalities. Current research on other cerebellar functions is contradictory. One study indicates a toning up influence on cortical activity, while a second study indicates a general inhibitory effect on the entire nervous system. Ayres feels that clinically both of these roles are observable. Vestibular input, along with possibly spinal afferent flow, does have a calming effect on the hyperactive child. This sensory input is believed to flow to the cerebellum, which in turn performs an inhibitory function, thus lowering the excitatory state of the reticular formation.

The Basal Ganglia

The location of the basal ganglia, superior to the brain stem and beneath the cortex in each hemisphere, suggests that the adaptive behavior that is mediated by them is more complex and less stereotyped than that which the brain stem makes possible. However, the adaptive behavior that is mediated by the basal ganglia is not believed to be as precise or as conceptually advanced as that mediated by the cerebral cortex Current research suggests that the basal ganglia are involved in a type of sensory integrative process that allows one type of sensory input to influence the integration of another type and to utilize that input for moderately complex postural responses and other bodily movements (athetotic cerebral palsy). Convergent properties have been demonstrated for visual, auditory, and somatic stimuli.

The Old Cortex and or Limbic System

The limbic system is concerned with primitive patterns of behavior necessary for survival, including vegetative functions, defense of the body from attack, and the simple perceptual-motor functions needed to fulfill these survival functions. The limbic system is considered the primary cortical area in a large portion of vertebrates. Fish, amphibians, reptiles, and birds have little or no neocortex, yet all show basic but well-integrated behavior, including perception, motor activity, and simple learning and memory. The close interconnections between the limbic and reticular systems suggest that perhaps both systems are fundamental integrative mechanisms of the central nervous system. The limbic system is thought to mediate sensorimotor, cognitive, and affective function at a level of complexity that is less than that of the neocortex. The hippocampus, a structure within the limbic system, is known to "process events for storage." When the hippocampus functions inadequately, defects occur in learning and memory. Since some of the input to the old cortex arrives from the brain stem and from other lower structures, a hypothesis is made that integrating sensation at lower levels and normalizing brain stem functions may give the old cortex better opportunity to function in its learning and memory operations.

Neocortex (Cerebral Cortex)

Ayres (1972) had the following to say about the neocortex:

> The neocortex might be thought of as a consultant to the brain stem and limbic system, providing information of a more specialized nature than that available at those lower levels so that the latter can utilize their drive in implementing mechanisms for optimal adaptation. At least that is the intent of the brain's organization.

The cortex can serve as both a facilitator and an inhibitor of all less complex levels. The neocortex has a much greater capacity for receipt of sensory information than the lower centers have. It receives stimulation from all the sensory modalities (through the thalamus) as well as stimulation from other centers.

Therapy is generally directed toward enhancing neocortical functions through achievement of better integration at lower levels (e.g., the brain stem). In the case of children with dysfunction, the belief is that the role of the neocortex is not fully developed and that the child is being directed by more primitive lower-level brain structures. Activities that involve the entire body moving through space involve the brain stem to a greater extent than desk activities involve it.

The Sensory Modalities

This section deals with the vestibular system, tactile system, proprioceptors, auditory system, olfaction, and vision.

Vestibular System

The vestibular system includes not only the receptors but also the vestibular muscles and tracts and each brain part that makes contact with this system. Vestibular input descends to the spinal cord, where it influences sensorimotor activity at that level. It also ascends to the cerebellar, pontine, and cortical structures. Vestibular input is frequently one of the sources of influence on convergent neurons.

Functionally, the vestibular system enables one to detect motion, especially acceleration, deceleration, and the earth's gravitational pull. The close association of the vestibular system with the extraocular muscles (such as that demonstrated by nystagmus after rapid spinning) enables the organism to know what is moving – the eyes, the head, or the visual field itself. The vestibular system also exerts a strong influence on muscle tone and thus plays an important role in the development of body scheme or image (body image in part due to the interpretation of movement of the limbs). Finally, the vestibular system serves (1) an arousal function by acting on the reticular activating system; and (2) an inhibitory function, which is probably enacted via the cerebellum. Which function the system performs is dependent upon the type of vestibular input. Rapid movement, such as spinning, is excitatory, slow, rhythmical movements that require no adaptive response are inhibitory or calming (e.g., a mother rocking an infant to quiet it when it is upset).

The Tactile System

Ayres (1972) had the following to say about the tactile system:

> The process of perception involves the continuous ordering and sorting of sensory stimuli into both temporal and spatial sequences with an ongoing intersensory relationship. Touch is one of the senses that is especially involved in the ongoing process contributing to perception of other types of sensation. Touch has been one of the predominating sensations throughout evolution, is a predominant sensation at birth, and probably continues to be more critical to human function throughout life than is generally recognized.

An extensive amount of research has been done on the effect of the tactile system on other sensory systems and upon perception. Tactile perception has been found to influence the visual system; the somatosensory system; motor tracts; and, to a lesser degree, the auditory system. Tactile input also affects the reticular activating system. This influence is thought to aid in motor planning, visual perception, and the ability to perform eye-hand tasks. Ayres believes that in children up to eight or nine years of age the degree of integration of the tactile system is a fairly accurate but not invariable index of sensory integration. Tactile perception is also a fair measure of brain damage in adults.

Proprioceptors

The term *proprioception* refers to sensory input arising from muscles, joints, ligaments, and bones. Proprioceptive input is critical to motor response, by which reflexive, automatic, and planned movements occur.

Proprioception is believed to aid in sensory perception, especially of visual impulses. Scores on tests of kinesthesia (the conscious awareness of joint position) correlate closely with scores on visual perception and praxis (motor planning). One can assume that reduced kinesthesia limits the development of visual perception and body scheme by limiting the amount of information that reaches the brain during purposeful and manipulative tasks.

One of the more important roles of proprioceptors is that of providing afferent flow, which is necessary for normal muscular contraction and, thus, movement. Movement is a major means of gaining sensory integration. Spery (1952) has described the role of brain function as the transformation of sensory patterns into patterns of motor coordination.

The maintenance of muscle tone is also a function of proprioceptors. Reduced muscle tone results in reduced postural responses, less than optimum motor development, and poor development of body scheme. Many children with learning disabilities are hypotonic. Proprioceptive input, like input to other senses, influences the arousal and inhibitory mechanisms.

The Auditory System

Auditory stimuli are among those that are most frequently found to elicit a response in the convergent neurons that are located throughout the brain. Auditory stimulation is also directed to the reticular activating system and to the cerebellum, which would indicate a role in arousal and inhibition.

Olfaction

The olfactory sense has not been studied to the degree that the other senses have been studied. However, when one considers that the cortex evolved from the olfactory nerve, the suggestion may be made that the sense of smell plays some role in sensory integration.

Vision

Each eye sends impulses to both cerebral hemispheres. The assumption is made that interhemispheral communication is necessary for perception of the visual field as a whole. As has been shown, perception is influenced by a variety of other senses. The emphasis in this brief discussion of the visual system is on lower structures rather than on the cortical component.

Experimentally induced lesions in the midbrain-thalamic area have been linked to disturbances in visual and kinesthetic function even though the primary sensory tracts for vision and kinesthesia were not damaged. Damage to the superior colliculi has been found to interfere with visual following, localization of stationary objects, and tactile stimuli. Effects have also been noted on movements of the eyes, head, and body.

Ayres proposes that some of the symptoms seen in children with learning disabilities reflect a failure on the part of the brain stem visual integrating centers to contribute to the cortical visual process.

Summary

In summation, keep in mind the four interrelated functions that are essential to survival:

1. Perception of gravity and motion through space
2. Extraocular muscle control
3. Locomotion and postural responses and proprioception relative to them
4. Visual perception of space

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Sensorimotor Development: Normal and Abnormal

Presented by Helene Kaplan
Physical Therapist

Those of us who work with "special children," that is, children with sensory, motor, or cognitive deficits and combinations thereof, should have knowledge of normal child development.

To memorize or to refer to charts of normal milestones (e.g., at four months, child rolls from side to side, at six months, child sits with minimal support, at ten months, child creeps, and so forth) is helpful in identifying children whose development is delayed and some of the areas in which their development is not normal. The prevalent scales of normal child development do not tell *why* the baby turns over or *why* he or she creeps at a certain age. To know *why*, we must study the maturation of the human nervous system.

The human embryo responds to the environment even before birth. Medical specialists have devised elaborate tests for assessing neurological maturity in newborn infants The responses of individuals at any given age level vary greatly from person to person, and variances within the same child are dependent on his or her developmental state at the time of the examination

The normal newborn's sensorimotor responses are primarily primitive reflexes of a survival nature rooting to find the nipple, sucking for nourishment, or lifting his or her head to maintain airway. The total withdrawal and Moro (startle) reflexes are also survival responses as the infant withdraws from a stimulus. The infant's movements are gross and random, and sensations are reputed to be diffuse, the infant being unable to pinpoint even a pinprick but reacting with a total withdrawal response.

The higher centers of the brain are not fully developed at birth Maturation of the nervous system proceeds in an orderly sequence, although the timetable may vary among individuals. The primitive reflexes that enabled the infant to survive disappear gradually as more advanced responses are developed. These new responses are the righting, protective, and equilibrium reactions that allow the child to develop into an "antigravity being"

The developing righting responses allow the child to keep his or her head in line with his or her body and the body in line with the head. They also enable the child to turn over. The labyrinthine righting response enables the child to hold up his or her head against gravity. From this position the child looks around and pushes himself or herself up on his or her arms, using them for support. This act thus paves the way for the protective responses of the upper extremities and at the same time inhibits the Moro and grasp reflexes. The inhibiting of the grasp reflex will allow the child to release objects voluntarily. The equilibrium responses will allow him or her to shift his or her weight and to move from one position to another without falling over. All of these higher responses develop in the first two years and are the basis of the automatic postural reflex mechanism that allows people to function against gravity without conscious effort to maintain balance.

Development of responses starts with information from the sense organs visual, auditory, olfactory, vestibular (with receptors in the middle ear), kinesthetic (movement), and tactile. The tactile sense includes touch and proprioception (with receptors in tendons, muscles, and joints). Even the primitive reflexes of rooting and sucking are elicited by sensory stimulation, that is, touch The more advanced responses are also the results of sensations. The child lifts his or her head to see an object or turns it toward a sound, he or she feels the movement (kinesthetic sense) and learns the position of the head in space (vestibular sense). He or she looks at an object and then reaches for it. If the child is "on target," he or she feels the object, if the child misses, then his or her vision helps to correct the reach. At the same time, the child is receiving feedback on the position of his or her arm and the movement. The senses of vision, proprioception, touch, and kinesthesia are all involved. The sensory and motor aspects are closely interwoven, with sensations causing movement and vice versa hence the use of the word *sensorimotor*

The child's early protective and avoidance responses progress to reaching out into the environment and exploring. Learning is based on the sensorimotor experiences. The child feels his or her body; brings his or her hands and objects to the mouth; and learns sizes, shapes, and textures by the way they look and feel. He or she moves and by moving learns about space and even more about his or her body.

Damage to the central nervous system (brain damage) often results in arrested or delayed sensorimotor development. Despite the child's chronological age, he or she may not have progressed beyond the infantile stage. The normal modification of defensive responses (i.e., withdrawal from a stimulus) and the integration and inhibition of primitive responses will not have occurred. The child will not have progressed to the stage of reaching out to explore the environment. The vestibular system will not have matured, which will adversely affect balance and movement and development of the reactions to movement (i.e., equilibrium and balance reactions and a discriminating tactile sense).

Deficits in one area will affect other areas. Lack of movement will result in lack of sensation, and, conversely, lack of sensation will cause lack of movement. In either case motor retardation results. Lack of movement and sensation also affects the state of arousal, which further compounds the problem.

Those working with the brain-damaged child must be aware that, despite the child's age and size, his or her problems are partially the result of the immaturity of the sensorimotor mechanism of the central nervous system. The stimulation techniques that are used must be appropriate and meaningful to the child at his or her present level, and the response must be a desirable one. Stimulation must be for the specific purpose of advancing the maturation of the child's central nervous system.

The child with cerebral palsy presents a complex picture. His or her neurological maturation is interfered with in many ways. He or she may retain infantile primitive reflexes and may not develop the more advanced righting, protective, and equilibrium responses. Furthermore, the child may be "possessed" by a variety of abnormal conditions and reflexes that "lock" him or her into set positions. These include asymmetrical tonic neck; symmetrical tonic neck and labyrinthine reflexes, and positive support reaction. Varying degrees of spasticity impede and prevent movement, and total patterns of flexion and extension may persist. The brain damage prevents the development of control by the higher centers of the brain over the lower centers of integration, that is, the spinal cord, brain stem, and midbrain. The child does not develop the automatic postural reflex mechanism and is a victim of his or her abnormal reflexes, spasticity, and gravity.

The cerebral palsied child may also have sensory and learning deficits that result from either the brain damage or the physical disability that prevents normal movement and exploration.

Ideally, treatment should be started in infancy, with skilled therapists teaching and training the parent or caretaker to position and handle the baby in ways that block abnormal movements and reduce spasticity. This first step should be followed by the facilitating of normal movement and responses along the lines of normal sequential development. Development will take much longer than in the normal child, but without careful treatment the symptoms (not the brain lesion) worsen. The more abnormal movement and abnormal muscle tone, the more the abnormal movement is reinforced as the child's sensory feedback system "learns" the abnormal movement. The child must be assisted to explore his or her environment. Materials can be presented to the child in ways that allow him or her to examine them with mouth, hands, and eyes without causing an increase of abnormal movement. Changes in the older child who has learned to use his or her abnormal reflexes and who has abnormal muscle tone will be limited because of the difficulty of unlearning habits. However, the development of the older child can be enhanced through evaluation of reflexes, muscle tone, and movement and the planning or use of equipment and sensory activities that will aid his or her ability to sit, stand, move, and learn.

Developing a Sensory Integrative Team Approach

Presented by Mardy Zimmerman
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The Tempe Center for the Handicapped began working with multihandicapped children five years ago. The two people responsible for the development of the philosophy and approach used at the center were a neurodevelopmental physical therapist and myself, a speech therapist and elementary school teacher. Our initial efforts involved working as a team - both of us working with a child at the same time and constantly teaching each other. This resulted in many, many hours of discussion about the approach we would use with our very deficient children. We subsequently developed our program on the basis of the following conclusions:

1. *Multihandicapped children should be provided with experiences similar to those of normal children* A most striking difference between the multihandicapped child and the normal child was the severe deprivation of experience of the former. As we watched normal children, we saw the need to bring similar experiences to our handicapped children. The experiences we brought to these children were often integrative and usually heavily tactile.
2. *Strong attention should be given to neurology and the developmental sequence* The children we were seeing were brain damaged, and we felt the need for all the information we could obtain about the brain and how it functions
3. *A complete team approach should be used when working with the multihandicapped* From the beginning the therapists, teachers, and aides at the Tempe Center all worked together in the same classroom. We felt the need for a constant flow of knowledge among the people who were working with the children. This approach was not always easy for professionals to accept since it was quite different from the traditional method of separating therapy and education.

During the second year, the physical therapist and I attended an intensive weekend workshop conducted by Jean Ayres. Her research and approach was in every way in line with the approach we were developing and the knowledge we were seeking. We gained a great deal from the workshop and adopted the sensory integration approach in earnest. At that time the center hired a pediatric occupational therapist with a strong background in neurology and the sensory systems. She became an important addition to our team.

Today the Tempe Center serves 50 children in various classes. Their ages range from birth to fourteen and most of them are multihandicapped. We continue to use a strong sensory integration approach and find that it provides a logical, neurologically sound, and organized way of dealing with difficult children. The initial evaluations are done by a three-member team consisting of a speech therapist, a physical therapist, and an occupational therapist. Under special study now at the center is the problem of the cortical versus the subcortical functions of the brain and how such functions should affect commands to handicapped children.

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Sensory Integration Therapy

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Our senses are "alert" all the time. Our nervous system is constantly bombarded with information, which must be prioritized; interpreted; and, when indicated, acted upon through a process of sensory integration. The ability to arrange this chaos of sensory input in a useful way is lacking in children in whom the process of sensory integration has been disrupted because of neurological damage or insufficient maturation. This disruption of sensory gathering and processing may be noted in children who seem intelligent but who are slow to learn. It may be noted as well in the mentally retarded child, the multihandicapped child, the poorly coordinated or overly active child, and the physically handicapped child Regardless of the reason for poor sensory integration, the results are often the same: problems in learning, in physical activities, and in behavior.

Early identification of these children is important. Although damaged nerve cells cannot be made to function again, the potential does exist within the young nervous system for other cells to take over those functions. For the immature nervous system, therapy can provide the integration needed to stimulate maturation, thus minimizing the severe gap that would otherwise exist between the child's chronological and neurological ages. Whenever this gap exists, for whatever reason, the child is often burdened by yet another type of handicap emotional. Children become frustrated because they simply are unable to function as their peers do or as they think their parents would like them to. The result may be withdrawal; aggression; uncooperativeness; social immaturity; or, in some cases, oversociability. All are efforts to compensate for or to avoid what they cannot do. Early intervention is vital to the physically or severely multihandicapped child to prevent the physical deformities that result from abnormal movements, improper positioning, and lack of mobility.

Initially, the child should be evaluated by registered therapists or clinicians who are knowledgeable about the neurodevelopmental or neurophysiological approach to sensory integration. Those conducting the evaluation may include occupational therapists, physical therapists, speech therapists, psychologists, and special educators. One must remember that sensory integration is an approach to treatment based on a thorough understanding of the neurological processes involved in integration. It is not a technique employed by any one specialty. Neither is it a collection of "exercises" that can be utilized successfully with all children or that can be implemented by personnel who are not trained in the approach or who are not at least supervised by a consultant with such expertise. Although each therapist or clinician has his or her own orientation to the child (e.g., development of gross motor skills, fine motor and self-help skills, or social and intellectual skills), he or she will, in sensory integration, generally use the same approach in treating the child.

The method of evaluation depends, of course, on the child to be evaluated. For the minimally brain-damaged or learning-disabled child, a standardized battery of tests, such as the *Southern California Tests for Sensory Integration*, the *Marianne Frostig Developmental Test of Visual Perception*, and the *Illinois Test of Psycholinguistic Abilities*, may be used to assess areas of sensory dysfunction. For the severely handicapped child, however, one must usually rely on behavior observations and simple tests of the primary senses tactile, vestibular, and proprioceptive.

The tactile sensory receptors are located in the skin, which covers the entire body, including the tongue. They "record" touch, pressure, temperature, vibration, and so forth.

The vestibular receptors are located in the ears and record the speed and direction of movement of the head as well as the "relationship" of the entire body to gravity. Thus, they are responsible for both equilibrium responses and for maintenance of sufficient muscle tone to allow one to move "free of gravity."

The proprioceptors are located in the muscles and joints. They work very closely with the vestibular system, feeding back to it information about how much muscle tone exists. They also record all muscle and joint actions as they occur so that the individual can immediately and continuously correct or adapt his or her responses. The most correct response is then fed back into the memory banks for future use. Thus, the individual is able to learn rather than having to go through trial and error each time.

The senses described above are called the primary senses because they are most responsible for the individual's ability to "experience" his or her environment. Visual and auditory stimuli alone do not generally provide enough information to be "meaningful." Thus, one may say that the child has functional vision or hearing, or both, but does not use them.

Behavioral observations that frequently are associated with a child who has a tactile sensory deficit include the following bangs head, only hits, throws, or ignores toys, moves constantly from one object to another in a random, nonexploratory fashion, shows aggressive behavior for no obvious reason, becomes easily overwhelmed or upset and takes a long time to calm down, dislikes being handled, preferring to be left alone, responds passively to people or things around him or her, fails to cry when falls, constantly takes clothes off or insists on having certain clothes on, and pulls back or becomes upset when approached quickly. Tactile disturbances in and around the mouth area will also result in the following behaviors. violently fighting having face and hands washed, gulping loudly when swallowing, swallowing food whole, overstuffing mouth or gagging easily, refusing certain foods adamantly, and biting down consistently and hard on spoon when fed.

A few simple tests can be used to determine whether the child has a tactile sensory problem. Will the child allow you to approach and stroke his or her arms, hands, legs, and cheeks with a plastic brush without immediately pulling away, grimacing, giggling excessively, or completely ignoring the stimulus even when brushed very hard? Will the child (1) allow you to place a tongue depressor gradually onto the center of his or her tongue without biting it, gagging, or pulling the tongue way back, and (2) automatically (within five seconds), after the tongue depressor is placed on the tongue, close his or her mouth and swallow repeatedly? No one of these behaviors suggests a tactile sensory problem, but a "yes" answer to a number of them may be significant.

Since the vestibular and proprioceptive sensory systems work so closely together, separating their symptoms is not easy. Behavioral clues to a deficit in these areas include walking stiffly or awkwardly more than six months after beginning walking, seeming fearful of stairs or even bumpy ground; shifting weight constantly, being unable to sit or stand still, getting "sick" when tossed around or even riding in a car; leaning on objects; preferring lying or always seeming "lazy"; falling constantly; seeming to be very weak in some things and yet appearing very strong other times; constantly "forgetting" learning from day to day, scooting on his or her bottom to get places rather than crawling, sitting or standing straight-legged rather than rotating to one side or using one foot and then the other; showing tremors in fine movements but not in gross-motor movements; failing to use eyes to look at what he or she is doing, not using both arms or legs equally for bilateral tasks, refusing to run or be moved quickly, appearing very clumsy or uncoordinated, sitting and rocking self repeatedly, giving up extremely quickly, and assuming unusual postures or movements with arms and legs. Proprioceptive problems in and around the mouth area will often result in the following observations. fails to babble or make sounds even though hearing is functional, can say words spontaneously but not imitatively, fails to chew properly, has tongue constantly out of the mouth or is unable to stick it out, and still drools past the age of two years. The therapist can conduct a few simple tests to substantiate these observations. Will the child follow a moving object from right to left and back again with his or her eyes only, without losing it and without jerky eye movement? Will the child, when placed on his or her tummy on the therapist's lap and offered a dangling toy, lift his or her head, arms, and legs equally and maintain that position easily for 25 seconds while playing with the toy? While on his or her stomach, can the child support himself or herself on elbows without his or her shoulder blades "popping out"? Following ten slow rotations in both lying and sitting positions, does the child "show" ten seconds of repeated eye movements without dizziness afterwards? Does the child quickly, repeatedly, and easily tilt the head and body to prevent falling when held only at the hips and tilted side to side and front to back while seated on a ball, barrel, or lap? Does the child repeatedly catch himself or herself on his or her *hands* (not elbows) when quickly moved off-balance to both sides and backward in sitting? Again, one "yes" answer does not suggest a problem. Only when one considers all the responses will one have a rather complete, and hopefully accurate, picture of those sensory areas that are not functioning and that are therefore not available to the child for learning, playing, relating, or developing

The visual, auditory, and olfactory senses should not be overlooked either. Testing and observing the child's response to these will help to determine exactly what the child's sensory strength and weaknesses are so that they can be utilized appropriately in a multisensory-treatment approach.

The suggestion has been made that children with minimal sensory deficits "outgrow" these problems, but I contend that most do not. Instead, because of the adaptability of the nervous system, the child learns to compensate, and in some cases learns to do so quite well. Even in some severely handicapped children in whom the cognitive processes have not been impaired, compensation (or voluntary control of otherwise automatic processes) takes place. Treatment is aimed at using multisensory means and combining sensory strengths and weaknesses to facilitate integration on an automatic level. Once the child can feel, support himself or herself, move, and protect himself or herself automatically, the cognitive area will be free to develop to its maximum potential.

In a multisensory approach the importance of as-accurate-as-possible identification of areas of sensory strengths and weaknesses is obvious. Only when they are combined in an organized and meaningful manner will automatic integration and carryover learning take place. The child is *never told* how to respond If sufficient sensory information is given to the child, he or she will "feel" what he or she should do, and the child will do it, assuming that he or she has the physical ability to do so Since learning requires adequate sensory input, integration, motor response, and feedback of that response into the memory banks, the physically handicapped child who cannot make an appropriate motor response is just as handicapped in learning as those who receive inadequate sensory input or who are unable to understand the input that they receive.

How can one know if sensory integration is taking place? The assumption must be made that if a normal motor response (smile, reaching out, active exploration, and so forth) occurs consistently (suggesting feedback into the memory banks), occurs spontaneously (suggesting automatic integration), and is appropriate for the situation (suggesting that sufficient input was received without overreaction or underreaction to it), then sensory integration is taking place, and a normal learning process has been established If the appropriate, consistent, and spontaneous motor response is not present, then the assumptions must be made that the sensory input was insufficient or nonmeaningful and that the learning process "topped" at that point. If this is true, then the sensory input must either be increased or better organized for the process to continue. The input that should be increased, the way in which it should be increased, and the manner in which it should be organized will depend on the needs of the particular child and should be determined in cooperation with the sensory integration therapist.

The child's emotional needs should not be overlooked even though with sensory integration treatment his or her need to avoid or act out will decrease. The child still tends to associate certain experiences with failure or unpleasant feelings and may need both time and patience to again trust those people or events involved. Allowing the child to control these happenings, either directly (through self-initiation) or indirectly (by attending to his or her emotional reactions), is the best way to establish trust and consequently to increase his or her involvement in sensory integration. Imagine your distress, anger, and subsequent avoidance of someone who would pour a glass of liquid down your throat faster than you are capable of swallowing it, despite your vigorous signs of protest. As cruel as this may sound, this is sometimes exactly what we do to children who cannot integrate quite fast enough. Yet, despite their protests, we feel that this is something they "must" learn. In fact, one can do a child an equal disservice by helping him or her to "avoid" those experiences he or she finds difficult or upsetting. The key is in *how* the experience is presented. The child is the one who knows his or her sensory needs. The child knows how much he or she can tolerate and for how long. Overstimulation can result in the child being overwhelmed and disorganized. It can increase his or her behavioral problems and, in the case of excessive vestibular stimuli, can result in changes in consciousness. If the child cannot communicate his or her feelings directly, your responsibility is to monitor his or her nonverbal communication (grunts, smiles, stiffening of body, paling of face, and so forth). Remember, also, that the child's nervous system does not integrate rapidly. Even the normal child engages in a tremendous amount of repetition with each new task, at a very deliberate pace, before he or she considers it "mastered" and goes on to the next task. The normal child also needs and seeks more intense stimuli than you would. For example, you are "done" after one trip on the roller coaster, but he or she requires at least five rides. Thus, repetition at a pace and intensity that the handicapped child can relate to are important for facilitation of normal sensory integration.

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