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ABSTRACT

This paper reports on three studies within a 6-year longitudinal study which explored the use of Piagetian sensori-motor substages as a curriculum base for individuals with profound mental retardation (MR). In the first study, a simple observational inventory, the Cognitive Marker Natural Observational Tool (CM-NOT), was developed and evaluated with 20 caregivers, most with little formal education, who evaluated the cognitive skills and secondary processing differences in 38 individuals with profound MR. Caregivers were relatively successful in using the measure, as demonstrated by 86 percent agreement with earlier clinical assessments of the same individuals. The use of electroencephalographic (EEG) reports to analyze behavioral and language differences was the focus of the second study. Participants (n=31) with profound MR were assessed by caregivers using the CM-NOT and the results were compared with EEG reports. Areas of seizure activity matched predicted behavioral/language dysfunction 82 percent of the time. The third study showed that nine out of ten individuals with profound MR demonstrated an increase in pulse rate and behavior when in a highly stimulated environment. The report includes a chart of cognitive milestones for infants, illustrations of regions of the human brain and their functions, and a sample CM-NOT test form. (Contains 21 references.) (CR)

Developing a Holistic Approach for Educating Persons with Profound Disabilities

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Developing a holistic approach for educating persons with profound disabilities

Generalizing methods for demarcating cognitive abilities in persons with profound mental retardation requires a developmental understanding of information processing abilities and neurological integration that is not possessed by all educators. Thus establishment of training goals for persons with profound mental retardation may be so haphazard that gains are seldom longitudinally progressive. Nor for this population, are there the same social expectations imposed on the majority of society, to grow in understanding of the world around us throughout our years. It is not inhumanity or the lack of theoretical substance that has stagnated educational efforts for persons with profound cognitive deficits. The problem is the inability to practically apply theoretical methods to investigate individual differences.

Related Topics

Educational efforts for persons with profound cognitive deficits in recent years have focused on a number of major areas of interest including cognitive readiness, behavioral state, gentle teaching, and sensory integration. Singularly, no area of research is able to offer broad directionalilty to educational approach for persons with profound mental retardation, integration of useful methodologies within prominent areas of research does however offer much generalizable insight into helping individuals with profound deficits realize cognitive growth.

"Behavior state" is a term first coined by Wolf (1959) to describe different physiological levels of activities, from asleep to crying, occurring at different times of day within infants. A number of investigators have employed the term to describe the behavioral states under different environmental conditions observable in persons with profound mental retardation. This type of analysis is useful for determining under which environmental conditions individuals are most alert and receptive to learning. Among individuals with profound mental retardation, there lies a significant portion of persons with limited environmental responses (e.g., Campbell, 1989). Complicating conscious awareness a number of these individuals receive anticonvulsant medication for seizure disorders which also increases their drowsiness. Increasing states of arousal to receptive conditions (overstimilulating persons is also possible) has been associated with both endogenous and exogenous factors (e.g.., Guess, et al., 1995). Educational activities need be aligned with time periods when individuals are most commonly alert and environmental activities that have been associated with increasing response patterns need to be provided (e.g., position changes, social opportunities, preferred materials). Failure to provide environmentally engaging stimuli during alert stages when individuals are conducive to learning is considered to be a primary obstacle in skill development for this population.

A structured behavioral format which includes errorless learning, task analysis, response prompting, co-participation, identification of antecedents, reduced verbal instruction, choice-making, fading prompts, the use of dialogue and avoids aversives is advocated in gentle teaching. The central theme of gentle teaching is "valuing" the person in therapy (McGee et. Al., 1987; McGee & Menolascino, 1992). These methods have been controversially successful in treating persons with severe behavioral problems but generally respected for their humane intent (e.g.., Jones et. Al., 1991). The fact is, severe behavioral disorders often require more than kindness and behavioral interventions. Self injury and aggression can be caused by the inability to accommodate sensory stimuli, neurological and/or physical discomfort, care giver intervention that is not appropriate to an individual's reasoning abilities, hormonal changes, mental health disorders and a wide range of other variables. No one strategy for solving behavioral problems will be effective across a varied population.

The concept of sensory integration has been developed by neurologists across the last twenty years. Investigation of sensory integration attempts to notice and define normal and deviant sensory integration processes. Differences in processing and integrating sensory information are observable in stroke patients, persons with learning disabilities, persons with tactile defensiveness, persons with balance and coordination problems, persons with anxiety symptoms, persons with problems filtering extraneous noise, persons with visual tracking problems, and, within a wide range of subtle to extreme individual differences amongst all persons that affects individual differences to environmental stimuli. Neurological research promises great potential for understanding more about how the brain functions and determining just what accounts for differences within and between individuals.

Among current fields of research there lies common ground for directing educational efforts for persons with profound mental retardation. Provide cognitively stimulating opportunities, when persons are receptive to such, in a humane and measurably structured way, that an individual can integrate through working sensorial modes. In order to enhance skills or determine what if any specific sensory integration or neurological deficits accompany a generalized developmental delay an educator needs to begin with a generalized concept of developmental expectations, so we will begin with a simple review of early cognitive processes.

DEVELOPMENTAL AGE = 0 - 1 MONTH (SG)
Goal: Develop Responses to Environment

COGNITIVE MILESTONE	ASSESS BY	DEVELOP BY
SENSORY RESPONSES: Sensory Touch, Taste, Hear, Smell, See, Vestibule Reflexive Movement Cries, Sucks, Grasp, Root, Startle, Walk, Orient to light/sound, etc.	Are behavioral responses to sensory stimulation valid?	Promote environmental responding by finding best mode for sensory input, and enhancing sensory cues. ■ Compensate for sensory deficits, as needed. ■ Promote reflexive movements. For example: place small objects in palm for grasp, provide pressure for rooting and reflexive kicking; utilize adaptive cuffs for holding, if needed. ■ Inventory all sensory responses to auditory, gustatory, olfactory, visual, tactile, and vestibule stimuli and represent exaggerated cues among fields with best responses.

DEVELOPMENTAL AGE: 1 - 4 MONTHS (SG)
Goal: Increase Environmental Responses

COGNITIVE MILESTONE	ASSESS BY	DEVELOP BY
BASIC DISCRIMINATION: Similar body movements to like Sensory experiences. If a chance action is sensorially satisfying, it happens again. Perceptual recognition develops as a result of repeated stimulus.	Behavioral patterns. Similar responses to the same things. Sensory attending.	Provide satisfying sensory stimulation for whatever movement/responses exist to increase them. ■ Behavioral patterns determine preferences - use these preferred materials in association with more active responses to increase them, i.e., provide bright reachable adult mobiles that respond to movement, preferred social contact in relation to vocalizations, preferred music to increase alertness, etc. ■ Develop common tactile auditory/visual responding.

DEVELOPMENTAL AGE = 4 - 8 MONTHS (DG)

Goal: Increase Intentional Movement

COGNITIVE MILESTONE	ASSESS BY	DEVELOP BY
IN A BASIC SENSE CAUSE HAS EFFECT: Directed action for sensory stimulation.	Ability to move to get a specific desired object. Ability to make noises for attention. Ability to actively manipulate objects. Definite movements for social contact.	Provide consistent results for specific actions (i.e., respond to vocalizations). Encourage active object exploration (things that do something when manipulated). ■ Encourage directed reach and body movements (place things barley father away in increments/ teach to finger feed/ hold a cup). ■ Pair preferred sensory experiences with active behaviors (i.e., a back rub for hand movement on a novel object). ■ Provide materials that can be directly activated (i.e, key boards, active adult object boards, etc.).

DEVELOPMENTAL AGE = 8 - 12 MONTHS (CG)

Goal: Increase Casual Relations

COGNITIVE MILESTONE	ASSESS BY	DEVELOP BY
MEANS HAS ENDS Preforms separate intentional acts to bring about desired outcome.	Object permanency. Points or gestures. Indirectly activates objects. Preforms a specific behavior or a set of behaviors to get attention or a desired object. Anticipates events.	Provide with indirectly activated objects (i.e., switches, pulleys, environmental control devices, buttons etc.). Provide with indirect methods (i.e., store things in cupboards/ drawers/ find missing objects/ cookies can be used as reinforcers effectively/ encourage entire body movement and wheelchair mobility if possible/ etc.). ■ Offer objects from different positions for altered viewing. ■ The effect is motivating in itself- drop an object in water for a splash/ cue similarly for similar events to increase anticipatory responses. ■ That which receives attention is likely to increase.

DEVELOPMENTAL AGE = 12 - 18 MONTHS (PG)
Goal: Exercise Mental Imagery

COGNITIVE MILESTONE	ASSESS BY	DEVELOP BY
PLANNED MOVEMENTS Imitation The ability to copy another's action or utilize mental imagery to plan movements. (Behaviors which are part of one's natural repertoire, i.e, smiling, do not meet criteria for truly planned action whereas hand clapping after you see an audience do so does.)	The ability to copy any one step behavior. Planned use of an object as a tool.	Utilize enthusiastic model to teach many simple motor one step functional tasks (i.e., brush, put in, wipe, turn on, roll, stir, etc .) ■ By enthusiastic model teach words or expressive gestures. ■ Set up with simple tools and/ or previous means-ends subordinate tasks which require new steps (can now also coordinate use of dinning utensils for independent feeding, is likely to follow several steps of actions for desired outcome, can use a pencil to scribble, may be able to use a basic augmented communication system, etc.)

DEVELOPMENTAL AGE = 18 - 24 MONTHS (FR)
Goal: Exercise Self Originated Action

COGNITIVE MILESTONE	ASSESS BY	DEVELOP BY
ORIGINAL BEHAVIOR: Combines different common actions and/ or materials to exercise self originated actions. Uses other things for functions of known things (i.e, wears a towel on his head for a hat).	Observation of the original behavior in natural settings.	Provide new and varied material and encouraging creative use of them (attention span is too low for monotonous pre-vocational training) ■ Provide much "safe" space/time to explore. ■ Teach how to use more simple materials/ tools in new ways. ■ Teach more complex sets of signs/ words by "fun" model- manual guidance likely to be resisted. ■ Consistent routines/ expectations are important to gain cooperation and set minimal limits due to need to exercise self originated actions/ self determination.

Generalizing Piagetian Principles at the Sensorimotor Level

Piaget's finely defined sensori-motor stages, when conceptually generalized to reflect differences in a person's ability to interact with their environment, serve a sound theoretical basis to ascertain cognitive abilities. Reviewing a simplified model of Piaget's sensori-motor categories is helpful for understanding developmental differences within persons with profound mental retardation.

Application of Piagetian Principles at Sensori-motor Levels

From the premise that human beings are sensory driven and operated being's cognitive growth begins. Humans are born with sensory input capabilities and reflexive movement (Piaget's Sensori-motor Schematic). First this human system is able to discriminate specific sensory input (Piaget's substage of Primary Circular Reactions). Then this system intentionally acts to obtain desired sensory experience (Piaget's substage of Secondary Circular Reactions). In time this system is able to act with indirect complexity to attain desired sensory outcome (Secondary Schematic). Then predictable outcomes become so assured that this system can plan acts using mental representation (Tertiary Circular Reactions), and, eventually, this system can put together previous plans to create new acts and sensations (Inventions of New Means through Mental Combinations). The ability to enact capabilities attained at lower levels remains incorporated into all higher levels of development, thus noting one's highest level behavior dictates current cognitive level. An educator utilizing Piagetian concepts to direct educational training might consider the following.

Piaget's "Sensori-motor Schematic" reflects the environmental interaction of individual responses to sensory stimulation. An individual who doesn't respond to his environment is having difficulties receiving sensory information. An **inventory** of **sensory** responses to varied gustatory, olfactory, auditory, visual, tactile and vestibule cues will determine just which areas receive input (and serve a further purpose in determining sensory integration flaws).

From earliest Piagetian perspective ("Substage of Primary Circular Reactions") environmental manipulation to increase the likeliness of an individual being able to obtain preferred sensory stimulation invokes greater responding. Sensory discrimination can be assessed and used to build active movements. Provide sensory stimulating conditions that enhance the likeliness of self initiated movements to increase environmental responding.

Active Discrimination is marked by the individual-to-environment evolution of intentionality. Piaget's substage of "Secondary Circular Reactions" describes simple directed acts which provide sensory satisfaction. Banging an object for the sound it makes or reaching for a favorite treat or person demonstrate direct interaction with the environment. Motivation is to attain preferred sensory experience. A care giver who consistently responds to specific behaviors, like attending to a person, who vocalizes, increases the likeliness that individual will again vocalize, this care giver also helps build a repertoire of expectations in regards to anticipating environmental events.

Active experimentation with the things in one's environment leads to the development of early **causal relations**. Causality, in a basic sense, is observable as an individual's ability to perform any act on the environment that is separate from the desired effect. Piaget included the ability to search for something under cover and the ability to anticipate an effect during his developmental substage of "Secondary Schematic." Extending causal relations can be as simple as handing a favorite bangable object backwards so the receiver has to turn it around to bang it, or, similarly creatively adding minor single step obstacles for attaining any preferred stimuli. Performing a simple behavior for a reward and effective use of adaptive switches to turn on music, or the like, are most practically first attainable at this cognitive level.

The ability to predict outcomes leads to the development of mental imagery. Piaget's substage of "Tertiary Circular Reactions" is a description of **planned movements,** behaviors that are multifaceted in their ability to yield predicted effective outcomes. Intact mental plans allow an individual to copy another's behavior, utilize a utensil effectively, repeat the words they hear, and develop schemes for attaining desired materials that are multiply complex in action or involve tool use (like getting a chair to reach the top of the shelf). Modeling simple functional tasks is an effective training strategy for teaching persons with planned movement capabilities. The ability to coordinate several steps of behaviors for desired results is now more common to observe, as well, so further complicating previous indirect task mastery is recommended, too.

Piaget determined that an internal symbolism allows for one behavior to be represented by another during the development of mental imagery, he coined this substage "Inventions of New Means through Mental Combinations." Materials can be used to represent other materials because they are functionally related to each other. **Functional Relations** can be observed in creative manipulation of materials, like throwing blankets on the floor and calling them a bed or spinning a cap like it's a top. When one first understands the functional relationship of the things in one's environment, exploring this relatedness of things is natural and useful for engaging interest in the common uses of materials and the norms of social activities (including combing hair and toilet training). The emotional tone of language, and the functional value of such, can be used advantageously at this cognitive level to increase cooperation as well, so sounding "fun" is a useful training strategy.

Across time, abilities are associated with mental plans that involve entire active series of expectations and **Functional Categorization** develops. Categorizing information by similarities of properties and expectations aids in developing the performance of new functional tasks. Language use, sorting skills, color recognition, familiarity with seating arrangements, preference for favorite objects, and most daily activities readily demonstrate an obsession with common denominators. To readily adapt to exceptional circumstances, categorize by more than a couple similar characteristics at a time, or, to put oneself in another position to view how your behavior affects others, requires a more advanced ability to understand interrelational environmental factors than those found at the sensorimotor levels.

Why gear training to Sensori-motor Level?

As early as the 1800's, Edward Sequin determined more of a sameness to the developmental patterns of persons with extreme cognitive deficits with us all than significant oddity. Edward Sequin found sensori-motor stimulation helpful and advocated its use, as did, Skeels and Dye (1939), as has Wolfensburger. Piagetian theory has been considered as likely to hold practical value for understanding and educating persons with mental retardation since its inception, gaining particular popularity throughout the 1970's (e.g., Robinson, 1975). Formal tools developed for assessing children and infants' abilities, and the adaptive skills of persons with mental retardation have failed to provide enough adequate generalization of cognitive processing abilities at the sensorimotor levels to be of practical use for persons with extreme disabilities. The application of these tools has left evaluators unsure of an individual's cognitive abilities and referring to the mixed results as "splinter skills." This concept suggests persons with mental retardation somehow develop cognitive processing abilities in a haphazard nonhierarchial fashion that doesn't necessitate directing skill training to cognitive processing abilities. The theoretical and observable evidence that exists however suggests humans develop in common ways. This makes it practical and incumbent for educators of persons with profound mental retardation to apply a useful developmental cognitive model. A word toward addressing behavioral oddities, those unique behaviors that don't follow typical developmental patterns. Persons with profound mental retardation, as all persons with sensory integration deficits or neurological problems, face additional specific challenges for processing specific types of information. An understanding of the perceptual differences that are associated with specific areas of brain dysfunction within individuals is important to successful education of any student one hopes to teach. Much effort in understanding more about the human brain has evolved across time. For educators of persons with profound mental retardation, and for neurologists attempting a clearer understanding of how the brain functions, there lays potential for great exchange. This fact remains, the ability to engage in a higher order cognitive task, defines general intact cognitive processes to that level. To generalize the ability to determine intact cognitive abilities, a simple useful method for demarcating sensorimotor level is needed and this effort frames the first inquiry. Consideration to brain differences which may explain disparity among one or another skill category will then be considered.

A Step Toward

The Practical Application of Cognitive Assessment and the Understanding of Secondary Processing Differences.

The First Inquiry

Developing a Simple Tool to Assess Sensorimotor Level

Across a six-year longitudinal study we demonstrated the ability to consistently enhance skills for participants with profound mental retardation utilizing a simple generalized distinction of Piagetian's sensori-motor substages as a curriculum base (Williams, 1996). All of the experimental subjects demonstrated skill gain. Significant skill gain across the comparative adult population was only 13%. Comparative analysis of the historical failure to gain new skills within both experimental and control participants demonstrated that in a given instructional year, utilizing popular assessment tools, educators only chose skill tasks at appropriate sensori-motor levels at chance rates. About one half of those misaligned skill tasks exceeded sensori-motor levels and the other half were below sensori-motor level. More commonly misalignment of the training strategies employed to teach new tasks was a problem. This suggests there is need for educators of persons with profound mental retardation to be able to better differentiate sensori-motor substages. Simple assessment methods with items that include behaviors fairly common to observe in persons with severe disabilities would provide greater practical aid. The natural observation format utilized in our previous efforts for assessing sensori-motor substage (see previous insert) was engaged to construct test items for a simple inventory in an effort to expand the number and variety of personnel who could perform sensori-motor assessment. In line with the most common behaviors reported from natural observations in our previous efforts we developed this tool and set forth a small trial test for reliability.

Methods

Participants

We employed twenty different adult care givers and service providers who worked within the same residential unit for at least one year to evaluate 38 individuals with profound mental retardation utilizing the Cognitive Marker Natural Observational Tool (CM-NOT). The experimenter had completed clinical sensori-motor evaluations for this group six to twenty-four months earlier. Each participant assessed one to three persons. The care givers were not aware of clinical assertion to sensori-motor level. Educational experience in cognitive developmental theory was low among participants as indicated by a lack of understanding of cognitive developmental theory and the inability to verbalize Piagetian concepts. Five of the participants had attended college courses. The rest had High School degrees. Age range for participants was 23-54 years and there was slightly more female than male care givers involved in this sample review.

Procedures

Each participant was instructed to complete the natural observation inventory. Assurances that they knew the resident well were required but because all participants were involved with at least half of the residents random assignment was possible for the majority of exams. Each resident was retested by at least one additional participant in a separate session. The assessment tools were collected and analyzed in relation to the previous clinical assertion of sensori-motor range.

CM-NOT

Cognitive Marker Natural Observational Tool

Individual Test Form

Name:____________________
Address:____________________
____
Sex:______ Age:____________
Date of Evaluation:__________
Date of Birth:_______________
Examiner:__________________

% attained in CM_____ --/10

Results:
Cognitive Marker:*________*(Highest+)

Total scores	**SG**_______	(1-4 month)
	DG_______	(4-8 month)
	CG_______	(8-12 month)
	PG_______	(12-18 month)
	FR_______	(18-24 month)
	FC_______	(24-36 month)

Directions for administration on back page.

+/- **SG** Sensory Inventory Group

- ❑ Looks at your face when you are close by
- ❑ Leans into preferred texture/person
- ❑ Spits out non-preferred foods
- ❑ Moves arms/head in response to shaking chime/loud noise
- ❑ Nasal flail/facial expression change when opened cologne bottle is under nose
- ❑ Follows bright flashlight beam several feet with eyes
- ❑ Enjoys rocking/swinging or taking rides
- ❑ Refrains from self stimulatory behavior
- ❑ Responds positively when touched by others
- ❑ Appears more often than not alert/responsive to environmental stimuli

____ Total +'s

+/- **DG** Active Discrimination Group

- ❑ Grasps cloth/object when placed in palm (beyond reflex for CM)
- ❑ Reaches to touch you/a preferred object
- ❑ Anticipates spoon/cup or actively cooperates for feeding
- ❑ Makes noises with objects or to get your attention
- ❑ Moves within physical abilities to obtain a preferred material/ treat/activity
- ❑ Mouths on certain materials/objects
- ❑ Pulls away fom non-preferred activities
- ❑ Finger feeds/drinks from a cup
- ❑ Actively manipulates objects
- ❑ Definite movement for social contact

____ Total +'s

+/- **CG** Casual Relations Group

- ❑ Retrieves a preferred edible or object from a container
- ❑ Uses an environmental control device to activate an appliance or operates lights/ flushes toilet
- ❑ Shows off or performs with a specific behavior to get attention
- ❑ Points, vocalizes, shakes hand at, or otherwise gestures to indicate a need
- ❑ Moves cloth, opens a drawer or flip top box to attain a preferred treat/object
- ❑ Actively explores their environment
- ❑ Indicates wet or soiled clothing by common noise, gesture or body movement
- ❑ Drinks independently and is beginning to use a spoon
- ❑ Engages in a specific action for a known reward/ responds to reinforcers
- ❑ Actively engages with a variety of pulleys, buttons, switches, and active materials for their interesting effects

_____ Total +'s

+/- **PG** Planned Movement Group

- ❑ Uses a spoon to eat
- ❑ Imitates/ uses any word or uses a communicative device successfully
- ❑ Imitates a simple gesture (i.e, hand clapping)
- ❑ Wipes mouth with a napkin
- ❑ Throws a piece of paper in the trash
- ❑ Nods, waves and/or produces the sign for eat
- ❑ Uses a few words/signs functionally
- ❑ Reproduces sounds that are word like and heard commonly (not CM if only +)
- ❑ Uses objects as tool (i.e, a marker to scribble, a rod to move something out of reach closer, a chair to stand on)
- ❑ Performs a large variety of one step functional tasks when encouraged to and when they have been modeled by others

_____ Total +'s

+/- **FR** Functional Relations Group

- ❑ Initiates toileting or removes clothes to eliminate
- ❑ Initiates movement to area or prepares materials at routine times for routine events
- ❑ Uses some things for functions of other known things (i.e, wears a towel on his/her head for a hat)
- ❑ Utilizes playful greetings or fairly complex rituals to extend social notice/attention
- ❑ Throws and kicks a ball
- ❑ Turns pages in a book
- ❑ Utilizes at least several signs, gestures, or words to communicate as a matter of daily course.
- ❑ Proficiently uses a series of switches to activate appliances or commonly turns t.v. channels or the like
- ❑ Can locate his/her chair in the dining room or leisure area without assistance
- ❑ Responds to intonations of excitement, "words of adventure" with increased cooperation (obviously anticipates fun- not CM if only item.)

+/- **FC** Functional Categorization Group

- ❑ Labels similar people/things/animals with the same name or a similar quality (i.e., color)
- ❑ Commonly uses different household items to represent other objects in play (i.e., a rolled magazine for a microphone)
- ❑ Uses a word or complex gesture to mean "bad" and overgeneralizes its use
- ❑ Points to pictures of common/preferred things in book/magazine
- ❑ Unwraps the paper before putting candy in his/her mouth or performs similar other multi-step tasks for a reward
- ❑ Is toilet trained during the day and dines independently
- ❑ Can dress self except difficult to fasten items (ties, buttons, etc.)
- ❑ Matches similar items
- ❑ Puts several words together to form a sentence
- ❑ Gets own glass of water

____ Total +'s

Sensorimotor Development

(SG) The sensory value of materials, foods, activities, social interactions and all environmental experiences are analyzed by common sensory value. (DG) Productions of similar behavioral sets in order to recreate preferred sensory experience are discernible. Increasing the likeliness for obtaining sensory preference increases responding. Directed actions are first noted. (CG) Intentional movements across time increase in complexity such that actions not directly associated with desired results are engaged for anticipated results.Experimentation with the laws of effect lead to the ability to predict outcome. (PG) Visual anticipation takes the form of mental imagery and with it develops the ability to plan mental sequences, such as those required for imitating another's behavior. Hesitation before acts increases as mental images advance from relating simple actions (FR) to complex series of actions (FC) and relating simple labels(FR) to general categories (FC).

Directions

This inventory is to be given in natural time and space with reliable caregiver reporting to verify observations. Keep score by putting a "+" in front of each observed behavior. Put a "-" or leave blank behavior statements that have not been observed. Stop scoring when there have been no "+" for two consecutive sections. The highest "+" observed indicates cognitive marker group. Behavioral skills within this group and all physically capable nonattained items below this level (and similar group level skills) are potential areas for skill gain and training emphasis. Disparity between and within groups that are not related to physical deficits are experientially based.

Subject	Psych Assess	Examiner 1	Examiner 2
1	8-12	8-12	8-12
2	8-12	8-12'	8-12
3	8-12	8-12	8-12
4	8-12	12-18#	8-12
5	4-8	4-8	4-8
6	8-12	8-12	8-12
7	12-18	12-18	12-18@
8	12-18	12-18'	12-18@
9	4-8	4-8	4-8
10	8-12	8-12	4-8
11	12-18	12-18	12-18
12	8-12	8-12	8-12
13	12-18	12-18	12-18@
14	12-18	18-24	12-18
15	8-12	8-12	4-8
16	4-8	4-8	4-8
17	8-12	8-12	8-12
18	4-8	4-8	4-8
19	12-18	12-18	4-8
20	8-12	8-12	8-12

'Item deletion correction
@ examiner error (uses one word)
# napkin to wipe mouth (uses a towel to wipe face not after meals? Functional use)

Subject	Psych Asess	Examiner 1	Examiner 2
21	12-18	12-18	12-18
22	24-36+	24-36	24-36
23	24-36+	24-36	24-36
24	12-18	12-18	12-18
25	12-18	12-18'	12-18
26	24-36	24-36	24-36
27	12-18	12-18'	18-24
28	12-18	12-18	12-18
29	24-36	24-36	18-24
30	24-36	24-36	24-36
31	12-18	12-18	12-18
32	24-36	24-36	24-36
33	24-36	24-36	24-36
34	24-36	12-18	18-24
35	24-36+	24-36	24-36
36	24-36	18-24	24-36
37	12-18	24-36#	12-18
38	24-36*	24-36	24-36

'Item deletion correction
*skill validated ^ since last assess
overgeneralization of "bad" ? word finding vs. developmental
+ limit to assessment for higher skills
v VABS highest domain no cognitive milestones reported

Results

Average time to complete assessments was twenty minutes. Errors were rare, Participants had little difficulty understanding or scoring skills. Sensori-motor levels as indicated by this tool were compared with previous clinical evaluations indicating sensori-motor abilities. Agreement between clinical ascertains of sensori-motor range and participant test results occured in 86% (65/76) of cases. Participant agreement was less reliable, matching results only 74% of the time. Differences between ratings, in all but two CM-NOT results were within one categorical range. Specific item variability within categories was fairly common. Among obvious cases unknown behaviors were not credited and some participants were more aware of specific skills of residents than others. Participants who took a personal interest in the individual they were evaluating matched clinical evaluations most accurately. Most participants were successful in noting at least one of the highest level skill items accurately and the frequencies with which sensori-motor levels matched clinical evaluations were surprisingly high.

Discussion

Previous psychological determination of sensori-motor levels was based on hundreds of hours of observation and experimentation with Piagetian sensori-motor concepts. That participants with little expertise in developmental principle or formal education were generally successful at matching clinical ascertain suggests potential for expanding the usefulness and application of simplified Piagetian methods. Larger item testing and application of simplified

Piagetian concepts are needed to determine just how useful these methods may be to educators. Item analysis within the CM-NOT is needed to increase inter-rater concordance rates, and more importantly determine ways this or a similar tool may serve to enhance understanding of sensori-motor abilities in a manner that can be used to foster greater skill acquisition for persons with profound mental retardation.

Synthesizing the Variables

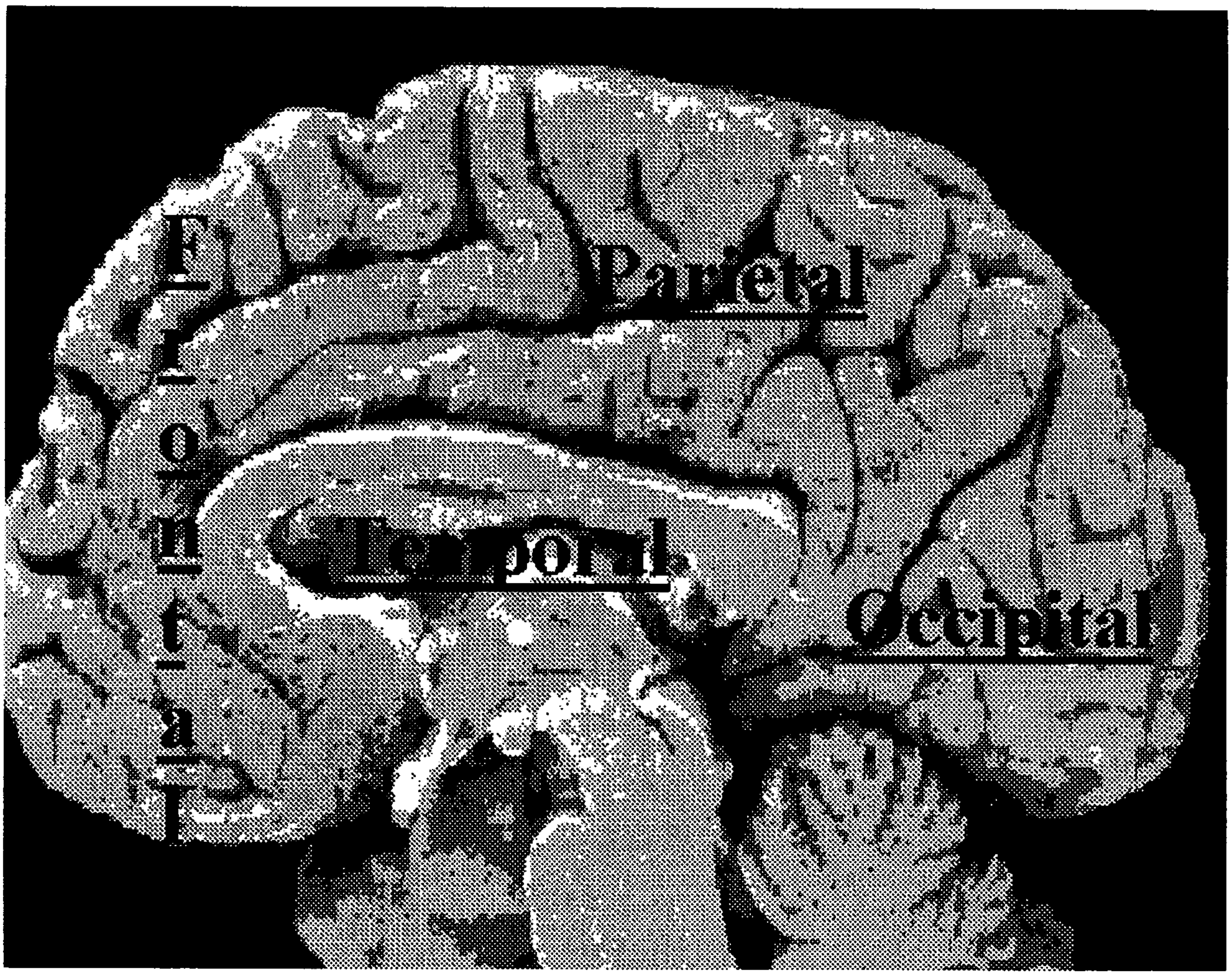
Enhancing sensori-motor skills is possible utilizing a generalized understanding of Piagetian concepts and such will likely be able to be delineated in a simple assessment method. There remains significant concern for identifying and understanding individual processing distinctions that differ from general developmental framing. The next challenge is understanding, assessing and where possible remediating sensory integrative or neurological problems when they present a secondary obstacle in limiting skill development.

There is the potential that as we learn more about processing dysfunction within a specific population, that knowledge may be expandable to other populations. Brain differences throughout development, as pointed out by Geschwind and Galaburda (1985) are likely to demonstrate physiological distinction on inspection. Brain imaging techniques are needed for locating small areas of brain dysfunction. Within the population of persons with profound mental retardation there are a significant number of individuals with epilepsy. Unusual electrical activity in a particular area of the brain is suggestive of an anomaly in that particular area of the brain. Neurons transmit information chemically through the exchange of electrons. Disruption to the balanced chemical exchanges of the brain are associated with uncountable concerns. A review of differences in EEG's (electrocephalgraphy) across a sample of persons with profound mental retardation and epilepsy is suggestive individually of gross areas of the brain that contain areas of dysfunction. Reviewing EEG's in relation to assessment of sensory processing problems and known areas of typical brain function may be useful to engage for its suggestive value in understanding differences in behaviors that are not explained by general developmental theory.

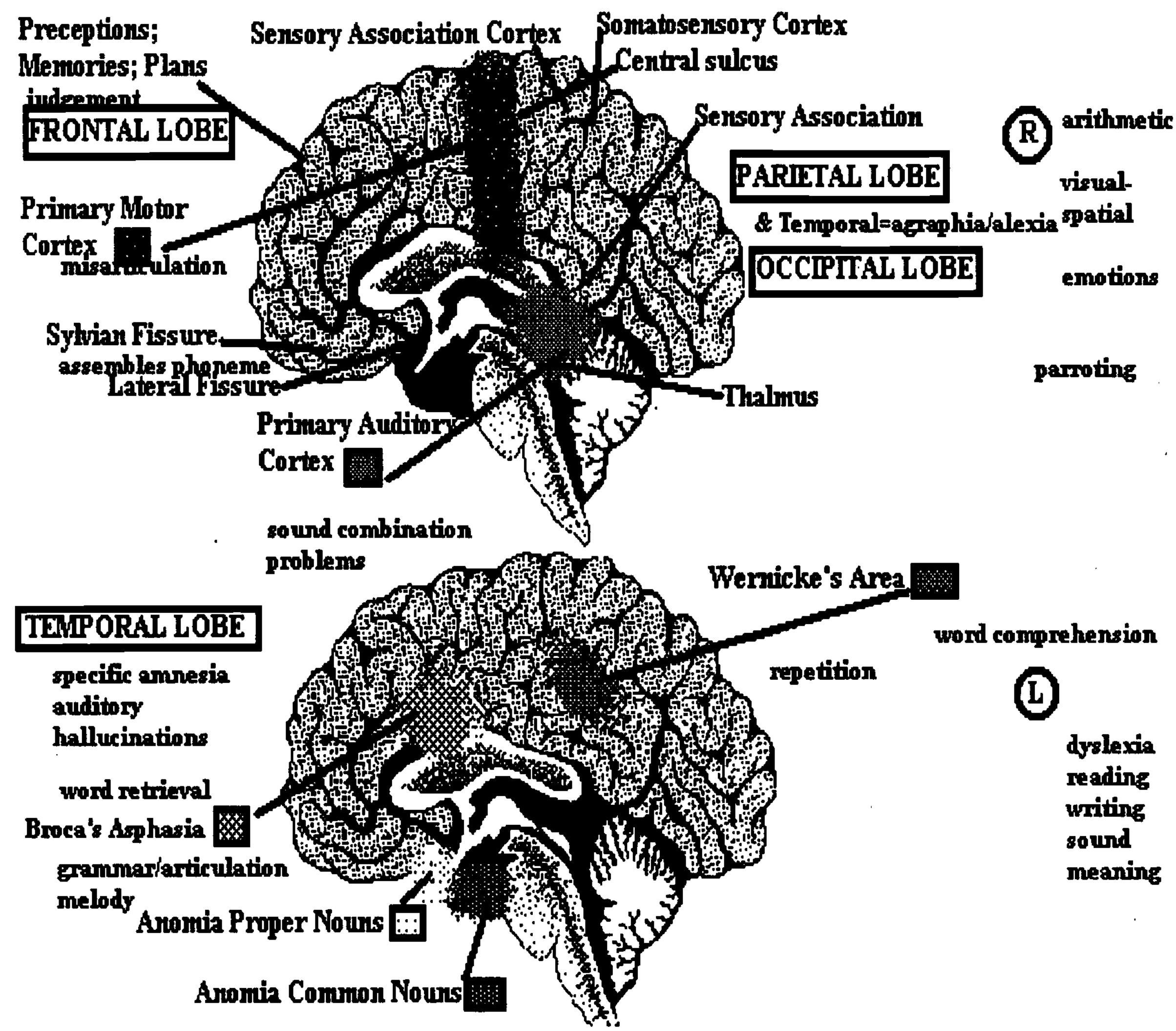
The Second Inquiry

Though a number of specific sites of brain damage have been associated with losses of specific abilities, language abilities have received extensive attention. One of the more common associated disorders within persons with profound mental retardation is the lack of verbal language or its apparent atypical development sometimes when it does exist. There appears to be a critical developmental relatedness to the automatic grammar that typical two-five year olds are able to apply in oral speech which older individuals learning a first or second language later in life are unable to so naturally obtain (e.g., Pinker, 1995). Among individuals who suffer strokes or another form of brain damage later in life there has been a number of language related disorders that have subsequently appeared and inspection of these individuals' brains has yielded considerable insight into the necessary operational segments of the brain related to specific areas of language function (Neurology of Behavior Synopsis, 1990).

Areas of the Human Brain



SPECIFIC AREAS OF INSULT



Brain lesion or damage to specific parts of the brain has been associated with difficulties in motor planning, speech, word retrieval, memory, sensory perception, and emotional state.

The brain is divided into four (plus an internal insula) lobes based on the bones that surround them, the frontal, the parietal, the occipital, and the temporal lobe. The temporal lobe has one of the lowest thresholds for seizure activity, so it wouldn't be surprising to find EEG activity within the temporal lobe among a significant portion of the population who have profound deficits and seizure disorders. Temporal lobe seizures which affect the limbic system have been associated with a mismapping of emotions with experiences because of disruption to the mechanisms coordinating emotive input in a psychiatric disorder referred to as "Temporal Lobe Syndrome." The associative meaning of words also appears to be organized within the temporal lobe.

In the middle and posterior portion of the superior temporal gyrus in the left hemisphere is an area known as Wernicke's area. Specific damage to this area is associated with poor comprehension and meaningless speech though articulation isn't flawed. Damage to a region of the inferior left frontal lobe anterior to the primary motor cortex (Broca's area) can result in the inability to speak and/or word retrieval problems, though comprehension may well be intact. Pathways connecting speech mechanisms between the frontal and temporal lobes seem to be used for meaning. A more directed pathway through the frontal lobe seems to be involved in just repeating sounds. Individuals with temporal lobe anomaly might be inclined to repeat words or phrases repetively in a parroting way, and individuals with frontal lobe anomaly might be inclined to require extensive prodding to speak a limited vocabulary, but may understand considerable more language than they can readily demonstrate. Differentiating individuals with comprehension skills but poor fluency from those with fluency but poor comprehension of language would better direct communication efforts and intervention strategies. Melodic Intonation Therapy or

Computer aided Visual Communication systems, for instance, might be indicated as useful for developing communication potential depending on specific areas of brain insult (Frumkin, et. Al, 1990). Certainly individuals with temporal lobe damage that involves the language areas may rely more heavily on tone, gestural and environmental cues than the words themselves for understanding what's being communicated to them.

The frontal lobe contains associative cortex for planning and coordinating motor movements. Dysfunction to this lobe may affect the production of language and limb movements. The parietal lobe contains the somatosensory cortex and it serves a function in determining body in space positions and integrating tactile information. The occipital lobe contains the primary visual cortex. Seizure activity can occur in one or all areas of the brain, and it can take the form of depressed or exaggerated electrical energy. The presence of seizure activity is often associated with lesions or physical damage to a specific area of the brain that disrupts typical energy flow; similarly chemical and hormonal activity alterations without physical insult may also produce seizure activity. Sometimes these abnormal charges occur in vary specific small areas of the brain and stop, but more often there is a spreading effect to these charges that encompass adjacent areas of the brain. Across years, continual seizure activity is associated with change in the involved neurons and alterations within typical brain structure. Most adults with profound mental retardation and life long seizure disorders have significant areas of brain damage. Reviewing neurological reports of EEG's serves as a probable, though imperfect map, of areas of likely brain dysfunction. A review of EEG's, will predictably provide useful insight into understanding language differences and odd behaviors within persons with profound mental retardation. Individuals whose cognitive levels exceed their speech abilities are likely to have temporal and/or frontal lobe damage. Individuals with temporal lobe seizure activity are likely to rely more on environmental cues than the words themselves to understand what is being communicated to them. Individuals with grossly generalized frontal, or frequent multi focal seizure activity are more likely to have problems with lethargy and sustaining an alert appearing posture than those with more moderate brain involvement. Frontal and parietal seizure activity is likely to predict difficulty with body in space perceptions that effect difficulty with gross body movement. Individuals with temporal lobe seizure activity are more likely to demonstrate inappropriate emotional responses than those who don't have such anomaly.

Methods

Participants

Thirty-one participants were assigned based on the availability of a recent EEG on file from a group of forty adults with profound mental retardation who were participating in one of three day habilitation or sensory stimulation programs that the experimenter provided behavioral and/or educational support services to.

Procedures

Participants were assessed by care givers and clinical teams for cognitive level utilizing the CM-NOT and for observable discrepancies in language use, emotional responses, movement patterns, and alertness using a simple check list. The latter investigation included analysis involving differentiation of language use (speech and sign), whether language was ever self initiated or not, whether the person was lethargic or demonstrated movement anxiety, and whether the person displayed emotional responses appropriate to ongoing dialogue and activity. Latest EEG's were separately reviewed and neurological reports indicating significant brain area/s of seizure activity were tabulated. Brain lobe indication of seizure activity was noted and when it was differentiated, right and left hemisphere activity, and, gross generalized or multi focal seizure activity was indicated.

CM-NOT assessments were engaged to determine sensorimotor expectation for language use. Fifteen of the nineteen individuals who demonstrated planned movement/imitation skills on the CM-NOT had been known to engage words or signs for language use. All individuals lacked the breath of language expected from sensorimotor level and only one individual had appeared to master use of appropriate tense and word ending in verbal dialogue. Neurological reports were compared to assessments to determine the frequency with which behavioral differences matched potential areas of brain dysfunction suggested by EEG's.

Behavioral Patterns Compared to EEG's

Total # Area Seizures EEG	Area of Problem	# Sharing Problem & Area
11	Temporal Lobe-Behavior or Emotional Oddity	11
4	Parietal & Frontal Lobe-Movement	2 identified/ 2 retrospect may
3	Temporal Lobe-Parrots	2/1 adds
4	Temporal & Frontal-Parrots and adds	4
4	Frontal-limited use but has initiated language use	4, maybe 5 (1 generalized)
3	Frontal-no language use but cognitive abilities	3, maybe 4 (1 generalized)
10	lethargy-multi focal spikes and generalized or frontal and generalized	8 (4-lethargy a problem with different combinations)

Subject	Place of seizure activity	Unusual Behavior
A B C D E F	Temporal Lobe Temporal Lobe Temporal Lobe Temporal Lobe Temporal Lobe Temporal Lobe	Unexplained Agitation Unexplained Agitation Unexplained Agitation Unexplained Agitation Unexplained Agitation Unexplained Agitation
G H B	Temporal & Frontal Lobe Temporal & Frontal Lobe Temporal & Frontal Lobe	Unusual laughing/Crying Unusual laughing/Crying Unusual laughing/Crying
I	Temporal, Parietal, Frontal	Unusual episodic behaviors
J	Temporal, Parietal, Frontal	Pouts and refuses meals or Smiles and is cooperative regardless to environmental events.
K L	Parietal & Frontal Lobe Parietal & Frontal Lobe	Anxiety during movement Anxiety during movement
A D	Temporal Lobe-both Temporal Lobe-right	Parrots/doesn't initiate speech Parrots/doesn't initiate speech
I C B J	Temporal & Frontal Lobe Temporal & Frontal Lobe Temporal & Frontal Lobe Temporal & Frontal Lobe	Repeats and adds to speech Repeats and adds to speech Repeats and adds to speech Repeats and initiates sign
E	Temporal-both	Repeats and adds to speech
M N O P L	Frontal Lobe & General Frontal Lobe General Frontal Lobe Frontal, Parietal, General	Initiates use of common word Initiates use of common word Initiates use of common word Initiates use of common word Initiates use of common sign
Q B I R S T U	Temporal, Frontal, General Temporal,Frontal, General Temporal, Frontal, General General Frontal & General Temporal & Frontal Temporal & Frontal	Lethargy a problem Lethargy a problem Lethargy a problem Lethargy a problem Lethargy a problem Lethargy a problem Lethargy a problem

V W	Occipital & Multifocal General & Multifocal	Lethargy a problem Lethargy a problem
K L X Y	Frontal & Parietal Lobe Frontal & Parietal Lobe Frontal Lobe Generalized	No language cognitive ability No language cognitive ability No language cognitive ability No language cognitive ability

Results

Area of seizure activity matched predicted behavioral/language dysfunction in thirty-four of forty-one cases, or 82% of the time. This suggests EEG reports may provide a useful tool for analyzing behavioral/language differences within individuals with profound mental retardation and epilepsy. Eleven of the eleven individuals with temporal lobe seizure activity demonstrated emotional/behavioral oddities. Most emotional oddities reported were mild, like laughing out loud without environmental reason, but a few involved outbursts of obscenities or serious episodic displays of rage without common environmental antecedent. Two individuals with parietal and frontal lobe seizure activity were noted to demonstrate extreme anxiety during ambulation, one darted and shoved people or things in his way and the other screamed and refused to go to unfamiliar places. Two other individuals not identified on original assessments as having movement anxiety, were in follow-up questioning thought to have some mild discomfort associated with such. Two individuals with primary temporal lobe seizure activity were assessed as having only parroting abilities for speech, a third was known to occasionally add words to phrases he heard others say. Combining commonly modeled phrases with other phrases or occasionally adding a word to common phrases was reported for five other individuals, four of them had EEG reports that noted both temporal and frontal lobe seizure activity, and the fifth had generalized seizure activity. Four of five individuals who, at least on occasion, initiated word or sign use but didn't demonstrate cognitively expected breath in language had frontal lobe seizure activity, the fifth had generalized seizure activity. Three of four individuals who demonstrated cognitive abilities beyond twelve months on the CM-NOT, who didn't use sign or a word, had frontal seizure activity. The fourth individual who didn't speak but demonstrated cognitive abilities in line with such, had generalized seizure activity. Eight of ten individuals with complex seizure disorders, either, multi focal spikes and generalized activity or frontal lobe and generalized activity demonstrated problems with lethargy. Four other individuals with different combinations were assessed as having problems with lethargy.

Discussion

This was a small population group and assessment inquiries were geared specifically to note dysfunction within the five discussed categorical areas. It is noteworthy that no individual's area of seizure activity profile appeared contrary to expected category. Identification and compensation for specific area of brain dysfunction is most possible in relation to the understanding of the general developmental state of the processing unit. The possibilities of the practical aid that an educator of persons with profound mental retardation might implement with a basic understanding of brain dysfunction are considerable. Individuals who primarily parrot language may require additional gestural and visual cues to understand communication. Individuals who have difficulty retrieving words or coordinating movements benefit from communication systems which rely less on motor articulation or complex gestures. Reassuring unrushed guidance needs to be provided for individuals during body movement whose perceptions during such are anxiety provoking. Caretakers made aware of why an individual demonstrates inappropriate affect, may themselves, better respond to unusual behavioral displays and provide positive anchoring emotional cues. The number of individuals clinical teams matched with unusual emotional displays to temporal lobe anomaly was surprising. The varied intensity suggests consideration for less remarkable subtle emotional oddities. The unusual anxiety symptoms related to the parietal and frontal lobe mix were also interesting. Greater analysis of this type of information may suggest potential for advancing understanding of mental health disorders within the general population. Individuals with complex seizure disorders and arousal problems require attention to 'behavioral state" and investigation into the ways to enhance environmental attending are needed. A broader understanding of both general developmental principles and the specific differences associated with areas of brain dysfunction between individuals has much potential to enhance educational efforts for persons with profound mental retardation. Trainer review of significant findings on EEG's for people's with severe impairments may well be another practical tool to aid in understanding and directing effective educational effort.

The Third Inquiry

Pulse Rate and Enhanced Sensorial Stimulation

An individual with profound mental retardation who rarely responds to the activities around him or her requires specialized efforts to provide sensory information that can be processed. Generally, educators for persons with profound mental retardation continue to find high stimulation environments beneficial (e.g., Belifore, et. Al., 1993). Sensory stimulation affects brain arousal and developmental framing is only useful when sensory information can be processed. Heart rate increases during arousal and measuring such provides an objective indicator for determining the degree of arousal in human beings (e.g., Johannson, et. Al., 1964). Enhancing environmental stimuli has long been considered useful for increasing active movements and alertness in infants and adults with neuromotor disabilities (e.g., Conner, et. Al., 1978). With these considerations in mind we hypothesized that in an enhanced sensory environment limited responders would demonstrate increased arousal that would be objectively measurable by increased pulse rate.

Sensorial enhancers such as visual effects projectors, color wheels, disco balls, aroma diffusers, mirror tiles, vibrating cushions, music synthesizers, etc., are useful for intensifying sensory effects. The eye's neural sensitivity to light differs (Gould, 1994) and color is what the eye sees best (Chaparro, 1993). Responses to visual stimuli and music are significant for their ability to either relax or arouse, and in most environments there exists easy access to a wide variety of music. Intensifying visual effects is a more expensive and less common practice.

The Sensory Room

Equipment to fill a small room and create a sensory domain can easily run two thousand dollars or more. It was necessary to organize day program staff to host fund raising events to help purchase the new equipment. Loud music can be disturbing to some individuals so in developing our sensory enhanced environment we chose soft music and soft scents and concentrated on intensifying visual stimulation. We purchased a solar projector, mirror sheets , a disco ball, an aroma diffuser, and a color wheel. The room was painted white. A stereo and tapes were donated.

Methods

Participants

The ten most limited responders from the thirty adults with profound mental retardation involved in a sensori-motor program that the experimenter provided support services to were prioritized for participation in this project. This group, in previous sensory inventory attended longer in seconds to a bright flashing red light (3-5 seconds) than a more subtle but more interesting tornado spiral lamp (0-2 seconds). One of these individuals' was legally blind and the others were considered to have near normal vision (though visual assessment methods were not remarkably thorough). Most program staff preferred the tornado lamp so this distinction had been noted. Few methods of increasing alertness, beyond physically touching or feeding these limited responders had been considered, on a daily basis, helpfully stimulating by programmers.

Procedures

Several weeks after the sensory room was developed and individuals had opportunities to spend novel time in the room the inquiry began. Behavioral observation and pulse rates were attained for each participant in their programming or residential areas and within the sensory room. Pulse rates were taken after participants were in each area for at least ten minutes. A wrist and fingertip pulse meter were first employed but body movements interfered with their accuracy so a nurse's aide lent instruction on taking wrist pulses to the experimenter. Each pulse rate was taken twice to confirm count from the same arm limb (deformities of limbs can alter typical pulse rates). Rates were than tallied and compared by individual and area. Program staff rechecked pulse rates and confirmed pulse rate change trends in follow-up investigation.

Results

Nine of ten individuals demonstrated increased pulse rates and increased behavioral attending in the sensory room, range of increase was 4-22 beats per minute, mean increase was more than seven beats. Three individuals demonstrated a remarkable increase in active limb movements. One individual remained lethargic and put his head down. On investigation this individual was found to have occipital lobe multi focal seizure activity. The occipital lobe relays visual information and specific sensory stimulation can be associated with invoking seizure activity. This man's behavior indicates he is probably not an appropriate candidate for enhanced visual stimulation. Overall results indicated enhancing visual stimuli appears useful for increasing alert states in individuals who attend to bright colored light.

Pulse Rate Changes in Limited Responders in Different Levels of Stimulation

Subject	Pulse-residence	Pulse-high sensory	Pulse difference
1	62	70	+8
2	56	54	-2
3	80	88	+8
4	60	62	+2
5	54	76	+22
6	62	76	+20
7	78	82	+4
8	62	68	+6
9	84	88	+4
10	52	56	+4

Discussion

This type of intensified visual stimulation (patterned colored illuminated movement) was effective in increasing alertness for most individuals who previously attended briefly (3-5 seconds) to a bright red flashing light. A similar program population assessment of visual responses may be helpful for others to employ. During this brief investigation several programming aides reported their pulse rate decreased after ten minutes in the room. Comparing the effects of pulse rates in individuals with sensory integrative problems with individuals with intact sensory systems might yield interesting results across other sensorial domains. Intensified stimulation appears important for the input and integration of sensory information in some people with profound mental retardation. Persons with psychosis or autism may well be overstimulated in such an environment because of their difficulties accommodating sensorial stimulation and caution should be employed for individuals with occipital lobe seizure activity. The speed of light movement from this projector wasn't a problem in provoking seizure activity though in previous experience high photic stimulation pulses, like strobe lights, generally need to be avoided with persons who have epilepsy. The provision of enhanced stimulation for infants who are low responders might affect developmental course and such a longitudinal query would serve significant information in understanding the remedial potential of sensory enhancement for serving persons with difficulty in receiving and integrating sensorial input. Educational efforts for persons with profound mental retardation are likely to be enhanced with greater understanding of neurological integration and information processing abilities and further investigation along these lines will likely aid in the establishment of longitudinally progressive practices.

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