Sensory Aspects of Neurodevelopmental Disorders

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Learning Outcomes:
1. Describe the differences between the serial image of sensory input and multi-dimensional inputs.
2. List at least two ways that normal infants demonstrate the ability to shift from one sensory mode to another.
3. Describe two ways in which the therapist can utilize rhythm and timing of movement to achieve a desired response.
4. List at least 4 ways that the concepts in this article can lead to more effective treatment for persons with neurodevelopmental disorders.

Cerebral palsy is a sensory-motor disorder that disrupts the normal postural reflex mechanism and alters the input from sensory systems. A hyphen is often used between the words sensory and motor to emphasize the dynamic interaction between these two aspects of the central nervous system. Dr. J. C. Moore suggests that therapists amend the term to "sensory-motor-sensory" disorder to more accurately reflect the observed responses of these children. This orientation places more emphasis on the complex feed forward and feedback mechanisms at the level of the midbrain that permit control of posture and movement. In order to suggest an even stronger description for a dynamic and inseparable interaction we will use a single word, sensorimotor, to describe the difficulties and the corresponding action of the central nervous system.

In our most limited consideration of the phenomenon of "sensation", we focus on the neurologist's pin-prick test to know whether there is gross responsiveness of the skin area in question. We speak of the "sensory systems" and think of vision, hearing and a sense of smell to investigate our world. As therapists we are keenly aware of the vestibular, kinesthetic and tactile senses that permit us to reach the central nervous system and influence its output.

One of the most important aspects of sensation when working with neuromotor conditions is the interaction within proprioception, between firm pressure and vestibular input. That interaction permits the righting reactions, which rely on deep pressure receptors, to establish a relationship with the equilibrium reactions that depend on visual and vestibular information to control the position of the body in space.

Pain is also an aspect of sensation and represents an area in which more specific research has been done. Findings in that area have stressed the variability – the individuality of pain perception. Thresholds for pain will vary with the changing state of the organism as well as experiential memories. The sensation of pain is subject to individual interpretation and is a very personal somatic experience. We can apply most of these statements to individual responses to physical treatment as well.

In the development of the infant, the various forms of sensory information are mutually reinforcing. The normal baby of eight to twelve months demonstrates well the rapid shifts in posture that result from the various sensory messages that are processed simultaneously by the central nervous system. In a fraction of a second a familiar sound causes a change of direction, a reach into space results in overbalancing and culminates in the use of a support reaction.

The traditional "senses" of vision, hearing and touch help establish postural reactions as they motivate exploration of the environment. The eyes suddenly focus on an interesting object while the body is moving to cross an open space. The visual fixation contributes to a stable posture of the head and body while the new object is examined. This ability of the normal infant to cease moving and stabilize in an anti-gravity position creates a secure postural base for the eyes to function appropriately. The vestibular system is optimally aligned when the face is perpendicular to the base of support, and the equilibrium reactions attempt to preserve this vertical alignment. Again, the systems are mutually reinforcing each other. A novel environmental sound will also pause the body reactions and postural change temporarily. Movement is generally resumed after the sound is identified or seems to blend into the environment. The system thus accommodates to changing events.

The infant uses touch to understand relationships, object size and textures. Information is gathered not only through manual exploration but also through oral exploration and the close integration of manual with oral. From the early months of life the infant moves the hand as he visually examines an interesting object or contrasting pattern. Gradually the eyes learn about the object, and the ability to reach and touch permits a tactile "knowing" as well. This is the beginning of a "matching" process that encourages one system to confirm the impressions of another system. The hands do their own investigation of clothing and nearby objects and the eyes may provide secondary information that describes items already known to the other senses. The individual baby demonstrates distinct preferences in sensory input and priorities in its organization.

In these examples of developmentally important sensory function, the common factor is the ability of the system to shift from one sensory mode to another, while maintaining the focus of attention on an environmental learning process. The way in which the incoming information is processed automatically by the central nervous system frees the cognition to create perceptions and make sense of related information. Priorities are established as to the most important input for the present moment. This adaptability is closely related to the ability to attend to a selected activity. The random perceptions of the environment are useful to the learning process only when meaning is assigned to them by the child's brain processing.

Dr. Richard Restak (author, The Brain, the Last Frontier) has given us an image of the central nervous system that makes it easier to visualize this four or five dimensional process, which makes timing as well as clusters of input extremely important. He has offered us an alternative to the serial image of sensory input once put forth. The old sequential model was inappropriate for us to apply to the experience of direct treatment handling of children or adults with neuromotor disorders. That idea of sensation as a particular isolated experience processed by the central nervous system as a part of a sequence of messages can now be replaced by Restak's analysis of brain function. He has presented us with a model of the brain that deals simultaneously with multi-dimensional inputs. In this model a crucial feature is the timing of the inputs as well as the exact combinations that form the resulting hologram.

This perspective is congruent to the analysis of the moving human body developed by the Bobaths when faced with the complexities of cerebral palsy and its effect on the body. It also confirms the impressions we have gathered from the multitudinous inter-connections present in the midbrain and brain stem.

This brain model also fits more logically the audio-visual world that we have created for ourselves. Many of us have difficulty viewing a silent movie or concentrating for long periods of time on a taped lecture, which requires us to focus on a single sense avenue. Our concentration might be better had we grown up in the generation who knew radio sets as the only "mass communication". As important as it is for us to have visually pleasing objects in our environment, we look for a tactile appeal and physical comfort as well. Dolls are seldom popular with children unless they make a nice sound when you hug them, or push their button to talk. Now dolls even respond to the child's voice and learn vocabulary sequences over time. Play is a preparation for adult function within the society. Children are now more oriented to being entertained by a variety of electronic resources.

So, our created environment reflects the significance of combining input from the various sensory systems, while recognizing the intimate link between the leading visual system and resulting postural change. There is an emphasis on sensory system interaction, which integrates the various sources of information to create a sensory gestalt. The whole becomes more than the sum of its parts.

Closely linked with sensation, by means of the proximity of the limbic system, is behavior. A child during therapy may be observed to move from laughter to tears and again to laughter. This expression occurs at times like a release phenomenon that reflects the state of the central nervous system. It is also linked to fascia or tissue memory. An activity that appears to be very difficult may be exactly what the child requests to repeat. This is the integrating effect of moving to new learning experiences in order to perfect previous accomplishments. Simple weight-bearing over a previously unused side may be perceived as "painful". One fourteen year old girl, standing alone for the first time with a midline orientation, described the sensation as "weird".

Utilizing this sensation/behavior connection to address the problem of posture and movement in children with cerebral palsy, Dr. Karel and Mrs. Berta Bobath impressed us with the need to see the whole body simultaneously and to notice how the inter-relationships are constantly changing. There are specific combinations of movement that we try to elicit, such as those expressed by the normal righting reactions. We know that it is not sufficient to move a single limb in isolation or to practice one posture or movement in isolation because it needs to be perfected. By speaking and relating to the sensorimotor language of the central nervous system, we ask that the system process a precise combination of inputs that will result in the maintenance of a new body posture against gravity. We offer different "clusters" of the same information to permit the system to develop or to re-organize its basis for a particular movement response.

In the disordered system, a predictable combination of abnormal inputs is also trying to establish itself. Reflexive patterns of movement are non-functional and fail to maintain the body in a secure anti-gravity position. Their presence and repeated activation are creating the postural characteristics that we observe in children with cerebral palsy. Without intervention these abnormal patterns solidify into contractures and deformities. However, even this uninterrupted pattern of abnormality comes about through a combination of predictable clusters of input over a period of time. Changing the input helps to prevent abnormal movement patterns by re-directing the active motor learning of the individual. Learning is a constant, in abnormal as well as normal circumstances.

In the condition of cerebral palsy we are faced with a disordered system, an immature system, and/or a system that has built a repertoire of abnormal experiences. Why has this happened? One reason is that the child's central nervous system has lacked normal experiences or normal sensations. We might say that there have not been enough simultaneous normal inputs to form the normal hologram. There would then be no solid basis for repetition or learning.

All therapists know of clinical examples where a child or adult with a neuromotor disorder has suddenly, when we have been able to therapeutically manipulate enough factors, taken over a normal physical control. Initially, the maintenance of that control is a difficult task, but we have found that Berta Bobath's ideas of working through a wide variety of situations to obtain a response does succeed. We have seen normal responses initiated only to succumb to abnormal interference. Looking at the situation from this viewpoint, our resource of "tapping" to alter tone distribution and our keen awareness of shifting the body weight appropriately permits us to configure the sensory gestalt needed by that system at that moment. We are giving the system the combination of inputs necessary to elicit the desired response.

For a moment we will analyze the pattern of our successful intervention, for it has been demonstrated repeatedly in individual cases that the therapy approach we are using has a more than adequate rate of success. We are utilizing weight-bearing to normalize postural tone while requiring an active movement response to align the body in space.

We combine the proprioceptive, kinesthetic and vestibular messages in a combination that is meaningful for motor learning. The input suggests that the body control its position in the anti-gravity posture and simultaneously introduces a sufficient number of clues to form the holographic message. We often emphasize the proprioceptive message of normal weight-bearing with additional deep pressure "tapping" or lighten the weight of a limb by positioning it away from the influence of gravity. We focus on the development of dissociated or differentiated movement that permits functional use of the extremities while the central body maintains postural control. How can we expand on this message to the central nervous system? Is there a developmental sequence that is characteristic of normal movement? Of course we must answer in the affirmative.

The seven-month infant is just beginning to experiment with weight shifts on his hands and knees. He moves forward and back in a rocking motion. He most often moves quickly and may succeed in completing two or three complete transitions; then he suddenly collapses. If he collapses forward on his chest, his little legs lift and extend in a single adjustment. He may decide to resume the activity by flexing the knees under his body or a toy may distract him. He responds at other times with a somewhat exaggerated extension of the trunk or pushes his toes against the surface to once again lift his pelvis. He may raise his chest and head with the strength of his arms or pivot to one side to find something new.In any event, the initial experience is characterized by a sudden reversal in direction and abrupt transition from intense activity to momentary rest in collapse.

There are many options for a normal response, always being combined in new and different ways. The elaboration of these choices gradually builds the coordinated repertoire available to the normal child and adult. It is not only the initial movement that is important. The centrally coordinated recovery from collapse requires an integrated mechanism for postural control that affects the total body simultaneously. Concern for the quality of an expressed movement in the disordered system may cause us to over-assist every movement. There is also a danger of isolating the movement of a limb rather than working for a more complex motor response of the body. Initiation by the child or adult should be assisted only as necessary by the therapist. Otherwise we interfere with experiential hologram of input that is closest to the normal one.

We must also avoid allowing the initiated movement to deteriorate in quality to a point that new learning is less than random. We want the resulting movement to be initiated later in the moment that it is needed for recovery from a loss of balance or to complete a functional task.

Is there a parallel development of the ability of the system to process sensory together with motor messages? We must also answer this in the affirmative. Are not the movement patterns just described inextricably entwined with the sensory input and the sensory feedback that acts as their source? The system is gradually accepting more and more complex clusters of information.The baby can hold a toy securely while turning to investigate a sound and later can walk while carrying an object. Dissociated movement and postural control is not merely a physical experience but also reflects the ability of the system to process simultaneously contrasting messages of stability and mobility.

What other sensations contribute to the more normal postural control combined with fluid movement responses? Rhythm and timing of movement are characteristic of individual adults and are also observed to follow a developmental pattern. The preschool child seldom walks when he can run, hop or skip. His system is attuned to movement. This is the first language that he uses to interact with the world. He looks for a reason to move. It feels good to combine the sensations that are a part of his primary system for exploration of the environment. The baby shifts his weight laterally from one foot to the other as he holds on to the crib rail and the toddler jumps, turns and runs when excited. Children continue to look for this combination of visual, vestibular and tactile input in playground equipment and riding toys that can stop and go.

Dr. Julio de Quirós and Dr. Jean Ayres focused much of their professional effort on determining how the proprioceptive and vestibular systems integrate and also specialize their respective functions. Dr. de Quirós was able to evaluate the sophistication of a child's transition from reliance on the proprioceptive system to active use of the vestibular system by use of a specially designed wide balance board. The surface appears continuous but actually changes midway in its length from a wood substructure to the tightly stretched fabric surface alone. At that midway transition point the child's adaptation behavior is easily observed. The reliance on firm pressure information must give way to a momentary vestibular dominance to maintain equilibrium.

It is important to review the developmental rhythm that we can offer the child under our hands as another aspect of the normal experience. Commonly in therapy we are moving the child's central body in one way or another over the limbs, most often to reduce tone and to introduce changes in rhythm. In addition we can observe carefully the range and quality of movement tolerated by the individual child in a functional situation. Sometimes we are able to change our input in one plane of movement, while alteration of the pattern in another plane causes a tone increase or the activation of an abnormal reflexive pattern. The organism seems to tell us that it is overwhelmed by that particular combination and wants to take refuge in the old, the familiar and the abnormal.

At times it is necessary and helpful to work through the changes of timing while specifically inhibiting the abnormal response. One may, for example, increase speed with maximal inhibition of an unwanted aspect of the response, and then reduce external control for the client to handle the average speed of the movement while avoiding activation of the abnormal component. With this experience we let the individual absorb the sensation of going beyond his range of control within the safety of our inhibition. Fear of the unknown is diminished and the sensory threshold is changed with the experience.

Contrasts in sensory input can also be introduced. For example, gentle moving of the arm in the air may be suddenly interrupted by firm support against the surface. The support placement may be repeated several times before the more general movement pattern is resumed. This type of experience permits the child's system to absorb a more complex constellation of sensory input as preparation for the eventual independent movement output. The system that is unable to tolerate the sensory aspect of the experience being introduced by the therapist will not tend to initiate the accompanying movement. The reason is that the same combination of sensory inputs will occur as feedback during that self-initiated movement and the system is not prepared to cope with the feedback that is generated.

As part of the preparation necessary for functional anti-gravity ambulation, we may facilitate a step or a particular reaction necessary to maintain the upright position. Here again, the smoothness of our facilitation may be successful within the treatment session, without necessarily leading to the use of the same response outside the therapy setting. When working at this level, it is often helpful to repeat the response, change the speed or even permit some of the abnormal distractions to come through so that the client receives the feeling of the control needed. A mental image of the sensations associated with perfectly controlled walking may not be consistent with the patient's need to initiate the step from a more familiar but inadequate base. Distorted visual input may alter the individual perception of available space. It can happen that with individual patients or clients we are not synchronizing our input with the specific needs of their system. We may fail to analyze correctly their starting point or their individual strengths and thus offer excessive support or control.

A sensory intolerance for the repetition of a particular postural response may prevent the person from initiating the first action of sequential movement. If there is a concomitant retrieval of a stored memory of an impending abnormal response, the system is likely to reject the initiation of the particular activity. The entire organism tends to halt action, and then take refuge in the old familiar pattern, which is likely to be the abnormal one. By merely imposing the free movement of a limb with changing velocity while the individual maintains a given posture, we facilitate better central stability. We also give that person the security to experiment with the sensation of free movement. To know the sensation accompanying the action is to have confidence to initiate that action.

For the child bound by spasticity or high tone, effortless movement is not necessarily a joy and it does not bring immediate awareness of how to process the accompanying sensation. The tremendous contrast between the past experience and the new sensations that we offer during treatment may initially elicit a fear reaction. Moving away from the excessive stability of spasticity is a fear-provoking experience. The organism feels itself to be in danger. The system is not accustomed to the complexity of the input that enters simultaneously. One eight-year-old, after experiencing a significant decrease in postural tone while over the ball expressed his reaction: "My arms are falling off – are you going to put them back?" How drastic this type of perceived contrast can be when we are helping a child toward what we see as a "more normal sensation, and a more normal distribution of postural tone."

A five-year-old child who had been diagnosed in one setting as psychotic and in another as a perceptually disordered child reacted to light contact of the therapist's hand to guide lateral displacement of his body with, "Take me out of here. They have nails in their hands." Working slowly and carefully to change this child's sensory threshold and helping him to experience a midline orientation and greater differentiation in his sensory awareness resulted in this same boy accommodating himself to a normal school setting six months later. When told that he was to return to the therapy setting for a check-up, he told his mother, "I'm sure glad those people gave me a new body. The old one bothered me very much." An experience such as that assures us that sensory change is pervasive – and that we cannot think of separating behavioral responses from the subjective somato-sensory experience.

Most often the child's reactions are not so clearly articulated and we have to "read the behavior" of the child to tell us something about the internal reactions that might be occurring. This is a moment when it is helpful to be able to differentiate various types of crying reactions. There is a cry of panic that tells us that the system is going out of control. This may also carry a touch of anger because of our involvement in bringing that feeling about. The emotional reaction may be modified by physically supporting the child's body, and stopping the irrelevant movement temporarily while the child adjusts his posture. Abandoning the postural control before adaptation occurs may result in an over-reaction and a resistance to return to the position. Often children who have a very sensitive vestibular system react in this way and the panic response can build very quickly. It diminishes just as quickly when the therapist remains calm and introduces the same movements interspersed with a holding of the posture.

To a large extent this is what happens with placing reactions. We are offering a stimulus followed by some time for the system to assimilate. We might refer to this as an intermittent sensory input – much as we think of intermittent physical support.

At times the child may appear to enjoy a movement, but start weeping spontaneously. When the therapist stops the activity, the child may request to continue. That type of response seems to occur as a release from the internal tension of the system. There is a somewhat approach/avoidance reaction. Overcoming this barrier frees the child to go on with a new level of experience. It is important that the therapist acts as a partner with good reading of behavioral clues. This type of reaction may occur mildly in some children as a labile response that seems out of character for the particular child. The emotional component is seldom repeated for exactly the same activity, as active adaptation occurs in response to the sensory input.

Do we always have tears as an adaptive feature of the system? No, this is not the only associated emotional release. Sometimes the response is a silly type of laughter, characteristic of a group of six or seven-year-old girls getting together on the steps of a school. This reaction often accompanies vestibular activity. We have had the experience of a seven-year-old quadriplegic girl able for the first time to initiate and control a really free dissociated rolling on the mat. She laughed and giggled and continued rolling – while her mother tried in vain to have her start to the car with her walker.

It is important to clarify what we mean by vestibular activity or facilitation of a vestibular response. This is not a large displacement of the entire body through the air, but rather a subtle intermittent support of the head to stimulate independent control of righting responses, or the movement of the body over the ball as we are giving some approximation to the hip in preparation for standing. Much of our therapeutic handling activates the vestibular system and this reinforces postural alignment. Movement of the shoulders with the head supported on a small roll can also stimulate a vestibular response through the neck receptors.

Vestibular activity provides strong reinforcement of postural tone distribution and can readily reinforce abnormal patterns when the body position is not controlled appropriately. This means that the same vestibular activation can be activated to reinforce carefully controlled positioning of body parts for functional postural control.

Often the emotional expression that we are discussing comes in the moment when we feel no resistance from unwanted tonus. There is a momentary freedom from the constriction of spasticity. Might this be the moment in which the message has been able to get through clearly, without interference? Is there a release of fascial restrictions and an associated emotional liberation? By organizing the conditions necessary for a more normal response, are we forcing a concomitant timing of the various systems? Is this multi-dimensional timing essential for the system to take over true control of the postural reactions or to guide accurately a graded flow of movement?

Normal movement is not only the interaction of certain muscle groups, but also the interaction of specific proprioceptive and vestibular messages received by the central nervous system from joints and the soft tissues. Thomas Myers, author of Anatomy Trains, has done an extraordinary job of presenting the complexity of myofascial meridians in a clearly articulated manner. Many of our movement goals for persons with neuromotor disorders are better understood by analyzing the fascial system influences rather than just the muscle connections and directional pulls. In therapy we work for the control of a combination of circumstances that prepare for better movement control. We may want to obtain weight-bearing over the knees while the hips extend actively. However, we may be suggesting this "heretical idea" to a system that has always focused on hip flexion and has rarely, if ever, sustained weight on the knees. In another instance, we are seeking a free movement of one lower extremity, but only after the body weight has been shifted to the opposite lower extremity. When we facilitate a support reaction it is necessary for the individual to control the extension of the limb during the establishment of contact with the surface. These combinations of alignments, weight changes and sequenced movement patterns represent new clusters of information for sensorimotor learning.

I have emphasized the simultaneity and ordering of the responses for a reason. One of the specific features of neurodevelopmental treatment is the space/time component. Perhaps our intervention is forcing an inner control of the timing of sensory reception. Possibly we are saying to a system in disarray, "You must attend to this factor first and not that one." Priorities in processing and critical combinations need to be established. The cluster of sensory messages must have a coherent pattern that can stimulate more normal output. This gives support to the concept that Mrs. Bobath expressed so beautifully when she said that these children have to "know the feeling" of normal movement. The sensory experience serves to organize the new motor patterns in a functional context.

The therapy environment is generally full of features important to the sensory system. We take into account the characteristics of the surface on which we choose to work. We know that a firm surface for some children will increase the strength of their abnormal movement patterns, while for others it will offer better organization of their emerging postural control. The amount of padding in a chair may determine the success of the child in attending to his schoolwork while maintaining a seated position. Even the air pressure in the ball or roll can influence the child's success in making a functional adaptation.

There are times when a particular child fails miserably in coming off a ball to a standing position on a comfortable mat, yet he is successful on the first try when the surface under his feet is a firm tile floor. Here we can understand the subjective sensory experience if we imagine the activity in slow motion. As the foot approaches the giving, softer surface, it must initially make a contact that is received as a light touch. This results in the immediate withdrawal of the foot, before experiencing the firm pressure of weight-bearing. The firm, consistent surface permits the proprioceptive input to dominate the experience. Proprioception in the form of firm consistent pressure offers security rather than stimulating a withdrawal reaction as light touch often does.

The conflict within the sensory system of the cerebral palsied child is particularly evident in the hands. There is often difficulty in sustaining voluntary grasp. Light touch in the palm of the spastic child can increase the retraction of the entire arm at the shoulder, rendering the hand quite useless from a functional point of view. The insertion of even two fingers of the adult against the palm while moving the child will result in a more relaxed hand and one that will gradually open of its own accord. Weight-bearing on the heel of the hand has a very strong effect on tonus distribution, without the need to have the fingers entirely open initially. The shoulder girdle often needs physical facilitation to move over the controlled hand or forearm placement. Voluntary opening and controlled grasp may occur spontaneously after using the arms for support. Again it is an issue of preparing the proximal body for the posture and preparing the sensory system for the next developmental experience. Behavior is but a reflection of the state of the central nervous system. Where does the child with cerebral palsy have the greatest difficulty?

There is usually an inability to reconcile the expression of excitement, anxiety or any other normal emotion-filled reaction of childhood with coordinated movement and postural control. The attempt to carry something while using a precarious balance for walking is frequently interrupted by a fall. The very thought of a favorite grandparent making an appearance can interfere with coordinated activity for a day or two in advance. The central system is unable to reconcile the emotional messages with the sensory input needed for posture and movement control.

There is a difficulty in dampening down the system or using the systemic inhibition to grade a response of any type. Particularly in the athetoid condition we can see how the inability to consistently control the physical body relates directly to the sensory system and to the emotional response. The state of over-excitation is a sensory condition that the system is unable to solve.

We do note significant alteration in emotional control as the physical body becomes more predictable. To know our own body and to have a measure of control over it gives us the possibility of directing our innate energy outward to our environment. As we begin to relate to our environment we are also expressing the readiness of our system to accept more complex input. Our awareness has expanded. We seek what our system needs, and it needs sensory nourishment as surely as it needs physical sustenance and emotional support.

As we discuss and think through these various aspects of sensation and our experience with it, we enlarge our view of sensation and the functional aspect of the sensorimotor system. We have looked at some of the ways that somatosensory experiences are described by the children with whom we work. We have examined some of the complex relationships between the sensory world of the individual system and its behavioral expression. How does all this affect our primary interest of more effective treatment for persons with neurodevelopmental disorders?

First, it gives us a means by which we can further explore in an articulate way some of the input that many clinicians use intuitively as they observe carefully the reactions of their client. There are terms that we all use in practice and in teaching that refer to varying combinations of messages given to the sensory system. We have so integrated these terms and the concepts they represent into our treatment that we may no longer acknowledge the unique characteristics of each. By exploring them more closely, we have an opportunity to make the language of our messages more precise. We have a sensory vocabulary with which we can explore our own work, monitor cause and effect, and differentiate therapeutic factors more specifically among ourselves.

Second, it offers us as therapists an almost unlimited means of enhancing the experience that we offer the patient or client. It gives us the language that the system understands and forces us to think in multi-dimensional rather than sequential terms when planning treatment experiences. This will increase our effectiveness immensely. By embracing a more complex concept of sensory processing, myriad numbers of new possibilities emerge from the diversification and recombination of defined sensory inputs. With a more precise language, we are able to think more specifically about what we are doing and how to improve it.

Third, it offers another support for the concept of early treatment intervention. By treating early we are not only avoiding the infant's learning of unwanted, ineffective or abnormal patterns, but we are giving him a means of learning how to learn. If our system is a multi-dimensional system that thrives on varying input entering simultaneously from different subsystems, it seems logical and reasonable that it would not develop well by feeding on rather dull, predictable and repetitious patterns. In such a circumstance, there is a major breakdown in the inner communication system. Like a motor that is racing without a transmission to support it, the body tries to respond initially, only to have the energy re-routed into meaningless and inefficient motor expression. Without the key to future sensorimotor learning the infant is also blocked in his or her investigation of the world.

Fourth, it offers us a direction in which to move to substantiate our treatment effectiveness. We are unlikely to develop an "objective" way of measuring physical change, for many have tried it before us, but we have the possibility of documenting a changing response to the same structured constellation of sensory messages to demonstrate the maturing sophistication of the central nervous system at the processing level. This data would support therapy intervention as an ordered preplanned sequence of inputs that result in more functional responses in the child.

As therapists we have the additional challenge of knowing our own sensorimotor system and our habitual style of processing incoming information. We must acknowledge our biases in our way of using our own body to communicate with our client. It is important to analyze the personalized expectations that we project onto others and match them with the needs and abilities of our client.

We then have a s tronger base from which to determine the starting point for our interaction. With experience we are able to project the treatment path likely to be needed by an individual in order to be able to take over the postural control necessary for independent function. The sensory aspects of neurodevelopmental disorders are there for our exploration. They raise many questions as we observe individual clinical responses to direct handling and this opens a fertile field of investigation.

Emerging understanding of motor control and the important network of fascia give us new ideas and have extended our appreciation of the daily somatic experience of children with neurodevelopmental problems. It may also give us some new insights as to how we might make more specific our teaching and attempted research. The very fact that we are attempting to improve the functioning of a very complex and adaptable system gives us ever more avenues through which we can make positive change.

The following are the CEU Exam questions for this article. For ease of completion select your answers before clicking on Take Exam.

Sensory Aspects of Neurodevelopmental Disorders
CEU Verification Exam

1. The term sensorimotor describes the intricate interaction between the postural system and the sensory systems.
a. True
b. False

2. The old serial image of sensory input was the idea that a particular isolated experience processed by the CNS as part of a sequence of messages.
a. True
b. False

3. Restak's analysis of brain function presents us with a model of the brain that deals simultaneously with multi-dimensional inputs.
a. True
b. False

4. Our created environment underlines the importance of focusing on one sensory function at a time.
a. True
b. False

5. Dr. Karl and Berta Bobath stressed:
a. moving a single limb in isolation.
b. practicing and perfecting one posture in isolation.
c. offering a cluster of inputs that result in a new posture.
d. encouraging reflexive patterns of movement.

6. To give the system the combination of inputs necessary to elicit the desired response, the therapist could:
a. “tap” to alter tone distribution.
b. shift the body weight appropriately.
c. none of the above.
d. both a & b

7. A successful intervention utilizes weight bearing to normalize postural tone while requiring an active movement response to align the body in space.
a. True
b. False

8. Rhythm and timing are sensations that contribute to the more normal postural control combined with fluid movement responses.
a. True
b. False

9. It is necessary to analyze the fascial system influences as well as the muscle connections and directional pulls.
a. True
b. False

10. When the cluster of sensory messages have a coherent pattern, new motor patterns can be organized in a functional context.
a. True
b. False