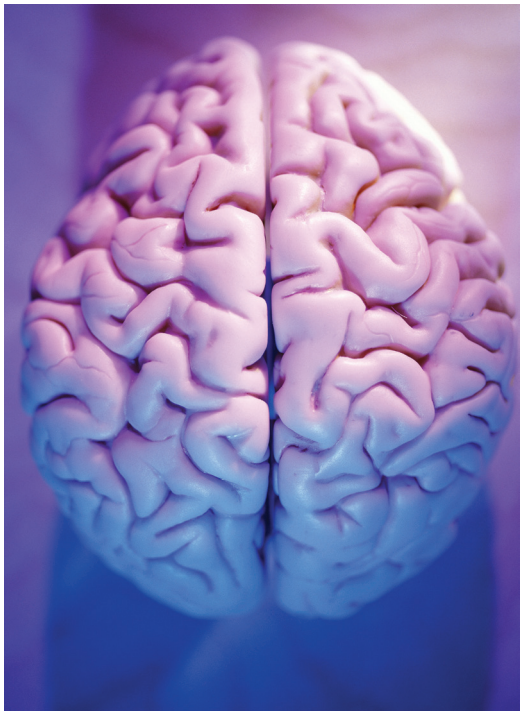
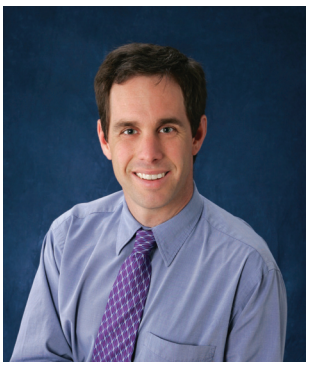
# NEUROLOGICAL REORGANIZATION FOR BRAIN INJURY:

## The relationship of structure and function with therapeutic applications



By Sargent L. Goodchild, Jr.



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I am the oldest of three children, but I was not my mother's first child. My mother had a history of miscarriages. My birth was difficult. I had the umbilical cord wrapped around my neck leading to an unknown degree of oxygen starvation. The doctors in the room looked concerned, so she asked, "Is he okay?" Their answer: "We will not be able to tell you until he is about 4 years old, Mrs. Goodchild."

*Some are born great, some achieve greatness, and some have greatness thrust upon them. Shakespeare.*

Each of us can reflect on the moments of our lives and recognize those that helped define the adults we would grow into. In my case, there are those I can remember and those which have been passed down to me through conversations with my parents. Many of my formative years were spent heavily medicated for epilepsy, so my strongest recollections regard schoolyard bullying, teasing, embarrassing drooling, and seizures that caused me to lose all bodily control.

In my first years, my parents' friends would remark about how well behaved I was. It was not until I was 3 years old when my sister came along that my parents became concerned. Now there was a typically developing child to compare me against. What had been characterized as admirable behavior now became a point of concern. Before I turned 5 years old, I had a baby brother and a diagnosis.

*Never allow someone's opinion of you to become your reality. Les Brown.*

In addition to epilepsy, my parents were told I had mental retardation and autism. The best answer coming from the medical community was various cocktails of medications prescribed in a futile attempt to control my seizures. The only way to even partially control my seizures was to maintain medication levels so toxic that my gums were too inflamed to allow my teeth to come through and my eyes were nearly swollen shut (see photo of me at 8 years old on page 75). During this same period, an appropriate educational setting for someone with my level of disability was sitting in the back of a classroom in an individual study carrel such as might be found in a public library. I could not see the teacher, my peers, or the blackboard. Eventually, it was suggested I be placed in an institution so my parents could focus their energy on my healthy brother and sister. Fortunately, my parents were able to find a solution by turning outside of modern medicine.

As parents, we can watch our children develop and see glimmers of the adults they will become. At a time when parents of children with conditions like mine were given very little hope, my parents made a courageous choice. I am grateful to both of them for having hooked onto the moments in which I demonstrated the greatness within me rather than the prognosis of many of the most prestigious medical institutions of Boston. They facilitated the healing of both my mind and body through the process of neurological reorganization as learned from Arthur Sandler, PT, of Sandler-Brown Rehabilitation Consultants in Pennsylvania.

While the medical doctors at Children's Hospital of Boston were busy treating my

symptoms, Art Sandler offered a fresh perspective on my problems. He made the simple statement that I had a brain injury which was the root cause of all my symptoms: an injury I most likely suffered due to oxygen deprivation at birth. It has long been my belief this initial insult was compounded by each additional vaccine I received. Art went on to say my brain must be the focus of a treatment plan rather than the symptoms of that injury. Art was suggesting that my brain was endowed with a natural plasticity and had the potential for healing. I was 8 years old.

The idea of neural plasticity was a brave suggestion back in the 1970s, but it has gained tremendous ground in the last decade. Jon Kass, a professor of psychology at Vanderbilt University in a *Boston Globe* article commented on the brain's plasticity: "It will push people back toward more consideration of environmental factors in creating normal brain organization."[1] In the same article, other researchers said, "the results challenge current thinking by showing how powerfully information from the environment can override the effects of genes in shaping the brain as it develops."[2] In an earlier article, scientists at the University of Illinois said, "it is clear the adult brain continues to be modified structurally and functionally by experience."[3] If the adult brain can be modified by experience does this stand true for the brain of a child with autism, too? Yes! Absolutely, but it is a two-way street.

While admittedly simplistic, in some ways children are similar to computers. Babies are born with an innate set of instructions that develop in a self-sustaining process and create neurological and anatomical growth, much like a computer bootstraps.[4] A computer sequentially loads programs that allow it to run its operating software. The difference for a child is they create a healthy nervous system and physical body through graduated perceptual-motor activity. In other words, children go through a process of purposeful movement and interaction with their surrounding environment that modifies the brain and body each functionally and structurally. Of course, if something goes astray during a child's progression through these movements, it can cause problems that require a much more sophisticated reboot.

***No man exists who was not made by the child he once was. Maria Montessori.***

Genetics gives us our options; experience determines which road we take. For the development of proper physical and neurological health, we must consider what type of experience is the most important. Developmental milestones that are part of the shared human experience are recognized as being very important. We celebrate when our children learn how to roll over, tummy crawl, creep on hands and knees, balance on two feet, walk, run, and skip because we innately recognize their importance. What is not as well known is the vital role each skill has in helping the emergence of higher functioning brain levels. If a child is prevented from acquiring these specific developmental milestones with full sophistication and in the proper sequence, it can not only prevent healthy brain development but also lead to conditions as varied as attachment and bonding disorders, autism spectrum disorders, epilepsy, dyslexia, behavioral problems, and learning disabilities. Implicitly, we probably understand this too, which is why it can be so gut-wrenching to watch a child struggle with these and other milestones. Fortunately, because these skills are acquired, they can also be taught. In fact, experience shows if you can create healthy movement at an early developmental stage you will help to create proper brain health at the correlating brain level.

More often than not, the specific skills focused on in intervention are guided by which ones seem to be missing in the [child] relative to the expected age (a deficit orientation).[5] This is the practice of facilitating the skills of a similarly aged typical child in a child with autism or other disability. The problem is that rather than seeing the correlation between an aberrant movement pattern and a neurological deficit, the movement problem is viewed as a separate output problem. Some unfortunate things can result; the child can be separately taught individual skills at a great cost both financially and in terms of time spent, the root cause of the child's behavior may have been hidden by emergent and compensating behavior, and the child's skills are not being framed in a way that promotes self-initiated learning. If we want to understand why a child is struggling, we must look at their entire developmental history and determine where she got off track and perhaps why.

Every child with autism is unique in ways that will dictate which therapies will facilitate healing and when to employ them. The causal factors in an individual child are challenging to determine, but in general can be broken down into three categories. There are the chemical/nutritional factors, such as overgrowth of yeast, food intolerances, heavy metal toxicity, oxidative stress, inflammation, viruses, and environmental triggers. There are the physical factors such as imbalances in the cranial bones, subluxations in the spine or other muscular-skeletal problems. Of course, there can also be emotional factors caused by traumas. However, no matter what the causal factors, children with autism have their typical developmental motor experience altered

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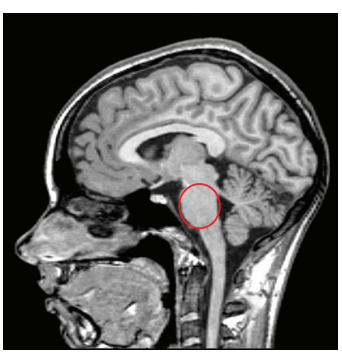
by one or more of these factors and develop a movement disorder with perceptual and cognitive consequences.

For the child with an autism spectrum disorder, aberrant movement patterns can be seen in the first year of life. This is significant because it is during this time when the child's brain is growing at its fastest rate. Myelin, the insulating sheath that allows nerve impulses to efficiently travel and is essential to the health of the nervous system, is moving upwards into the higher brain centers. Parts of the brain that are not yet myelinated are not fully functional. As the child becomes more mobile, she is able to explore and gather more information about her environment. It has long been believed by practitioners of neurological reorganization that the developmental experiences of crawling, creeping and, eventually, walking are what drive and strengthen the myelination of the corresponding brain stages. Recent studies support this claim by suggesting "that myelination may be an underappreciated mechanism of activity-dependent nervous system plasticity."[6] Researchers have shown that putting rats and/or monkeys in an enriched environment can impact everything from increased brain weight, cortical thickness and the density of dendrites, to influencing cellular plasticity. This information is processed and elaborated forming an ever-expanding intelligence and pushing the myelination of the brain progressively upwards.[7] We must take precautions to ensure the functions a child performs during this critical developmental time period (i.e., the first year of life) are fostering a healthy brain and body. If the child performs any stage incorrectly, it can impact the manner in which the child develops and further affect all of the "higher" functions. Some of the functions that could be affected include how the child sees, feels, hears, and processes information; this, in turn, could ultimately cause the brain to be structured atypically. As Piaget said, "the sensorimotor process is foundational for cognitive development."



*Above: The pons*

***The floor is the child's neurological workshop.[8] Ian Hunter.***

It has been my clinical experience over the last 15 years that children on the autism spectrum have the greatest challenge with learning to combat crawl on their stomach. This milestone occurs at the same time the pons, an area of the brain that sits near the top and back of the brain stem, is becoming fully myelinated and, therefore, functional. The aberrant movement patterns the child adopts at this early stage will perseverate into all the later milestones as well, but so will any positive changes that can be taught. Facilitating growth at the pons stage can profoundly help the child with autism. Creeping on hands and knees is the next developmental step and is associated with the midbrain and its myelination. It is also a skill requiring significant boosting early in a child's program of neurological reorganization. Since these skills are both acquired they can both be taught. In the same manner in which a gymnast is coached to improve his technique, a child with autism can be coached to develop healthy movement in both these and other areas. For the child with autism, however, the reward is anonymity and independence.

The pons has many functions: as a relay station for the sensations of pain, temperature and touch as well as body movement between cerebral hemispheres, cerebellum and spinal cord. It serves as a bridge between the decision making part of the brain and the rest of the body. There is serotonin in the pons and, therefore, it has a role in the emotions of pleasure, aggressive behavior, and anxiety. Children who have sensory integration disorder, display self-injurious behavior, or feel the world is a hostile place likely have dysfunction at this level of the brain.

Crawling has many advantages secondary to the development of the pons:

- Assists in the development of the primary curve in the spine
- Develops loose heal cords
- Arches the bottom of the feet
- Teaches the child to lift his toe while flexing his knee – this will be important later when the child learns to walk
- Creates healthy hip sockets
- Stimulates the most tactile sensitive areas of our bodies
- Coordinates horizontal tracking skills
- Forces the child to breathe against his own body weight promoting stronger lung and chest capacity.

Unlike the pons which is one organ, in the practice of neurological reorganization the midbrain is considered a collection of organs whose functions are very closely related to one another. This includes, but is not limited to, the midbrain itself, the cerebellum, and the limbic center. According to Pamela Lyons Nelson, a licensed professional counselor, "disorganization at this level is very predominant – almost everyone has it physiologically. We see disturbances in hypothalamic functions: appetite, temperature, rest/activity cycles, hormone balance issues that result in weight problems (usually overweight), being too chilly, depression, insomnia, anxiety, inability to make decisions,

# THE ONTOGENY OF HUMAN NEUROLOGIC FUNCTIONS

| Brain Stage | Average Time Frame | Vision | Auditory | Tactile | * | Highest level of skill | * | Mobility | Language | Manual |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | 6 years to peer level | Skills equal to or above peers and consistent w/ dominant hemisphere | Skills equal to or above peers and consistent w/ dominant hemisphere | Skills equal to or above peers and consistent w/ dominant hemisphere | CONCEPTION | CORTEX | UNIQUELY HUMAN PHYSICAL AND INTELLECTUAL SKILLS | Skills equal to or above peers and consistent w/ dominant hemisphere | Skills equal to or above peers and consistent w/ dominant hemisphere | Skills equal to or above peers and consistent w/ dominant hemisphere |
| 11 | 5-6 years | Reading books | Sophisticated concept of time and space | Sophisticated stereognosis<br>Sophisticated proprioception | | | | Hop, skip, jump and other sophisticated skills | Sophisticated ability to express an abstract thought | Spontaneous writing of many words |
| 10 | 4-5 years | Reading initial books | Conception of sophisticated abstract language | Concepts of solidity | | | | Run and walk in complete cross pattern | Ability to participate in an organized conversation Proper articulation | Spontaneous writing of several words |
| 9 | 3-4 years | Reading sentences | Conception of gramatical and idiomatic language | Concepts of Shape | | | | Initial walking in cross pattern | Structured sentences Advancing vocabulary | Reproducing symbols and words |
| 8 | 2-3 years | Reading phrases Reading many words | Conception of worldly information leading to concept of time & space | Concepts of size | | | | Initial running in cross pattern | Initial sentences Many phrases | Sophisticated bimanual skills |
| 7 | 18-24 months | Reading several words Identifying complex symbols | understands basic directions | Concepts of texture | | | | Walk and run with arms down without pattern | Initial phrases Many new words | Bilateral and simultaneous cortical opposition |
| 6 | 12-18 months | Complete convergence Identifying simple abstracts | Understands many words and phrases | Initial stereognosis | | | | Walk with arms in primitive balance role Free standing Cruising | Several meaningful words however pronounced | Primitive use of tools Initial bimanual function |
| 5 | 9-12 months | Initial binocularity | Understands several single words | Awareness of third dimension | | | | Functional creeping culminating in a cross pattern Pull to stand | Word like sounds | Bilateral cortical opposition Unilateral cortical opposition |
| 4 | 6-9 months | Appreciation of fine detail | Appreciation of environmental sounds | Proprioceptive ability as related to balance and space Gnosis | APPRECIATION | MIDBRAIN | MEANINGFUL | Initial creeping Assume and maintain quadruped | Range of expressive and meaningful sounds | Mature bilateral prehensile grasp |
| 3 | 3-6 months | Seeing gross detail Unified occular movement | Localization of sound | Localization of touch | | | | Functional crawling culminating in a cross pattern | Experimental use of sounds | Initial prehensile grasp |
| 2 | Birth to 3 months | Biocular outline perception | Response to threatening sounds Initial perception of sounds | Awareness of temp & discomfort Early proprioception Vital tactile | PERCEPTION | PONS | VITAL | Initial crawling | Vital sounds | Bilateral vital release |
| 1 | Birth | Pupillary reflex | Startle reflex | Babinski reflex | RECEPTION | MEDULLA & CORD | REFLEX | Complete movement of extremities | Birth cry | Bilateral grasp reflex |
| Source: Sandler & Brown 1980 Second ed. | | AFFERENT SENSORY PATHWAYS | | | Functional | Color key | Zero | EFFERENT MOTOR PATHWAYS | | |

*Table 1:*
*This table respresents the typical development of a human from birth to 6 years of age. It illustrates the motor and sensory functions present at the various stages of brain development. It is used as a diagnostic tool in the field of neurological reorganization. By determining the lowest brain stage at which there is disorganization, we can provide a program to stimulate and grow that level. It also provides a way to track a child's progress through their program.*

allergies, hypochondria – the annoying stuff that diminishes the quality of life." This is also the area I see as being impacted in a child who has ADD or ADHD, dyslexia, or is just generally disorganized.

Creeping stimulates organization of the midbrain structures, but has many secondary benefits as well:

- Assists in the development of the secondary curves of the spine
- Loosens the hips
- Builds proprioception throughout the shoulders
- Continues to exercise horizontal tracking
- Develops convergence of vision leading to depth perception
- Eliminates a primitive reflex involved in many cases of hyperactivity.

The sensory-motor evaluation of the child is based on the principal of the function-structure loop. Simply said, this is the idea that function determines structure and structure determines function. The brain is mapped, so specific structures have been identified as controlling specific functions we perform. Armed with this knowledge, we can use a person's ability to perform functions as a means to assess the underlying neurological structure. It is akin to determining in which area of the brain a stroke occurred based on what function has been lost. In neurological reorganization, we use the same principal when making an analysis.

A comprehensive evaluation looks at three sensory and three motor skills from the perspective of four different brain stages. Specifically, the various skills of vision, hearing, tactility, mobility, language, and manual dexterity are analyzed from the brain stages that control them. Let's look at an example of how this works from both the sensory and the motor perspectives. Using the sensory pathway of vision, the ability of the pupil to constrict or dilate is controlled by the medulla oblongata; having enough acuity to see silhouettes is a function of the pons; unified eye movement is a midbrain function; and reading is controlled by the cortex. Similarly, looking at the motor pathway of mobility, the complete movement of all extremities (including the neck) should be present at birth at the stage of the medulla oblongata, followed by combat crawling controlled by the pons, hands and knees creeping by the midbrain, and all upright postures by the cortex (see Table 1). In both these examples, we see how one pathway has separate aspects controlled by all four major brain stages. The other pathways are judged using a similar perspective. By following the resultant trail of evidence, we can get a glimpse into how well organized the underlying brain stages are integrated, and we can determine a starting point for a program of neurological reorganization.

If we simply put a challenged child on the floor and ask her to crawl or creep, we will continue to see the same disorganized pattern from which she will be deriving the atypical stimulation of her sensory and motor pathways. We have to physically take the child through the motions of healthy movement so she perceives what it means to move in a healthy manner. This is typically done through the rhythmic movement of her extremities in a dynamic range of motion. Due to the fact that movement and perception are tightly bound together, it is also crucial to change perception when trying to impact movement. Direct stimulation of the pons and midbrain through dynamic ranges of motion is often not the most efficient way to normalize a dysfunctional sensory pathway. With one or more of the sensory pathways acting as a filter and preventing much of the available information from accessing and being processed by the brain, the child may not be wholly available to receive the needed stimulus.

For parents who want to know what they can personally do to help their child, a program of neurological reorganization has an answer. The focus is to create a home-based program run by the parents that allows the child to benefit from a developmental process which she has not properly experienced. It involves two major components. The first is a detailed evaluation and history. The second is creation of an individually tailored program and comprehensive parent training. After this initial process is complete, most clients are seen every 2 to 4 months for re-evaluations so that their programs keep pace with whatever progress they are making.

> "Fortunately, having identified the stages in my development that I had deviated away from and putting the focus and energy on correcting those errors was my key to health."

***Practice makes learned, not perfect. Anonymous.***

What I had learned in my early years was incorrect. It may have been vaccinations during my early years, oxygen deprivation at birth, alcohol consumption during pregnancy, or a combination of other factors of which I am unaware. No matter the cause, my development was altered, and my brain was injured as evidenced by the fact I had no identifiable pattern when put on the floor and asked to crawl on my stomach or creep on hands and knees. As a result, I had not properly stimulated the growth of my pons or midbrain, learned to become a deep breather, or adopted a proper heal toe-gait. My functional vision was a mess, and I had an extremely high pain threshold. I was toxic from all

the anti-convulsant medication I was taking (to achieve only poor seizure control), and my quality of life was devastating for both my parents and me. Fortunately, having identified the stages in my development that I had deviated away from and putting the focus and energy on correcting those errors was my key to health.

> I was between 8 and 9 years old when I began my program, and after the first 9 months of intensive work, I was seizure and medication free.

***The human body is endowed with a remarkable recovery potential; it merely waits for your hand, your heart and your mind to release it.***
***George Goodheart, DC.***

I was between 8 and 9 years old when I began my program, and after the first 9 months of intensive work, I was seizure and medication free. It took me an additional 3 years to become whole. I accomplished this without sophisticated dietary intervention, structural work, or any other therapy. The central elements of my recovery involved learning how to crawl on my stomach and creep on hands and knees, both in a proper crosslateral pattern. In addition, I had a big vestibular diet which included some of my favorite elements such as somersaulting and learning how to swing across monkey bars. I also learned how to become a reflexive deep breather through use of a process referred to as masking. Masking, technically known as hypercapnia, is a process in which a person rebreathes their exhaled carbon dioxide to trigger deeper breathing and the dilation of blood vessels to the brain. The net result is richer oxygen content in the brain. To replace the dysfunctional mobility patterns I had incorrectly adopted during my earlier development, my parents placed me on a cushioned table and coordinated the movement of my arms and legs with that of my head in a dynamic range of motion. The prolonged stimulation of these various functions was able to structurally change my brain in a positive way.

Thanks to the persistence of my parents and the guidance of Arthur Sandler, I have gone on to recognize capabilities far beyond the potential any of my former medical doctors could have imagined. My story is not a unique story, and my only reason for sharing it is as a testimony for the recovery potential of the human body. Your child has potential not even you might be able to see right now. Hold on to the glimmers of hope they show you during their moments of greatness as you work towards a better future for all our children.

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[3] Hotz, R L. Active mind, body linked to brain growth. *Los Angeles Times*. February 23, 1999, p. A1

[4] Wikipedia tells us: "In computers, pressing a bootstrap button causes a hardwired program to read a bootstrap program from an input unit and then execute the bootstrap program which read more program instructions and became a self-sustaining process that proceeded without external help from manually entered instructions." **http://en.wikipedia.org/wiki/Bootstrapping**

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