



ENHANCING DEVELOPMENT WITH DYNAMIC WHEELCHAIR COMPONENTS

This article will discuss the concepts of how and why dynamic components on seating systems and wheelchair frames enhance a user's development via neuroplasticity. The case study will focus on the development of an 8-year-old boy with dynamic components on his wheelchair. Future research needs to include other methods of objective data gathering to support the use of dynamic wheelchairs and seating components for neuroplasticity.

I have been blessed with a profession which brings much satisfaction because I get to support individuals with complex neurological issues in meeting their mobility needs. I have been able to follow these individuals for years and have watched not only the individuals' progression, but the progression of the mobility equipment that improves independence. Within the last 20 years, neuroscience has transformed our understanding of how the brain works and how resilient it is. Can this understanding of how the brain works be applied to mobility systems to enhance an individual's development and function? I believe that allowing a seating system to move with an individual will enhance his or her development through neuroplasticity. Neuroplasticity is a broad term, referring to the creation of new neurons and the ever changing wiring that happens among all the neurons in the brain through interactions with our environment. The neuroplasticity is driven through experience-dependent actions. These actions follow specific rules:

1. Use It or Lose It
2. Use It and Improve It
3. Specificity
4. Repetition Matters
5. Intensity Matters
6. Time Matters
7. Salience Matters
8. Age Matters
9. Transference of Skills
10. Interference

(Kleim & Jones, 2008)

Number 7, Salience Matters, refers to the level of meaning an activity has to a person. This should be the first rule, because if the action doesn't have meaning, an individual will not pursue it, eliminating long-term results. Think of all those music lessons your parents made you take. Did you learn how to play that instrument? If so, you must have been very motivated. Experience-dependent activities enhance brain derived neurotrophic factor which enables a brain's recovery at the structural and chemical level. Brain derived neurotrophic factor is imperative in allowing new wiring and neuron connections.

Enriched environments that stimulate an individual to move and explore also enhance neuroplasticity. We are all familiar with the research studies that provide one group of animals with lots of opportunities to move and play while the other group of animals has limited access. The animals with enriched environments have more neuronal axons and dendrites than their comparison groups.

Seating systems have evolved over time. Sling seats and backs have been replaced with planar seating systems, supportive cushions and backs, customized production of complex body shapes and modular seating. As the science and technology improves, increased options are available for enhancing a person's development through seating and guided movement. Our community of manufacturers is developing more seating systems and components that can move

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with an individual if the user is motivated and able to do so, enriching his or her seated environment. The hope is that these initial movements will develop into new movements that an individual will be motivated to use. Other reasons for using dynamic components include, but are not limited to, enhancing arousal level, pressure relief, circulation, and integrity of materials, as well as extending the life of the system.

There are numerous types of dynamic systems that work with body movements. From full systems, including the frame and the seating system, to individual components, which may include:

- separate seats or backs
- dynamic seat and back mounting hardware
- dynamic back cane mounts
- lateral trunk supports
- dynamic/stretch anterior trunk supports
- pelvic positioners
- head support hardware
- dynamic front hanger/foot plate mounts
- flexible shoe positioners
- custom dynamic component

All of these components can be adjusted to limit the amount of movement by increasing force of the dynamic mechanism, whether rubber bands, polymer density, plastic or metal thickness. For more information please refer to the seminar that Jessica Pedersen and I did on “Using Seating to Enhance Body Movement in a Wheelchair” at the 2015 International Seating Symposium in Nashville (reference below).

CASE STUDY

Jeff (not his real name) is an adorable 8-year-old boy who was born at 23 weeks gestation secondary to maternal infections. He was on a ventilator and was hospitalized for 10 months. He had grade 4 intraventricular hemorrhages with hydrocephalus that was managed with ventriculoperitoneal shunts. This eventually led to periventricular leukomalacia. Jeff had numerous shunt revisions and currently has two internal shunts. Jeff came to live at our facility at 1 year of age. He had limited volitional active movement, no visual engagement and difficulty with staying calm. His first mobility system was a stroller base and supported him well, but did not allow for self-propelling and interaction with his environment. Jeff began to show improved volitional movement, as well as trunk and head control.

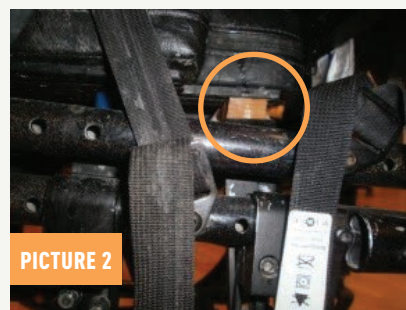
In 2010, when he was 3 years of age, we ordered him a mobility system that would encourage self-propulsion. On evaluation, Jeff had good alignment of his spine and pelvis and functional range of motion throughout his upper and lower extremities with the exception of limited ankle dorsiflexion. He had less active movement in his right arm when compared to his left. His gross motor abilities included rolling and when placed in sitting he needed support at his pelvis and trunk. We decided to get a reverse configuration manual wheelchair with a one arm drive and a simple planar seating system with lateral trunk supports, head support, pelvic belt and shoe holders. Jeff did well with this system until he started to rock it with side-to-side movement of his trunk. We decided to enhance this movement for two reasons: 1. To safely encourage this movement he was seeking; and 2. To help keep the wheelchair and seating system intact. We placed polymer washers between his seat mounting hardware and the seat rail and between his lateral trunk support mounting brackets at the point it attached to the back (see Pictures 1 and 2). The polymers we used were leftovers from various dynamic components. Jeff was able to rock side-to-side and the polymers absorbed this force and movement on each side. This pro-

vided the movement that he needed and craved, and his system remained in good working order. After the dynamic addition to his mobility system, Jeff began to show improvements in his gross motor skills. He is now able to go from supine to a seated position with no assistance and can sit for a prolonged period of time with supervision. The dynamic component to his chair enhanced his gross motor abilities. Jeff has grown considerably and we are looking at a new mobility system to further enhance his movements. At this point, because he doesn't pull to stand or ambulate, we are considering dynamic front hanger modifications along with the current use of polymers in the seat, back and lateral hardware.



PICTURE 1

Picture 1: Polymer between the back mounting track and lateral trunk support bracket.gravity distribution



PICTURE 2

Picture 2: Polymer between the seat rail and seat mounting hardware.

Measuring developmental abilities is only one way of verifying how dynamic seating can enhance an individual's life. Other objective methods that could measure improvement of brain

(CONTINUED ON PAGE 52)



ENHANCING DEVELOPEMENT ... (CONTINUED FROM PAGE 51)

function are electroencephalogram (EEG), computed tomography (CT) scans, functional magnetic resonance imaging (fMRI) and functional near-infrared spectroscopy. I attempted to look at Jeff's EEGs to see if there were appreciable changes that could be correlated to the dynamic modifications but because these EEGs were more focused on seizure and abnormal activities, no changes were noted. A review of Jeff's numerous CT scans showed no progression of his periventricular leukomalacia, but no other changes were identified. This could be attributed to the radiologist's focus of looking for new medical concerns rather than anatomical improvements.

Through evaluation and trials, dynamic components enhanced Jeff's life by contributing to his overall improvement in gross motor skills through neuroplasticity. Further research is needed regarding other objective methods to demonstrate improved brain function through the use of dynamic wheelchair and seating components which will continue to drive our industry to produce new types of products that will get funded for the end user.

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