Neuroplasticity and Performance Breakthrough's Vestibular-based, Multisensory Framework

Performance Breakthrough's central tenet is that **"organising three-dimensional space, time and energy is a fundamental component of human intelligence"**.

Balance (the vestibular function) is the first sense that develops in the womb. For a developing organism that has not yet gained the capacity to see, hear, activate movement, or feel, this sense provides the first relationship with the world. Neural networks, the fundamental structures of brain processing, form to handle the information derived by this sensory structure. They are the first sensory networks to form in the developing brain, and they become the template (the primary organising model) for the development of other neural networks.

As the vestibular system develops and senses motion, its process of sensing helps to stimulate the growth of the very first nerves that connect to its various physical structures. At this early stage of development, the vestibular system is the only developed sensory apparatus, meaning that the neural networks attached to it are the only developed sensory networks. One of the great mysteries—and also one of the great miracles—of how the brain works is that neural networks are shared, based on relevance to prior stimuli.

As a fetus grows in size and sophistication in the womb, the other senses develop in much the same way. By twenty weeks, the ears and the audio sensory system have developed. The child hears the beat of its mother's heart, but that sound is not constant. As it moves inside the womb, closer to or further away from the mother's heart, the intensity of the sound changes. As it turns, the direction of the sound changes. These changes are all referenced to information from the vestibular system. The vestibular system constantly measures movement; the intensity of the sound changes relative to that movement; and from that correlation, the child begins to establish an awareness of three-dimensional auditory space.

It is important to recognize that these sensory systems do not develop independently. As each new sensory apparatus grows, the brain initially processes the information that comes from it using existing neural networks (from previously developed senses). Neural networks dedicated to each sense develop over time as the sensory apparatus becomes more distinct, but they retain a high level of interconnection. They also have a natural tendency to entrain, or work together. That is to say, information often comes to the brain from more than one sense; multiple senses gather the information, compare it, and develop a higher-resolution picture than would come from any single sense by itself.

Each new sense that develops provides the fetal brain with another source of information in its never-ending quest to make sense of its environment. In the protected environment of the womb, it makes sense only of the physical information coming to it from its rapidly developing vestibular, motor, tactile, and auditory senses. But this fundamental process—the integrating of information sources, the neural networks, and the reference to inertia and gravity—provides the foundation for everything the child experiences after birth.

Babies develop the sophisticated processes that define language structure in a remarkably short time. I see a tree (a sensory function), I recognise it (a cognitive function), and I react to it by saying the word “tree” (a three-dimensional motor function). I’ve now developed a mental library of words and linguistic systems, so I can put my communication into the form of advanced language, but I still use the same organisational structure. That structure allows children to organise the chaos of stimulation they experience when they enter the world. Once again, new kinds of information are processed by existing neural networks. Over time they develop other neural networks. Still, the vestibular system is the most developed. It remains the template for new neurological structures; and because the child’s position in reference to gravity is so fundamental to their development, the vestibular sense is still highly involved in the continuing development of the brain.

Any time we learn to do something new, any time we’re confronted by a

stimulus we haven't experienced before, any time our environment demands that we adapt, our brain develops further. This is true whether we're learning to throw a ball or learning to read. New neural networks form; new sensory and processing apparatus evolve. The higher brain, home of all the human traits that are so mystifying and so sophisticated, has its roots firmly planted in the parts of the brain that allow us to sense the world around us, which have their roots firmly planted in the vestibular system.

The brain is not a static system. It changes over time and is subject to manipulation depending on the inputs it receives. Every act of the human brain involves a recalibration component. In order to recalibrate an instrument one must have a reliable standard of reference. The acceleration of gravity is that standard of reference for the brain as it uses information provided by the visual, auditory, motor, and secondary systems to perform the complex operations required in reading, writing, playing music, athletics, etc. In short, a person's ability to learn is dependent upon their ability to process vestibular information effectively.

This is why activities that promote balance efficiency and spatial awareness have such a profound effect on "higher" brain functions like reading, memory, comprehension, mathematics and evaluation. We all have native inefficiencies in our vestibular system. Our lifestyles contribute to those inefficiencies, and certain lifestyles (like sitting in front of a computer all day) can add new ones. Those inefficiencies exist at the root of our brain's function. Through that highly integrated system of neural processing with which we make sense of our world, those inefficiencies repeat and repeat, impeding the efficiency of every facet of our intellectual life.

In summary, the vestibular system establishes the basic relationship of a person to gravity and the physical world. It is the unifying sensory system. Organisation, integration and transmission of visual, tactile and auditory messages depend on the proper functioning of this system. When the vestibular system does not function in a consistent and accurate way, the interpretation of other sensory messages will be inconsistent and inaccurate and will weaken higher order

cognitive processes that depend on properly functioning message transmission. Motion (which stimulates and calibrates the vestibular system) excites the lower brainstem area where auditory and visual messages integrate with proprioceptive messages from the parts of body controlled by the muscles. By performing activities that increase the efficiency of the vestibular-based multi-sensory framework, you increase the efficiency of your whole brain by reorienting it to its commonly understood reference point, as defined by the vestibular system, namely gravity. Learning Breakthrough's activities bring more neurons into the sensory transmission process and those neurons are "trained" to connect in new ways so as to support higher level cognitive processes. You actually change the brain's chemistry by training it. After all, the brain is the only organ in the human body that learns from past experience and adjusts itself. This is the essence of the neuroplasticity model and the core reasoning that informs the effectiveness of Learning Breakthrough's balanced-based remediation and training approach.