Performance Breakthrough: *Unlock Your Potential* - by Improving your Vestibular Neurological Pathways and Increasing your Sensory Processing Capabilities!

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Introduction to the Performance Breakthrough Programme

The Performance Breakthrough coaching team has been established for over ten years working directly with children, young people and adults improving their cognitive performance and social and emotional development. The Performance Breakthrough (2019) programme helps develop and support all individuals, to *up their game* and unlock their potential. The programme has already supported numerous individuals to overcome the immense difficulties and challenges they personally experienced in relation to their poor cognitive, sensory, and motor capabilities. Areas of improvement noted by our clients include concentration, cognition, gross and fine motor skills and sensory and visual processing.

Performance Breakthrough Team [2019]

The Performance Breakthrough programme requires individuals to actively participate in daily exercises that use unique equipment. The programme is heavily founded on empirical research discussed in the comprehensive literature review section of this article. Research has clearly established that cognitive deficits occurring during the very early stages in the brain development of the foetus, is linked to children being born with an atypical cognitive developmental condition (Hulme and Snowling, 2009; Bremner and Slater, 2011).

The exercises outlined in the Performance Breakthrough programme, aim to alleviate difficulties associated with cognitive developmental and learning conditions, including: Autism Spectrum Condition (ASC); Dyslexia and other reading difficulties; Attention Deficit Hyperactivity Disorder (ADHD); Developmental Coordination Disorder (DCD), i.e. Dyspraxia; and Dysgraphia (Facwett and Nicolson, 2011).

It is rare that individuals experience stand-alone and singular cognitive difficulties. It is more common that they are diagnosed with a co-occurring secondary condition (Gurvich, Haghgooie, Kulkarni, *et. al.*, 2013). Performance Breakthrough's specialist equipment and exercises help individuals to develop their cognitive and sensory capabilities, whilst subsequently instilling the necessary confidence and belief in themselves to reach their full cognitive-learning and to unlock their performance potential [See Image 1].

The Performance Breakthrough programme is a drug-free, non-invasive approach, that not only supports cognitive development but often results in noted improvements in behaviours. The design of the exercises outlined in the Performance Breakthrough program, were demonstrated by research conducted by Dr. Robert

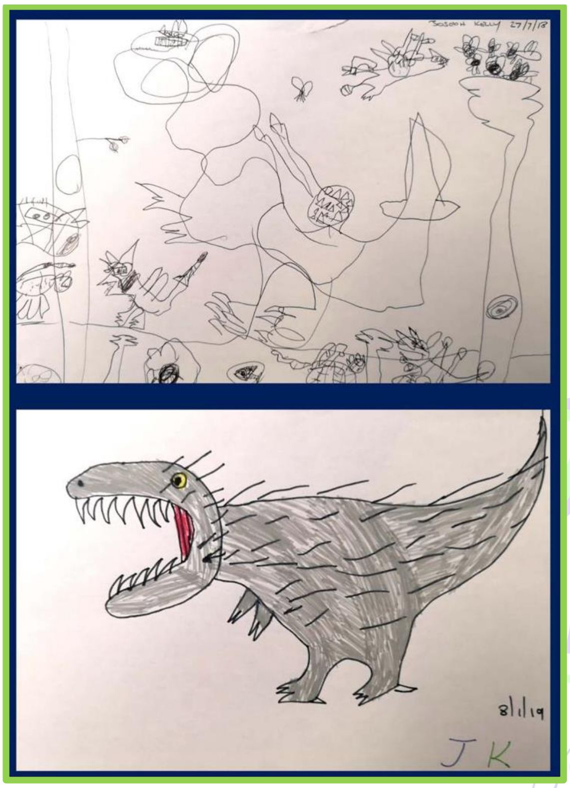

Image 1: Performance Breakthrough: From *Chaos to Clarity* in 9-months [2019]

Donatelli (2014) - in particular, his more recent collaboration with the 'Shuttle Systems Group'.

The Inspirational Dr. Robert [Bob] Donatelli

Dr. Donatelli (2014) worked in collaboration with the Shuttle Systems Group, an organisation that designed balancing equipment that targets the development and maintenance of an individual's sense of visual acuity, body movement and awareness, and neurological vestibular processing capabilities.

The equipment was designed on the principle understanding that our senses do not work in isolation [See Box A: The Prismatic Goggles Experiment]. The exercises are conducted whilst the individual is positioned on an unstable-balancing apparatus; which was specifically designed to primarily develop their vestibular system, known to be fundamental in maintaining good balance and stability. Empirical research has clearly established that the vestibular neurological pathways are meticulously interconnected in processing information from the visual; proprioceptive, and kinaesthetic sensory systems (Goodale, 1998); Gurvich, Haghgooie, Kulkarni, *et. al.*, 2013).

Research outlined by Hulme and Snowling (2009), has further demonstrated that visual acuity, is the most predominant of these senses [See Box B: The Swinging Room Experiment], that has the greatest impact on the smoothness, efficiency and effectiveness in an individual's cognitive learning and motor performance. Visual acuity sensory processing, produces better modulation and performance of the kinaesthetic [guided body motor movements] and proprioceptive [the awareness and spatial locations of our body and limbs] sensory processing systems. Inhibiting an individual's visual acuity, results in a significant decrease in the capabilities of these other key senses. However, hypothetically speaking, the removal of our proprioceptive and kinaesthetic senses, wouldn't necessarily affect our visual acuity capabilities in the slightest. Therefore, the next stage in the design of 'The Shuttle Group' balancing apparatuses, involved incorporating visual tasks into the balancing exercises. The exercises were then further developed, additionally requiring the individual to make motor movements, that develops their kinaesthetic and proprioceptive sensory processing systems.

The Shuttle Group

The Shuttle Group conscripted baseball and golfing participants for the online video demonstrations of their vestibular enhancing balancing equipment and improved sensory processing exercises. The participants were required to maintain and regulate their posture whilst standing upright on the specially designed unstable-balancing device, before swinging their baseball bat/golf club and making direct contact with the baseball/golf ball (The Shuttle Group: YouTube, 2014).

The Shuttle Group programme has helped sportspersons to develop their ability to evenly transfer their weight throughout an entire action motion; quickly learning to better maintain their balance and posture throughout the duration of their gross motor movements. Whilst synchronously utilising their dynamic visual acuity - though the connection of their baseball bat/golf club with the baseball/golf ball - the sportsperson increases their visual acuity capabilities, enabling them to make the necessary subtle gross motor adjustments - at unimaginable speeds - that helps unlock their full potential. Ultimately, the programme develops the vestibular system to increase balance during motor movement; allowing for better collaboration with the visual, proprioceptive and kinaesthetic sensory systems. This has resulted in those sportspersons consistently demonstrating a higher level of performance in their corresponding sport (The Shuttle Group: YouTube, 2014).

Prismatic Goggles Experiment

An infamous experiment conducted by Held and Hein (1963), demonstrated beyond doubt, that vision takes predominance over proprioception and kinesthesis. Participants in the study were required to wear prismatic goggles, that created a displaced lateral visual field. Participants were then asked to pick up an item on the table, that appeared to be directly in front of them - when in reality - the item would actually be placed further to the left or right of centre. Initially, with sensory input from all perceptual systems, i.e. vision, proprioception and kinesthesis; the participants would reach out in a guided manner and fail to grasp the item that appeared directly in front of them. However, with a little practice and a few failed attempts, the participant's visual perceptual system, adjusted and led to a rapid recalibration of the individual's sensorimotor map. Now the participant could aid and guide their motor movements in a way that enabled them to successfully grasp the items. The prismatic goggles experiment demonstrated that vision is the predominant perceptual system that is necessary for navigation and orientation. Whilst vision is the fundamental perceptual system required for calibrating our sensorimotor map, effective mapping depends on the overlapping of vision, auditory, proprioception, and kinesthesis sensory perceptual systems. Billions of neurons activate in the brain, firing along the interdependent neurological pathways that code this overlapping sensory input; equipping us with a body-centred map of our spatial awareness, control over our guided body movements, effective eye-tracking and orientation, our gait, and maintaining effective balance, through subtle muscle adjustments.

Box A

The Swinging Room Experiment

The renowned 'Swinging Room' experiment conducted by Lea and Aronson (1974) clearly demonstrated the fact, that our senses indeed do not work in isolation from one another. Participants aged 13-16 months were required to stand in an upright position on a stationary floor, with the walls and ceilings of the room capable of swinging towards, or in a backward retreating manner. When the room appearing to move forward, it caused the children to sway backward to compensate for their loss of balance; whilst the children swayed forward to compensate for their loss of balance when the wall retreated. The results from the swinging room experiment were staggering, with 26% children observed as swaying; 23 staggering; and a total of 33% children fell over. The same affects were seen in adults, with a minimal 6mm of movement causing them to sway and lose their balance, having not heretofore braced themselves for a shifting environment (Goldstein, 2010).

Box B

Literature Review

Neurodevelopmental Studies

Developmental psychologists have encountered many difficult challenges in acquiring a better understanding of brain development, particularly concerning: perception, cognitive, social, and both fine and gross motor skills. The main challenge presented, is that the participants of interest for developmental psychologists include: foetuses, babies, and children. The reason for targeting this young population, is due to the rapid rate of brain development during these early stages of life. However, the concern - both practically and ethically - is comprising this targeted population into empirical methodological research (Bremner and Slater, 2011).

Despite the ethical and practical challenges presented to researchers, a substantial amount of research has been published. Much of the evidence [discussed throughout this literature review] to date provides significant results that clearly link the vestibular to many forms of atypical cognitive developmental disorders, including: Autism Spectrum Conditions (ASC); Attention Deficit Hyperactivity Disorder (ADHD); Developmental Coordination Disorder (DCD), i.e. dyspraxia; Dyslexia and Dysgraphia; Severe Learning Impairment (SLI); etc.

Development of the Vestibular System

Empirical research outlined by Hulme and Snowling (2009), reported on clearly established associations that linked to the developing vestibular of the foetus during pregnancy, to our motor skill capabilities. It is known, that perceptual processing is key to effective motor skill development. Throughout pregnancy, the foetus frequently changes position, nevertheless, even at this early stage the foetus already possesses the ability to process sensory information that provides an awareness of its own position and movement. As a foetus, we very quickly develop the vestibular apparatus within our inner-ears that consist of three semi-circular fluid-filled canals; each canal is lined with millions of tiny hair neurotransmitters. Throughout those periods of active foetus movement, the fluid flows in each of these three canals and electrically stimulates those neuro-transmitters. Notably, when the foetus' head moves, one of those canals is stimulated at a greater rate than the other two, depending predominantly on the motion direction of the foetus. The neurotransmitters within the vestibular apparatus, send this sensory information to associated brain locations for neural signal code processing; providing the foetus with an acute awareness of its own position and its speed of movement (Hulme and Snowling, 2009; Bremner and Slater, 2011). During pregnancy, when the mother is active, the foetus appears to be relatively inactive; whereas, when the mother is inactive, the foetus will become much more active, moving around with greater frequency. It is understood, that these active and inactive periods of the foetus during pregnancy, are key to the development of the vestibular. It also develops the foetus' ability to regulate alternating states of arousal.

Consider how parents gently cradle their new born baby from side-to-side, in a swaying motion; resulting in placing that child into a subdued calm state of arousal. It is argued, that premature babies - denied this essential vestibular stimulation into the later stages of pregnancy - are at a susceptibly greater risk to atypical neurological developmental deficits. The characteristics of these cognitive deficits will likely affect the individual's vision, balance - and later in their development - their acquisition and expression of language (Bremner and Slater, 2011).

Perceptual Systems linked to the Vestibular

Hulme and Snowling (2009) stated, that proprioception and kinesthesis are two of the key perceptual systems involved in our cognitive development and motor performance. Whilst both systems are closely interconnected, proprioception is defined as the sense of awareness of where our body and limbs are positioned, whilst we are static position; whereas, kinesthesis is defined as the sense of awareness of when our body and limbs are in motion. It is reported, however, that it is our vision that is the dominant sensory perceptual system, that is crucial for initiating and regulating our motor movements. Vision is the perceptual sense with the greatest level of acuity for the awareness we possess regarding our spatial position.

It is established amongst developmental psychologists, that our senses no not work in solitary isolation; that our behaviours are influenced with by our senses interact with the environment, i.e. vision, taste, smell, touch, and hearing. However, it is our sense of balance and the awareness of our body and limb positions, that provide us with stimulants that help promote our cognitive development throughout childhood and long into adulthood. Either in motion, or standing statically still, our proprioception and kinesthesis capabilities, i.e. body awareness and movement, can be attributed to the vestibular canals within the inner ear; the neuro-receptors in our joints and muscles; and of course, our vision. Extricate one of these, i.e. vision; and it is immediately obvious that individuals will experience difficulties maintaining their balance. In the absence of visual acuity, we are severely inhibited in making the minor muscle adjustments necessary to stop us swaying, or from falling over.

Vestibular System and Associated Brain Regions

The vestibular system is seamlessly interconnected with our central nervous system. The vestibular and our cerebral neural pathways, have both been implicated in maintaining affective voluntary control over our balance; muscle coordination; and active motor behaviours. However, evidence suggests that there are several main interconnected brain regions associated with many of the principal atypical cognitive developmental conditions (Gurvich, Haghgooie, Kulkarni, *et. al*., 2013).

Contemporary modern day transcranial magnetic stimulation (TMS) technology, has revealed that the right-temporal posterior region and the right-anterior of the temporal partial cortex, are vital neural components in processing visual and proprioceptive sensory information. This information is received from the vestibular system to help with effective regulation of our voluntary motor control movements (Bresciani, Bültoff, Reichenbach, *et. al*., 2016). It is known, that vestibular signals are transmitted from the vestibular nuclei, through to the brain stem nuclei, before projecting onwards to various subcortical structures of the brain. These regions have been clearly established, as being essential for effectively maintaining our balance and making the necessary subtle adjustments for muscle coordination. The vestibular nuclei transmit and receive serotonergic and non-serotonergic projections to and from the raphe nuclei, whilst additionally transmitting axon collateral signals onto the central amygdaloidal nucleus. Vestibular nuclei and raphe nuclei both regulate neural transmissions within the vestibular, that further receives sensory input from specific regions located within the cerebellum (Gurvich, Haghgooie, Kulkarni, *et. al*., 2013). Facwett and Nicolson (2011) claimed, that the cerebellum continuously processes cognitive information, throughout the various reciprocal connections between the left-inferior frontal gyrus and the left-lateral temporal cortex.

The vestibular nuclei receive noradrenergic innervation from the pontine nucleus locus coeruleus, which then transits collateral projections onto the cerebellum, the neocortex, and the thypothalmaus regions. All these regions of the brain are associated with regulating the effects of our vestibular reflex functioning (Gurvich, Haghgooie, Kulkarni, *et. al.*, 2013). Furthermore, the parietal reach regions are thought to be the locations for sensorimotor coding for guided arm reaching movements - in the contralateral hemisphere, to that of the side of the moving limb. In addition, these areas responsible for coding our sense of kinesthesis, work in extremely close conjunction with visual and proprioceptive sensory information processing regions (Bresciani, Bültoff, Reichenbach, *et. al.*, 2016).

The occipital lobe was implicated as the neurological location responsible for transmitting vestibular signal projections to the various cortical regions of the brain. The parietal opercular region of the occipital parietal cortex, is a known key component in all vestibular processing (Gurvich, Haghgooie, Kulkarni, *et. al.*, 2013). Goodale (1998) reported on two identified visual neurological pathways, i.e. the ventral stream and the dorsal stream. The ventral visual pathway [regulates object vision to directly observe an object] was identified as a stream, that projects sensory information from the primary visual cortex, to the inferotemporal cortex; whilst the dorsal visual pathway [regulates spatial vision to locate an object] was identified as a stream that projects sensory information from the primary visual cortex to the posterior parietal cortex - a region that holds the memory of an object for a period of time, after having been removed from vision. However, it is notable, that eye movements and deliberate body and limb movements, specifically active cells in different anatomical regions within the posterior parietal cortex.

Albaret, Biotteau, Blais, *et al.* (2016) argued, that several brain regions including, the cerebellum, basal ganglia, the parietal lobe, the medial orbitofrontal cortex, and the dorsolateral prefrontal cortex [located in the frontal cortex], are collectively associated to developmental coordination disorder. Other brain regions identified as being associated with developmental coordination disorder included: the insula/claustrum; the anterior cingulate cortex; the dorsolateral prefrontal cortex; and the frontal lobe.

Angelaki, Broussard, Büttner-Ennever, *et al.* (2012) outlined five key components of the cerebellum that receive sensory input from the vestibular nerve and nuclei included: the nodulus and ventral uvula; the flocculus and ventral paraflocculus; the oculomotor vermis of the posterior lobe; vermal lobules I and II of the anterior lobe; and the deep cerebellar nuclei. Ito (2008) reported, that an expressive use of language ignited significant brain activity in the cerebellum and other closely associated brain regions that included: the mid-dorsolateral prefrontal cortex; the inferior frontal gyrus; the precuneus; and the supramarginal gyrus. Undertaking mental calculations triggered significant neurological activity in the cerebellum and other associated brain regions that included: the frontal operculum; the superior precentral sulcus; the posterior parietal cortex - specifically the intraparietal sulcus areas; and the anterior cingulate gyrus. Furthermore, exercises involving planning and working memory, also activated the cerebellum and other associated brain regions that included: the prefrontal cortex; the anterior cingulate; the premotor cortex; and the parietal and occipital cortices.

The corpus striatum region of the basal ganglia consists of two sub-components: the ventral striatum and the dorsolateral striatum [associated with body movement, control, posture, and balance]. These sub-regions of the basal ganglia have been identified, as the key neurological processing components involved in the direct transmission of sensory input from the vestibular nucleus, via the thalamus region. Some neurological pathways can occasionally, completely omit any neural-coding via the cerebral cortex (Smith and Stiles, 2015).

Some of the key remaining brain locations to note include: the parabrachial nucleus and the hippocampus. These regions have been identified, as the two key functional regions that have clearly established links with the vestibular system. They have been identified, as crucial neurological pathways involved in our cognitive and emotional processing and regulating the impact of our behaviour that includes: our actions, thoughts, and feelings (Gurvich, Haghgooie, Kulkarni, *et. al*., 2013).

Vestibular Impairments: Cognitive and Psychiatric Behaviour

Research evidence has identified clearly established neurological links between the vestibular system and the coded processing of our cognitive and emotional sensory input. Gurvich, Haghgooie, Kulkarni, *et. al*. (2013) reported, that the consequences of vestibular dysfunctional impairment in the foetus during pregnancy, can result in extremely discernible cognitive development during infancy, throughout childhood, and long into adulthood. Additionally, it is acknowledged that there is a high-correlation in individuals with an atypical cognitive development condition, experiencing a comorbidity with other primary conditions, along with potential secondary psychiatric conditions including: stress, anxiety and/or depression. These multi-layered cognitive conditions, will undoubtedly have negative consequences upon that individual's present and future behaviour.

Cognitive Behaviour

Dysfunctional impairment to the vestibular system has been associated with challenges in regulating cognitive behaviour, including: attention; working memory; spatial memory; and perception. Additionally, it was reported that an underdeveloped vestibular is linked to further cognitive symptoms including: poor postural control; an uncoordinated and unstable gait and balance; erratic ocular motor changes; and general reports of clumsiness and dizziness (Gurvich, Haghgooie, Kulkarni, *et. al*., 2013).

Angelaki, Broussard, Büttner-Ennever, *et al.* (2012) reported, that the cerebellum is a further key cognitive component necessary for functional timing and sequencing during our voluntary body movements. The cerebellum is a component of the brain that works in close conjunction with the vestibular system, regulating both our balance and visual perception. Goodale (1998) argued, that lesions in the dorsal stream causes individuals to display poorer performance levels in visually guided arm movements; accompanied by the subsequently erratic saccadic eye-movements. Furthermore, it was claimed that these lesions cause individuals to experience greater difficulty in modulating visual sensory input, affecting effective motor movement behaviour.

Facwett and Nicolson (2011) reported, that the cerebellum is a key brain component with established links to both our linguistic and cognitive capabilities, that included: phonology; working memory; and information processing speed. This is in addition to our gross motor functioning and coordination capabilities, that included: swimming; riding a bicycle; catching a ball; playing sports; etc.; and our fine motor functioning, that included: tying shoelaces; hand writing; using cutlery; etc. Furthermore, they claimed, that deficits in the development of the cerebellum are associated with problems in our writing, language, spelling and reading fluency; at a much-considered disproportionate level to that of the individuals' intelligence quotient (IQ). Ito (2008) stated, that whilst the cerebellum is directly associated with regulating our motor behaviour, it also plays an additional role in our non-motor functions, including: the acquisition and expression of language skills. There has been much greater research emphasis recently placed upon the lateral regions of the cerebral hemispheres; which along with the cerebral association cortex, was the most recent part of our brain to develop. Ito (2008) reported on significant interconnections of the anatomical neurological pathways between the two cerebellar hemispheres, and the prefrontal, parietal, and other associated cerebral cortex regions - that were observed as being activated during various mental cognitive exercises. It was reported, that the cerebellum regulates the speed and fluency of an individual's controlled thoughts, especially those thoughts specifically related to language, mental calculations, planning, and our general working memory capabilities. Ito (2008) further argued, that mutism in some individuals with a cognitive condition, directly inhibits their expression of language, which is directly linked to the dysfunctional development of the cerebellum [thought to be closely associated with word generation]. This demonstrates the significant role that the cerebellum truly plays in our use of functional language.

The basal ganglia, reported by Smith and Stiles (2015), is another key component thought to be necessary for effective control of our guided body movements, eye tracking, and regulating our emotions. However, more specifically, it is the corpus striatum nucleus that is located in the subcortical region of the basal ganglia, that allows for effective functional motor movement and planning, decision-making, motivation, and our perception of positive and negative reinforcement. Bresciani, Bültoff, Reichenbach, *et. al.* (2016) outlined, that regulating the spatial awareness of our body parts within our surrounding space, is key to the functional capabilities of our voluntary guided motor control, reflexive behaviour, and our motion movement within our surrounding environment. Goodale (1998) reported, that locating an object requires visual information on its location, in addition to utilising our eye and/or head orientation. Whereas, physically obtaining that object requires accurate visual acuity information on the distance, shape, and size, etc. of a specific object; before it is then neurologically coded into self-guided motor-movement behaviour, i.e. grasping the object. The ventral and dorsal streams work in collaboration with each other to produce smooth and controlled functional motor behaviours. Therefore, it is thought, that the sensory and motor neurological pathways cannot be considered as completely separate entities and highly co-dependent upon one another.

Albaret, Biotteau, Blais, *et al.* (2016) argued, that many atypical neurological conditions, have been identified as dysfunctional impairments in the corticostriatal and/or corticocerebellar circuits, with scientific consensus that links these deficits with cerebellum dysfunction. These cognitive impairments result in irregular timing of muscle contractions and movement, and these individuals are often depicted as being quite clumsy and unstable. Furthermore, individuals with a diagnosis of a developmental coordination disorder condition, might display clinically characteristic sensorimotor difficulties with the following behaviours: postural control; hand coordination; impaired balance; motor planning; and general learning capabilities. This is thought to severely impact upon an individual's normal everyday daily activities, including: dressing; writing; using kitchen utensils; playing games and/or sports; etc.

Bascharon, Donatelli, Landers, and Nash (2017) claimed, that diminishing levels of clarity in an individual's dynamic visual acuity, indicated the likelihood of impairments with their vestibular, visuomotor, and/or associated visual systems. Whereas, most studies had previously used balancing techniques to measure the vestibular functionality, this research adopted a variety of simple head moving exercises; movements that we modulate by utilising our vestibular ocular reflex (VOR). It was reported, that individuals with brain lesions in these regions, displayed statistically significant deficits in their VOR functioning capabilities throughout the head moving exercises. It was argued, that individuals with poor levels of visual acuity may be at significantly greater physical risk within a different range of social environments. This is thought to be due to their slower head movements and visual acuity reaction times. It is claimed, that children who develop problems with their visual acuity, will most likely have associated dysfunctional development of their vestibular; ultimately causing them to underperform both socially and academically, compared to their typically cognitive developed peers.

Psychiatric Behaviour

Dysfunctional impairment to the vestibular system has been associated with challenges in regulating many forms of psychiatric behaviour, that included: mood; anxiety; and depression; with specific reference made to peripheral vestibular deficiencies. Several initial research studies have reported, that an underdeveloped vestibular is additionally linked to further psychiatric conditions, that included: psychosis; mania; and agoraphobia (Gurvich, Haghgooie, Kulkarni, *et. al.*, 2013).

Cognitive Developmental Disorders

A vast catalogue of evidence directly links the cognitive deficits discussed, to problems with the neural coding processing that modulates our balance and vision. Research literature has linked developmental deficits to a variety of interconnected brain regions (the vestibular, cerebellum, basal ganglia, partial and frontal lobes) to many atypical cognitive conditions including: autism spectrum conditions (ASC); attention deficit hyperactivity disorder (ADHD); dyslexia; and developmental coordination disorder (DCD), i.e. dyspraxia.

Ito (2008) identified, that deficits in the development of the cerebellum, are clearly linked to autism spectrum conditions, with 90% of individuals with this condition were identified as having significant reductions in Purkinje-cell size, whilst nicotinic-receptor abnormalities were also identified in these individuals. Further neurological deficits linked to individuals with autism spectrum condition included, associated deficits with the prefrontal cortex. This region is known to perform executive functioning capabilities that are considered essential for consciously controlling our thoughts, feelings and other action behaviours. Furthermore, Facwett and Nicolson (2011) stated, that deficits in the cerebellum have been linked to developmental dyslexia, dysgraphia, and attention deficit hyperactivity disorder.

Albaret, Biotteau, Blais, *et al.* (2016) identified, that deficits in the development of the basal ganglia, the partial lobes, and the frontal lobe have been linked to developmental coordination disorder. However, they further reported extremely frequent, high comorbidity levels with other associated specific language impairments (SLI).

Neuroplasticity and Atypical Cognitive Development

Neuroplasticity is the ability of the brain to change the neurological processing pathways, throughout an individual's life-span. It is associated with brain activity that is directly involved with our functional, cognitive, and psychiatric behaviours.

Nature (2004) reported, on a longitudinal study that required participants to learn the a classic three-ball cascade juggling routine [utilising visual, proprioceptive and kinaesthetic sensory systems], within a three-month set timeframe. The researchers used brain magnetic-resonance imaging techniques to monitor the changes in the cognitive processing capabilities of the participants throughout the progression of their learning of this new skill. Statistically significant differences ($p < 0.05$) were confirmed, in the developmental of increased neurological pathways that interlink visual acuity and body awareness and movement, with the vestibular neurological pathways. Results from the study, confirmed improved transient bilateral processing capabilities in the participants mid-temporal area and the left-posterior intra-parietal sulcus [two areas identified in the literature review section of this report]. The upshot of learning the specific skill of juggling, consequentially proved to be a perfect stimulus for structural plasticity [including the cortex, cerebellum, and basal ganglia regions]; with statistically significant improvements reported in visual acuity and motor coordination, that involved planning and execution in performance their newly acquired skill.

Research has clearly determined, that recovery of cognitive deficits can be addressed more readily in children, compared with the adult brain. Children display greater degrees of neural plasticity, as their brain is still rapidly developing, whilst the adult brain is somewhat more concrete, due to having much longer established neurological pathways. (Buskist, Carlson and Martin, 2010). Due to the gradual reduction in neural plasticity capabilities as we reach adulthood, it has been strenuously argued by cognitive developmental psychologists, that early intervention in childhood is absolutely key in helping individuals unlock their full performance potential.

Performance Breakthrough appears to improve function across a range of areas concentration, gross and fine motor, visual acuity, sensory integration issue using exercises designed to target the vestibular system.

Research plasticity remains throughout lifetime but optimally earlier intervention has faster results.

Performance Breakthrough: Developing the Vestibular and Sensory Processing Systems to *Unlock Your Potential*

Performance Breakthrough (2019) specialises in balance and co-ordination training. The programme, supported by empirical research discussed in the literature review, takes cognisance of the impact of the underdeveloped vestibular system; known to result in poor postural, balance issues and other cognitive difficulties. The body of research outlined in the literature review clearly demonstrates, that when our body is not in balance, our minds do not work to their full learning and performance capacity; ultimately impacting on an individual's ability to reach their full cognitive potential.

The Performance Breakthrough programme was fully endorsed by Dr. Anish-Anish: Paediatric Consultant and leading ADHD specialist in Northern Ireland. Performance Breakthrough's programme requires the individual to complete exercises on a specially designed *Belgau Balance Board* - which is at the heart of the programme.

“I am happy to recommend this programme that encompasses every

Dr. Anish-Anish: Paediatric Consultant (2019)

Dr. Belgau's balance board

In the early 1960's, Dr. Frank Belgau, worked with school-aged children suffering from reading problems. He experimented to see what cognitive activities could help make immediate and observable improvements in the children's reading and overall academic performance. Dr. Belgau discovered, that simple-straightforward 10-minute balancing and motor-task exercises, helped to drastically develop children's reading capabilities.

Dr. Belgau led the Perceptual Motor and Visual Perception Laboratory in Texas: Houston, where he continued his work and refined his observations. He was instrumental in designing a parent-led training program, that required parents and their children to spend 1-2 hours, twice per week, for a period of one month. The exercises in the programme, resulted in these children significantly overcoming their individual reading and learning difficulties.

Dr. Belgau worked in partnership with scientists associated with the NASA space program, who highlighted, that the focus and attention of the programme design, must consider the effects that balance and the vestibular system have on our developmental cognitive learning processes. Dr. Belgau amalgamated this knowledge with his own observations, that many learning challenges are impacted by sensory integration disorders. The scientific approach to the programme, to the development of the Belgau Balance Board; and results of his programme have been reported as ‘astounding’, due to its effectiveness in showing consistent improvement in reading, academic achievement, physical coordination and cognitive performance.

The board is securely attached to two rocker leg pedals, that can be altered to increase the level of difficulty in individual maintaining their balance, as they progress through the programme and increase their level of performance. The exercises utilising the *belgau balance board*, directly targets the development of the vestibular and increases the individual's automatic responsive behaviour to their sensory input. The exercises increase the cognitive processing capabilities amongst the connected neurological pathways associated with the vestibular system; empirically documented as the root cause of many cognitive learning difficulties and those negative characteristic behaviours that are commonly demonstrated by individuals with various forms of atypical cognitive conditions. Results from the Performance Breakthrough programme, has demonstrated that the exercises had supported individuals in reaching their full learning potential and improved their overall level of functioning capabilities and general overall performance.

Breakthrough Results

The Performance Breakthrough programme is a non-medicated approach that addresses the functional, emotional and sensory difficulties, that are characteristic of many individuals with ASC, ADHD, Dyspraxia, Dyslexia, etc. The programme exercises aim to develop all the brain regions associated with various forms of atypical cognitive developmental disorders.

Jack's mum (2019)

"Our son no-longer needs medication thanks to Performance Breakthrough"

Client	History	Results	Parent and Teacher 'Breakthrough' Comments
A	Skin Picking; Anxiety; Low Concentration; Temper Tantrums	After 6 weeks and 15 minutes per day engaging in Performance Breakthrough exercises, the picking completely stopped and the skin has healed. Client is much happier within herself	Parents noted that their daughter is now calm and much less explosive; and delighted that her skin is completely healed. Concentration much improved.
B	Kicking and Screaming when woke for school; Behavioural Problems; Meltdowns	After 3 months of Performance Breakthrough exercises, this client received an 'exceptional role model' award at school.	He is now calm in the morning, getting up and going to school without any fuss. Temper tantrums have stopped.
C	Poor Hand/Eye Coordination; Poor Handwriting; Underdeveloped Fine/Gross Motor Skills	After 5 weeks of Performance Breakthrough exercises, there was improvement in hand/eye coordination [See Image 2, p.13 of Article]. Writing now on the line, smaller and well spaced.	Parents were so delighted with the improvement that they sent Performace Breakthrough samples of his writing and how proud they were of him.
D	Poor School Performance in School; Low Concentration; Poor Retention	After 3 months of Performance Breakthrough exercises, this client achieved full marks in his spelling tests, improvement on previous 4/20. He was able to better retain all the spellings he learnt.	Teacher's note to parents: "Did a fantastic job with his high frequency words today. He now knows 95% of his words; an improved of 50% in three months"
E	Anger Issues; Unfullfiled Potential; Frustration; No concept of Time or Consequences	After only 2 weeks of Performance Breakthrough exercises she was a less angry teenager and better processed her behaviour. Settled home-ife. Improved academic performance. Improved organisational skills.	"We believe that this programme was invaluable to our daughter's emotional development and in turn helped to improve all aspects of her life"
F	Poor Behaviour; No concept of Consequences; Drug Taking; Deeply Unhappy "A Lost Boy"	A few weeks of Performance Breakthrough exercises, this 20 year old client's whole attitude had changed; and he much happier within himself. He had become more aware of his behaviour and felt that "life had something to offer him"	"Once our son started doing the exercises for 15 minutes each day, the results were quick. Our son has found himself again and we have rediscovered our son. He had been of all forms of drugs since starting Performance Breakthrough and he is now able to hold down a job.
G	Anxiety; Temper Tantrums; Punching Walls; Kicking; Very Frustrated; Very Low Self-Esteem; Lost, Afraid and Feeling he annoyance everyone	After 6 months of Performance Breakthrough exercises, he is happy and confident. There are no signs of frustration. No reported meltdowns and better able to see reason. Improved reading and spelling scores and neater handwriting.	"Our home life is now calm and we do not have to shout in despair. We are so happy that we have found Performance Breakthrough. We would recommend it without hesitation to other parents. An extra confidence booster for our son is the huge improvement in his football.
H	Poor Hand/Eye Coordination; Underdeveloped Fine and Gross Motor Skills	After only a few weeks of Performance Breakthrough exercises, this client drew a vastly more impressive picture of a dinosaur.	See picture of a dinosaur drawn by candidate [See Image 1, p.2 of Article]

Table A

Parents and teachers have reported [See Table A] that the programme has been proven to increase children's levels of concentration and improves their short and long-term memory capabilities (Performance Breakthrough, 2019). These children have demonstrated their ability to remain focused and less distracted within the classroom environment; as well as being capable of following the teacher's multiple instructions. Reports of improved focus, concentration and attention to classwork are recorded alongside fewer incidents of off task behaviours. Teachers of pupils who have completed the programme report improved active listening skills for these children and that they are better able to process class instruction. It appears that by developing the child's vestibular system, utilising the *belgau balance board and carrying out the daily* exercises address the child's coordination difficulties often associated with those children with ASC, ADHD and Dyspraxia. The exercises in the programme utilise other items that operate the child's visual, proprioceptive and kinaesthetic sensory systems. Developing visual acuity addresses saccade eye-tracking problems, that are knowingly associated with cognitive conditions including: ASC, Dyslexia and other difficulties with reading, spelling and writing. Children completing the programme have demonstrated a vast improvement in their writing capabilities [See Image 2].

Patricia McCarthy: Occupational Therapist (2019)

"Hands down the best complete programme designed to address functional, emotional and sensory difficulties..."

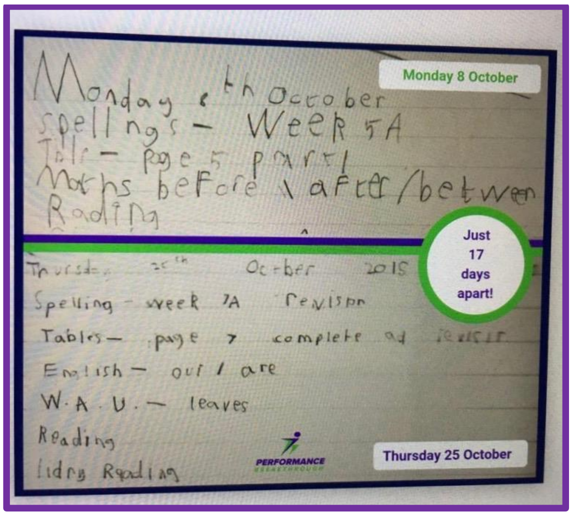

Image 2: Performance Breakthrough: Handwriting improvement after only 19 days [2019]

In addition, these children have further demonstrated the acquisition of much improved speech and language skills. The increase in the children's social interaction capabilities, has helped them to communicate better with their peers. The use of throwing and catching differently weighted bean-bags, or using a hand-gripped board with marked target sections and making contact with a swinging pendulum ball [whilst the child is positioned on the belgau balance board], addresses the issues that are associated with deficits in the proprioceptive and kinaesthetic sensory systems.

Results [See Table A] have shown further significant improvements in these children's psychiatric behavioural, including: reduced anxiety, stress and depression; as well as improved self-esteem and confidence (Gurvich, Haghgooie, Kulkarni, *et. al*., 2013).

The Performance Breakthrough programme can help your child unlock their full learning and performance potential, by aiding the development of the vestibular pathways, which in turn supports a more typical development across a range of cognitive and performance areas.

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