

## **Why do Movement Method & Horse Boy Method Work?**

Children on the autism spectrum - as well as those with ADD/ADHD, anxiety, depression and other neuropsychiatric conditions, typically struggle to learn in what you might call a traditional learning environment such as a classroom or therapist's office. What we have discovered through years of observation and experimentation (and have now had confirmed by neuroscientists), is that if you set up a more autism friendly - aka sensory friendly - learning environment, and allow the child the freedom to move within this environment (because most children with these conditions are kinetic learners), you will cancel out this stress and open the child up to learning in ways that can be astonishing. Here is the science of why:

### **THE PROBLEM - STRESS IMPAIRS LEARNING**

When we are confronted with a stressful event, the amygdala (the 'danger detector' of the brain) triggers the release of cortisol, one of the hormones responsible for the stress response in our body also known as the "fight, flight, or freeze" response. Short term high levels of cortisol are necessary for us to face a stressful event by allowing us to prepare our body to face a perceived danger. But a prolonged high level of cortisol presents a whole host of problems, and this is the nub of the issue.

If we are exposed to a long-term stress, long term high levels of cortisol begin to damage other parts of the brain involved in the inhibition of cortisol production and in learning. This is particularly true in the prefrontal cortex, a region of the brain involved in higher level cognitive functions such as emotional control (especially by inhibiting the amygdala); and in the hippocampus which is involved in the formation of new memories. What this indicates is that long term stress may lead to a negative cycle in which chronic high levels of cortisol damage the parts of the brain responsible for inhibiting cortisol production which leads to the production of yet more cortisol, which in turn traps the brain into a continuously increased anxiety response loop - a self-perpetuating vicious cycle if you will - that massively impairs its ability to learn (Cranston, 2014).

So how does this relate to autism? Well, it is well established within the scientific literature that children with autism have a malfunctioning sensory system (Ben-Sasson et al, 2009) so much so that 2013 the American Psychiatric Association added hyper- or hypo-reactivity to sensory input to their updated edition of the Diagnostic and Statistical Manual 's diagnostic criteria for autism (American Psychiatric Association, 2013). What this means is that children with autism can become negatively overstimulated by

everyday sensory inputs - especially artificial lights, noises, textures, smells, echo, or large numbers of people (these are known as ‘bad sensory triggers’). Studies have shown that autists in particular have over-reactive brain responses to these artificial sensory stimuli, over activating their amygdalas. This may in turn cause the release of long term high level of cortisol, impairing the prefrontal cortex and the hippocampus and therefore the person’s ability to learn. (Spratt et al, 2012). What’s more, research on the autistic brain has also shown abnormalities in the connections between the prefrontal cortex and the amygdala. The prefrontal cortex normally dampens amygdala responses over multiple trials, but fails to do so in autism which may further explain why we see increased cortisol levels in this population (Swartz et al, 2013).

## **THE SOLUTION PART 1- REDUCE THE STRESS**

One way that we can decrease the high cortisol levels so often experienced by children with autism is to set up a learning environment that is as free from as many bad sensory triggers as possible. As autistic and brain-science author Dr. Temple Grandin, so often writes: the ideal learning environment for a child with autism (or indeed any child) is outside in nature where most of these bad sensory triggers are just not present (Kuo & Taylor, 2004). It is also well-established in the scientific literature that simply spending time in nature greatly reduces cortisol production - which is exactly what we are trying to do (Ward et al, 2012). However, if we have to work inside, we can also make-over an indoor learning environment by removing the most common bad sensory triggers paying particular attention to lighting, smell and noise (Stein et al, 2013). In Horse Boy Method (HBM) and Movement Method (MM) we do just that - and by creating both indoor and outdoor environments that target the child’s sensory needs we break the child out of their negative cortisol cycle, thus decreasing the cortisol production and finally opening the child up to learning. But this is just the start of what we do.

Another effective way of reducing stress is to increase the production of a hormone called oxytocin, which one can think of as a kind of ‘antidote’ to that pesky cortisol. Oxytocin is the feel-good, pleasure and communication hormone, and its primary role within the body is to activate the mammalian caregiving system; which is why it is released when a mother breastfeeds or rocks her child (Medina, 2011). Oxytocin has also been found to facilitate stress regulation especially by reducing the activation of the amygdala in response to stressful stimuli (Kirsch et al., 2005) and generally decreasing cortisol levels (Heinrichs et al, 2003). Even better, oxytocin has also been found to counteract - to heal - the corrosive effect of cortisol in the brain thus reversing the long term effect of cortisol (Neumann, 2008; Heinrichs et al, 2003). In Horse Boy Method we use the rhythmic movement of the horse to try and stimulate the production of oxytocin. The theory behind this being that the more the child’s hips are rocked the more oxytocin they produce. In Movement Method we do not necessarily have access to a horse so we employ a wide range of other activities that promote the production of oxytocin such as deep pressure, rhythmic music, swinging and other play equipment that can rock the hips, and of course plenty of laughter (Medina, 2011).

## **THE SOLUTION PART 2: FACILITATE LEARNING THROUGH MOVEMENT & INTRINSIC MOTIVATION**

### **1. Movement**

In American schools in the last 15 plus years, opportunities for children to physically move have been drastically curtailed, with terrible results in terms of academic performance. The introduction of the No Child Left Behind policy in 2001 triggered a dramatic decrease in the amount of physical activity that children across the United States have access to on a daily basis. Schools have become so focused on 'teaching to the test' that they have cut physical education programs across the board. This has not only led to increased concerns over childhood obesity but also to exactly what the schools were trying to avoid in the first place – increasingly poor academic performance particularly in the STEM subjects of science of math (Sattelmair & Ratey, 2009).

Whilst much of our evolutionary history remains a mystery there is one fact that every paleontologist on the planet accepts – we moved. Our direct ancestors, Homo Sapiens, were thought to have walked and run between 10 and 20 kilometers every day all the while constantly encountering new food sources, predators and physical dangers. And their offspring moved with them indicating that we are evolutionarily programmed to learn on the move (Leonard et al, 1997).

In recent years neuroscientists and educators have become increasingly aware of this fact and there has been a shift in focus in the literature as to why movement is so beneficial to learning. What they have discovered is fascinating. Allowing and encouraging the child to move facilitates the neural connections in their brain that are involved in learning. This is possible because of the neuroplasticity of the brain (the brain's ability to produce its own neurons - reproducing and repairing brain cells all by itself), which allows us to create new connections or modulate existing connections between neurons throughout our lives (Ratey, 2008).

In addition physical exercise has been shown to trigger the release of an essential growth factor BDNF (brain derived neurotrophic factor - a sort of self-produced 'miracle-gro' for the brain that results from moving and problem solving together) which is important for the modulation of the brain's plasticity involved in learning and memory (Rasmussen et al, 2009; Tyler et al, 2002). Imaging studies have also shown that when we exercise there is increased blood volume in a region of the brain called the dentate gyrus which is the part of the hippocampus deeply involved in memory formation (Pereira et al, 2007). A recent University of Seoul study of children who rode horses regularly showed significantly increased BDNF in their brains (Lee et al, 2015). Other studies show that movements such as rocking, spinning and bouncing stimulate the vestibular system (located in the inner ear) which is critical for attention and learning (Hitier et al, 2014;

Bigelow et al, 2015). Of course we do all of this in Horse Boy and Movement Method and this is why the children we serve are so open to learning both during and perhaps more importantly, after, our sessions - or 'playdates' as we prefer to call them.

But it goes much further than this...

Studies show that physical exercise increases activity in the prefrontal cortex - an area of the brain involved in higher level cognitive tasks (what brain scientists call 'executive functions') such as decision making, logic and emotional control (Heyman et al, 2013). Researchers have also found that the part of the brain responsible for motor control - the cerebellum, which is activated during movement - connects to the prefrontal cortex and other regions of the brain via neurons called the purkinje cells (Bellebaum et al, 2007; Karatekin et al, 2000; Middleton & Strick, 1994). Animal studies show that physical activity increases the survival rate of purkinje cells ( Seo et al, 2010; Dickson et al, 2010; Lee et al 2014) which indicates that movement could help children to learn by stimulating their cerebellum and remodeling neural connections via the purkinje cells with prefrontal regions (logic and learning regions) in their brain[ thus promoting the neural networks involved in learning.

The proof of all this is in the pudding: over the last 15 years or so, as American academic performance has been plummeting, Nordic countries such as Finland have begun to dominate the scene, especially in math and science. What have they done differently? Cut classroom time by as much as 50% and done as much of their teaching as possible outside through movement (Ratey, 2008).

How does this relate specifically to autism?

Many studies looking at the post mortem brains of children with autism have demonstrated a cerebellar dysfunction resulting in purkinje cell loss (Allen, 2005). In fact this is one of the most consistent findings with approximately ninety-five percent of autistic brains examined at autopsy showing this reduction in purkinje neurons (Bailey et al, 1998; Bauman & Kemper, 2005). Recent research has shown that daily treadmill exercise enhances the survival rate of purkinje neurons in rats displaying autistic like symptoms (Cho et al, 2016). What this suggests is that movement may be of particular importance to a person with autism as it helps reduce purkinje cell loss resulting in a greater concentration of purkinje neurons which may lead to better learning connections between the different regions of the brain and the pre-frontal cortex in particular. In addition, autism is often associated with a delay in executive function - the brain function that allows children to flexibly switch between different places, people, moods or activities, stop themselves from yelling when they are angry or learn how to cope with

delayed gratification, all of which are often massively difficult for children on the autism spectrum (Hill, 2004). Executive control is governed by the prefrontal cortex and as previously stated physical exercise causes a significant increase in activity and connectivity in this region of the brain.

So how exactly do we use movement in Horse Boy Method & Movement Method?

In our equine therapy program, Horse Boy Method, we use the horse to provide the child with the movement that they not only crave but also need in order to be able to learn. We differ from most therapeutic riding in that we never lead the child from the ground, but instead ride in the saddle (back-ride) with the smaller children and drive the horse from behind (long-line) with the older children and adults that we work with. The reason that we do this is that when you lead a horse from the ground, as most traditional therapeutic riding barns do, you automatically pull the horse forward so that its center of gravity is at the shoulder/head. This results in a horse that is off balance and therefore a child that is off balance. When a person feels off balance then their psoas muscle (found in the pelvic region) contracts - which is thought to send a message to the amygdala that they are in danger, and which as we know causes the amygdala to trigger the release of cortisol which blocks learning. When we back-ride or long-line then we are able to produce a much more smooth and rhythmic movement as the horse's center of gravity is underneath the rider. This allows the psoas muscle to relax which in turn allows the child's hips to rock which may trigger the release of oxytocin which as we know promotes learning (Koch, 1997).

In our non-horse kinetic learning program, Movement Method, we use a wide variety of different movement based activities to provide the child with the rhythmic movement that they need. These activities can either involve the child themselves physically moving (bouncing on the trampoline, swimming, running) or the child being placed stationary on a moving object (swing, horse, wheelbarrow). The key is to ensure that the child feels safe - otherwise you risk causing the psoas muscles to contract and the amygdala to activate triggering the release of cortisol. And with that feeling of safety, the child's curiosity kicks in - and with that comes learning. Moreover with the addition of the oxytocin affect, the child also becomes motivated to communicate.

## 2. INTRINSIC MOTIVATION

Allowing a child the chance to explore in a natural environment is as important as movement itself. So too - and this is VERY important - is teaching a child through, rather than rewarding them with, their interests and obsessions.

Children are born with an intense and unrelenting curiosity and desire to explore the world around them. It's the joy of exploration that drives their learning, critical thinking, and reasoning. Recent research has shown that when we are interested in what we are learning activity is increased in the hippocampus which as we know is a region of the brain involved in the creation of memories (Gruber et al, 2014). What's more activation is also increased in the brain circuit related to reward and pleasure (Gruber et al, 2014). What this indicates is that we learn better when we are curious about and interested in what we are learning.

How does this relate to autism?

Studies have shown that children with autism often exhibit a dysfunction in their reward system (Kohls et al, 2013) indicating that they may respond less well to extrinsic or reward based motivation than neurotypical children. What this suggests is that it is particularly important to encourage curiosity and an intrinsic desire to learn in this subset of the population as they do not respond well to the more traditional approach. Basically this means that is if you try reward/punishment based learning with autistic children, you will not get nearly as far as if you teach by following the child's intrinsic interests and obsessions, using them as departure points from which to explore the whole academic spectrum. This means that far from being indulgent, when you allow the child to follow their obsessions, you actually have a more effective doorway into teaching them the stuff they aren't so interested in: you just have to start with their obsessions and then put that 'not so interesting thing' into the language and terminology of the obsession. For example, a child loves Minecraft wolves. So we start there and then gradually begin to talk about patterns and numbers of Minecraft wolves, and then geometry and statistics of Minecraft wolves. And after a short time this starts to generalize over into other contexts.

How do we foster curiosity in Horse Boy Method & Movement Method?

We start by creating what we call a 'YES' environment for the child - which means that we allow them to touch everything and explore everywhere so long as it is physically safe for them to do so - and set the environment up in advance to ensure this. We then teach the child in a flexible, fun, pressure-free way through their passions, interests and obsessions with the goal of helping them develop a joy for learning. We design educational activities - both general modules and individually tailored ones - which are adapted to each child's intrinsic interests, and find ways to indirectly test their knowledge through treasure hunts and specially designed games. In short we tailor everything that we do to each individual child and rely heavily on intrinsic motivation to encourage learning and discovery.

We design these modules in collaboration with several universities worldwide, including the University of Texas School of Education, Osnabruek University in Germany's

Department of Physics, Belmont University Nashville's Occupational Therapy Department, and specialists from France's leading neuro-science school The Institute Pierre et Marie Curie, and the Pedagogics program at Italy's University of Bologna, to name but a few. These modules, designed for every cognitive level, are available through our websites, [horseboyworld.com](http://horseboyworld.com) and [kidsmustmove.com](http://kidsmustmove.com)

## CONCLUSION

Whether using horses with Horse Boy Method, or in Movement Method's classroom, homeschool and therapeutic settings, we use this science to calm the nervous system and break the child out of the vicious cortisol cycle that has been blocking brain development, and finally help the brain re-pattern itself for learning - from the most basic cognitive levels to really advanced math and science modules and everything in-between. Finally the child begins to teach us: all without the child having any idea that they are having therapy or that they are learning academics. The child never resists what we try to teach them, whether it's basic communication, literacy or numeracy, or pre college level mathematical exercises like statistics, higher geometry and physics - because it all just feels like fun. And that is why it works.

As Robert Naviaux, founder and co-director of the Mitochondrial and Metabolic Disease Center (MMDC) and Professor of Medicine, Pediatrics, Pathology and Genetics at University of California, San Diego and one of America's leading researchers into autism, writes about both Horse Boy and Movement Method:

“ I think that specific kinds of motion produced by the horse's canter and other movements that you described have many effects. One is proprioception, vestibular, and cerebellar sensorimotor integration. Another is to work on the sacral, parasympathetic plexus of autonomic nerves that sends safety signals to the brainstem via the vagus nerve. We did a lot of work on cortisol and purinergic signaling early on. The release of extracellular ATP is a direct trigger of cortisol release from the adrenal cortex. This is a fundamental part of the cell danger response (CDR). You've hit on a hugely successful way of helping to turn off this danger/stress signal through healthy, rhythmic motion. Purkinje cells are the brain's "chill pill". They help calm all the other circuits by discharging 50 times per second, sending out the message, "All's well". When the rest of the brain circuits are working overtime with alarm or danger signals, Purkinje cells can become metabolically exhausted trying to calm the fire in the overactive brain. This can lead to cell death. Exercise and the right kinds of movement help to calm the brain, so Purkinje cells don't have to work so hard to calm the storms. This preserves the Purkinje cells, and fundamentally helps reinforce normal developmental circuits, not only in the brain, but also reinforces sensory motor, and neuroendocrine signals that connect all systems of the body. The body works best when all its parts are communicating and coordinated. Autism loosens some of these connections at a cellular level, producing

anxiety and fear of change. Movement and metabolism help to reconnect the islands with the main, and allay anxiety at a cellular level.”

And as Dr Temple Grandin adds:

“Horse Boy and Movement method provide many new insights into how helping individuals with autism using horses, movement, and immersion in the natural world; novel teaching techniques using play equipment, a car ride, even time on a couch can be done anywhere by anyone and they work!”

Now you know the science of why.

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