

THE MEAGHAN REPORT

**A Penetrating Look Inside The Mind of Autism That Will
Make You Question All That You Thought You Knew**

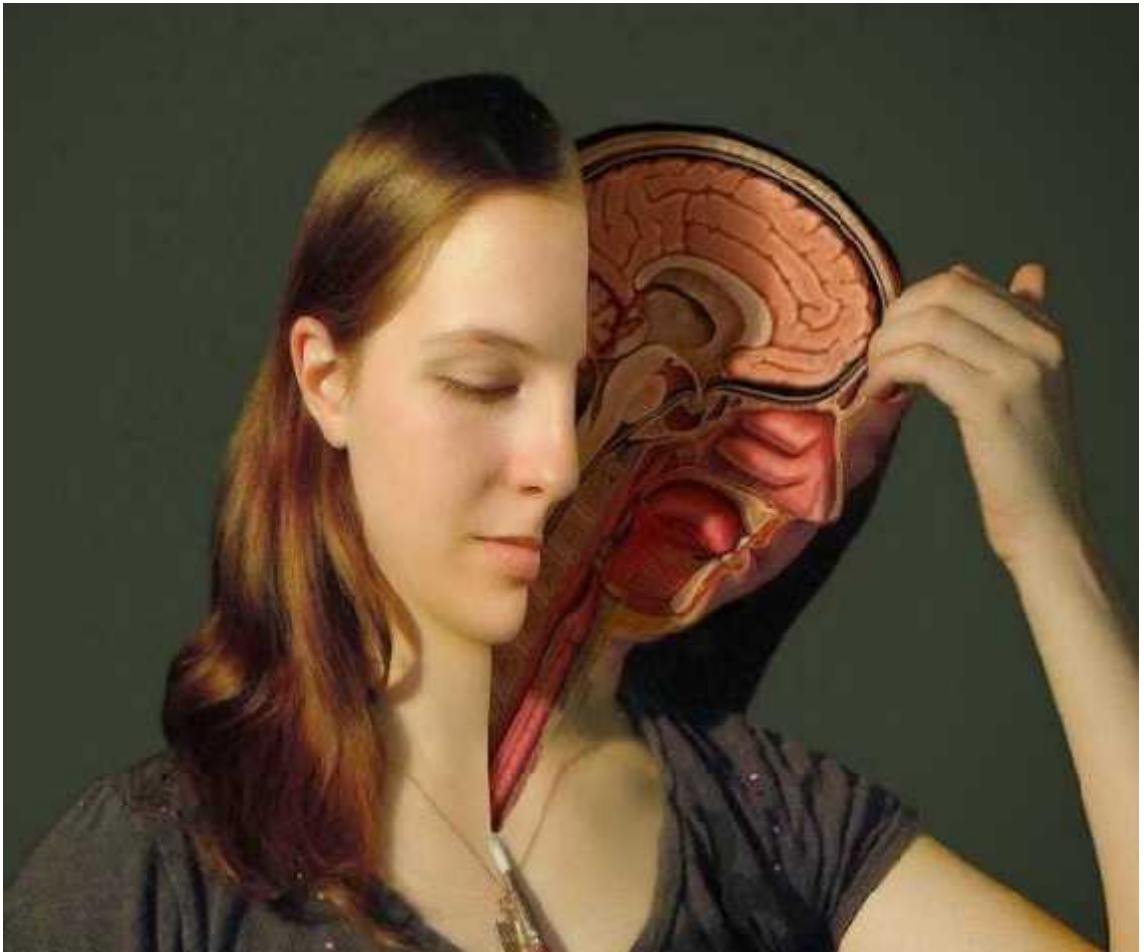


First hand account and exploration of the split brain, fragmented body sense and imbalanced intelligence of the autistic brain and why this extraordinary wiring is such a neurological gift to us.

by **Meaghan Buckley**, ASD Expert, Living with Autism For 34 years
and **Gail Buckley**, Meaghan's Mom, BS, Cornell University, Writer

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Meaghan's entries are written in this text throughout this document.

Having lived with ASD for 34 years, she provides the much needed insight on how it feels to be autistic. She does this by means of typing on an iPad. She started typing with support four years ago. Today, after a lot of hard work, she is able to type independently. This has changed her life and ours in ways you cannot imagine, It is our hope that her experience and intelligence along with my research will help others come to a better understanding of those whose brains are different than ours.

Having autism is not something you choose. It is something that gets brought to you, kind of like a lousy gift. At first it can be awful because the sensory distortions are truly frightening, but as you grow older and become more accustomed to them, you figure out ways to cope. You have to or you would curl up in a ball and stay that way forever.

Having autism is hard work. It feels like I am having a meltdown all the time. I am always on hyper drive. At first I thought I was crazy. Then I realized that I was just different. And I am OK with that.

What people don't understand is that everyone finds their own way of existing in the world. For some of us that existence is made more difficult by preconceptions that are false. For a long time too many of us were unable to refute these beliefs, but now I can communicate by typing.

You see, I have always had words inside my head. Piles and piles of words. The problem is, I cannot speak these words because my nervous system is too hyped up and my motor impulses are hard to control. I struggle mightily every minute of every day to control my impulsivity. The hardest thing I have ever done is learn to type without support, but it is also the most important thing.

This might not seem like a big deal to you, but when I discovered that my finger could do the talking it was the very best day of my life. For almost 30 years all my words and thoughts were trapped inside my head and suddenly they were being set free. For me typing is a natural means of expression, kind of like your voice is for you.

I have goals in my life just like everyone else. An important one is to teach others about autism. Understanding is the key to getting better services and results. I want to spread the word that autism is not something to fear but rather something to have respect for.

Those of us with autism are not crippled but rather blessed with having heightened sensitivities and abilities. That is if you look beneath the surface. Having autism is a strength not a weakness. Not being able to communicate this to those who so misjudge us is the ultimate irony and tragedy.

Meaghan Buckley



"Autism Is The Sensory
Upheaval of The Brain"

- Meaghan Buckley

SHATTERED BRAIN: THE BRAIN BODY DISCONNECT



“When I close my eyes, I feel like my body disappears.”

~ Meaghan Buckley

The year was 1943. Lieutenant Lyova Zazetsky, just 23 years old, led his platoon of soldiers west across the banks of the frozen Vorya River in Russia. The men were tired, as they had been fighting for several months to take back the occupied town of Smolensk.¹

Before long the Nazi enemy was engaged and a barrage of machine gun bullets were flying. Zazetsky ducked down, but not soon enough to escape a bullet that penetrated his helmet, then his skull.

He survived the battle, but his life was never to be the same. He sustained a severe head wound, causing massive damage to the left occipito-parietal region of his brain, leaving him in a coma. This injury shattered his whole perceptual world.²

His right field of vision had been destroyed, as had his memory and his awareness of the entire right side of his body - all shattered into fragments, causing him to experience the world (and himself) as constantly shifting and unstable.³

Zazetsky had been a gifted student who had studied at a polytechnical institute for 3 years before war broke out in 1941. Now he had trouble remembering the names of even the simplest things. He might want a drink, but instead would ask for a *duck* or a *bird*. 4

Being asked to identify different parts of his body was a major challenge, and he was frequently forced to "hunt" for the location of his hand, foot or arm that he was trying to name. 5

The "spatial peculiarities" that Zazetsky experienced made writing a particular challenge for him. He forced himself to learn how to sit at a table and grasp a pencil properly. After weeks of rehabilitation, Zazetsky regained the ability to write, although this process was slow and exceedingly difficult, and he could neither read nor remember what he wrote.

Not only was his concept of self affected, but his grasp of language was as well. He could utter a few words but only with great difficulty and for the most part, they did not communicate what he wanted to say. He was forced to retrain his brain to make simple logical assumptions and judgment tasks. 6

Despite his devastating impairments, Zazetsky began documenting his experience in a journal.

"This strange illness I have," he wrote, "is like living without a brain." 7

"I'm in a kind of fog all the time. All that flashes through my mind are images, hazy visions that suddenly appear and disappear... I simply can't understand what these mean." 8

Zazetsky would write in his journal almost daily for the next 25 years, filling 3,000 pages in dozens of notebooks. These diaries, documenting his struggle to make sense of his fragmented life, would form the basis of a long term friendship that he established with Aleksandr Romanovich Luria, a 41 year old psychologist and physician who headed up a research team at the Russian army hospital where Zazetsky was convalescing.

As luck would have it, Luria had been fascinated all his life by the brain and, in particular, aphasia, the difficulty speaking, reading and writing that often follows traumatic brain injury or stroke. So, for him, meeting Zazetsky and reading his writings was like winning the lottery.

After Zazetsky returned home, the two men stayed in touch for thirty years. The upshot of their shared passion for understanding Zazetsky's strange mental state

was Luria's 1972 publication, The Man with a Shattered World: The History of a Brain Wound.

I am frustrated and mad at my body for not listening to my brain.

When I close my eyes, I feel like my body disappears.

Body sense, we pay so little attention to it and yet, it is perhaps the sense that has the biggest impact on our life, as Zazetsky's account demonstrates. His head wound shattered his perception of the entire right side of his body and fractured his reality for the remainder of his life. He felt like he was "living without a brain."

Vision, hearing, smell, taste and touch. If asked which of these senses we would hate to lose most, for most of us it would probably be a toss up between vision and hearing. But there is another sense that we'd probably miss even more if it were suddenly taken away from us. Because unlike the five senses that allow us to experience the outside world, proprioception enables us to understand our physical place in that world. 9

Without a functioning proprioceptive sense there is a brain body disconnect, much like Zazetsky experienced on half of his body. As Nature's Allison Abbot says: "Without it, our brains are lost." 10

Close your eyes and bring the fingertips of your right hand to touch those of your left. If everything is working properly, this shouldn't be a problem because your brain can sense your body, as well as its position and movement through space. This is proprioception at work. 11

in 1906, neurophysiologist Charles Sherrington coined the term *proprioception*, a word that literally means "one's own." Proprioception, he said, was an awareness of the body, which stems from sensory receptors or proprioceptors in the muscles, tendons and joints.¹² Proprioceptors send pressure and movement impulses to the brain that let us know where our body is in space.¹³ This movement aspect of proprioception is called Kinesthesia.

Proprioceptive receptors also work in the absence of movement, which is how we instinctively know where our hand is, even when it's still.

Sensory information about balance, equilibrium and spatial orientation is provided by the vestibular apparatus in each of our ears. Our vestibular system is part of our proprioceptive system. If one is not working properly, chances are pretty good that the other isn't either.¹⁴

And if your proprioceptive system isn't working as it should to give you voluntary control over body, you might just feel that it has control over you.

Very few people understand what autism is all about. It is not a verbal disorder. It is a sensory motor disorder. What I mean by this is that you become a slave to your body. Anything you want to do you have to think really hard about and even then your body can screw it up.

Do you lack sensation in all parts of your body, Meg, or just some?

All parts.

What about facial expressions? I know that whenever you are asked to smile you say "cheese." Is it because you cannot feel your mouth?

Yes. I cannot stretch my mouth into a smile voluntarily.

Is this lack of sensation of your mouth why you chew on things?

Yes. I chew to feel my lips. I get really good sensation back from my mouth.

So when you hit yourself?

I am frustrated at not being able to communicate. And also it helps me to feel my body.

What about your repeating?

I repeat to escape myself. Believe it or not, it creates a calm sensation when I am feeling over-stimulated or anxious, which is pretty much all the time.

I don't have good system control. Each time I am not real wild I am trying really hard to control myself. Typing helps, it gives me peace.

Bear in mind, by body movement we are not just talking about moving arms and legs, but also your head and eyes, to visually explore the world, your facial expressions to show emotion, and for articulation, your lips, tongue and mouth to communicate.

The more intricate the neural processing task, the more ways my brain finds to screw it up. My mind just can't get coherent messages through to my mouth. Not just speech. I can tell myself to smile or stick my tongue out until I am blue in the face but my mouth won't respond.

The fact is, learning to speak is impossible without the proprioceptive sense. Our mouth, vocal cords, diaphragm and lungs incorporate thousands of nerve sensors that the brain uses to control their movement and determine their position. To pronounce even a single word we need to coordinate our tongue, breathing and jaw muscles. Now multiply this complexity as sentences are constructed in rapid succession during normal conversation. 15

Imagine your dentist has just given you a shot of Novocain on both sides of your mouth to numb your nerves. And then he asks you to drink some water. You silently curse him as the water dribbles down your chin onto your shirt, but you don't say anything because you know you will garble the words if you try to talk. You have lost proprioceptive control over your lips and mouth. Fortunately for you, it is only temporary.

You can bank on the fact that kids and adults with ASD want to communicate. It frustrates them that they cannot speak as easily and normally as we do. We take for granted all that goes into speaking: thinking of words to convey our idea or message, formulating them into a proper sentence and then using our lungs, vocal cords and mouth to create complex speech sounds. 16

That's a heck of a lot of complicated neural coordination, and all systems have to be on "go" if your motor cortex is going to get the job done. It would be next to impossible if your lips and tongue were not registering any proprioceptive sensation. You could not control your mouth well enough to form precise words. 17

I want to talk but the words are stuck inside my head. It is difficult to separate them out and make sense of them, much less add sound to them.

When I type, the words flow easily. For me typing is a natural means of expression, kind of like your voice is for you.

if you don't hear yourself speak, you are not going to learn to speak. It's not even a matter of hearing others speak. If language learning were only a matter of memorization, most people with autism would talk non-stop. But it is not. There is a cog in the wheel and that is proprioception.

Simply put, the only way to properly learn spoken language is to use spoken language. And in order to use spoken language, you must be able to feel and control the movement of your mouth, tongue and lips. The sense that enables you to do that is proprioception.

Before we learn to talk, most of us learn to walk and it is proprioception that allows us to recognize and control our limbs without looking at them. Of course, most of us don't realize this. We take our effortless ability to walk for granted.

Most of us walk with our heads and eyes facing forward, watching what's ahead of us or looking at our surroundings. We don't find it necessary to look down and watch every step our feet make, and this is thanks to proprioception. Without it, we would have to rely very heavily on our vision, our gait would be unsteady and our sense of balance tenuous.¹⁸

When Meaghan walks, her head is always down, always looking at the ground. I used to keep telling her to: "Look up. Look where you are going." I didn't realize that she was, in fact, watching her legs and feet to make sure they were moving because she had no sense of this. And she couldn't tell me. Imagining how frustrated she must have felt (what she wished she could say to me!)

We assume that they are looking down because that is just a peculiarity of autism, or because their eyes are sensitive to the light, which is another factor in my daughter's case. But there is so much more to it that we just don't understand. And because we don't understand, we prod them to do things that they are actually physically incapable of doing.

Never make assumptions, because they will surprise you - all the time. When I asked Meg why she kept hesitating before she hit the keys on her iPad, she typed:

Because I can't feel my finger.

I was astounded. I had never, ever considered this. Because I was thinking with my neurotypical brain and it was not an option that was part of my reality.

If you can't feel your arms and hands, it is hard to become adept at many gross motor activities, never mind fine motor skills.

In Sensory Integration and the Child, Jean Ayres says, "If the proprioception from your hands were not sufficient to tell you what your hands were doing, it would be very difficult to button clothes, take something out of a pocket, screw a lid on a jar, or remember which way to turn on a water faucet. Without adequate proprioception from the trunk and legs, you would have a very hard time

getting in or out of an automobile, walking down steep stairs, or playing a sport.”
19

Often times the problem is impulsivity. You want to do something, but your body does the exact opposite.

Picture the brain's sensory motor neurology like a garden hose. With most of us, the water power is moderated to just the right force and there is always a hand holding the hose and controlling the direction of the water flow. With the autistic brain, however, the sensory motor power is almost always on full force and most of the time there is no hand holding the hose steady, so it writhes about wildly and sprays all over the place. This is impulsivity.

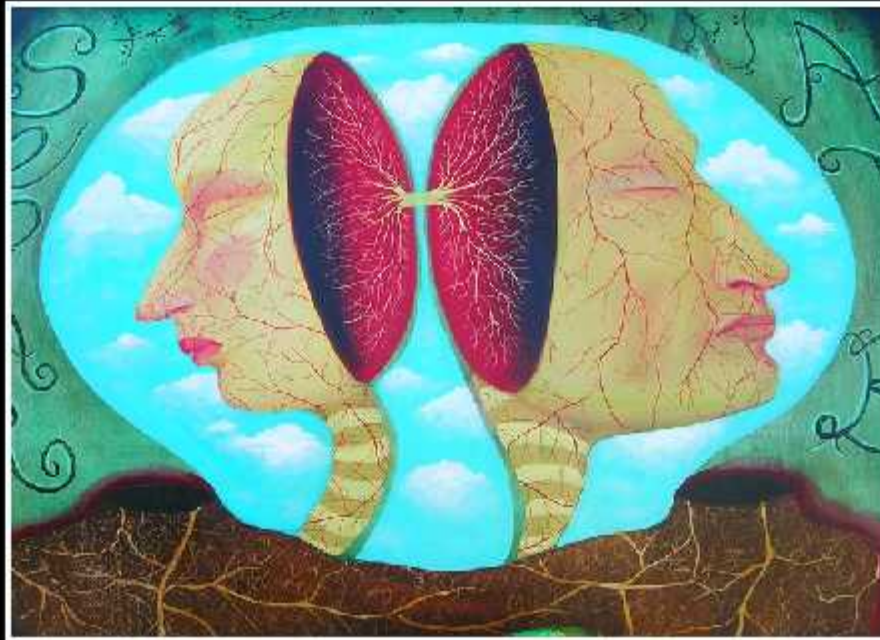
Meg and others with autism can't do much to diminish their neuromuscular impulsivity, but they can, with time, come up with ways to grab hold of the hose for brief periods of time and aim it where they want it to go. Meaghan does this with her "word focus" that allows her thoughts to flow through the garden hose to her finger. But if she lets go of that focus - or something causes her to let go of it - her sensory motor hose will go wild again.

When I type my body still wants to be in control. I have to focus hard to continuously fight the impulse to hit the same key over and over again. The funny thing is, the part you doubt most about me, my facility with words, is the very least of my problems when it comes to typing. It is the visual motor part, not the mental part, that is the real challenge.

From talking to walking to the simplest things we do each day without thinking about them, proprioception is vital to our daily life. Without it, we can't feel our bodies in space. It is crucial to our sense of body ownership and forms the basis for distinguishing "self " from "non-self." Although we tend to take it for granted, **a feeling of body ownership is the foundation of our self-awareness.** 20

Lyova Zazetsky had to find this out the hard way. Only after he had his brain blown to bits was he able to truly appreciate all he had lost. Not just the ability to speak and to see properly, but a feeling of being connected and in control of his own body. However, he could still think and, with considerable effort, he could write. And it was this writing about his fragmented perception that gave purpose to the remaining years of his life.

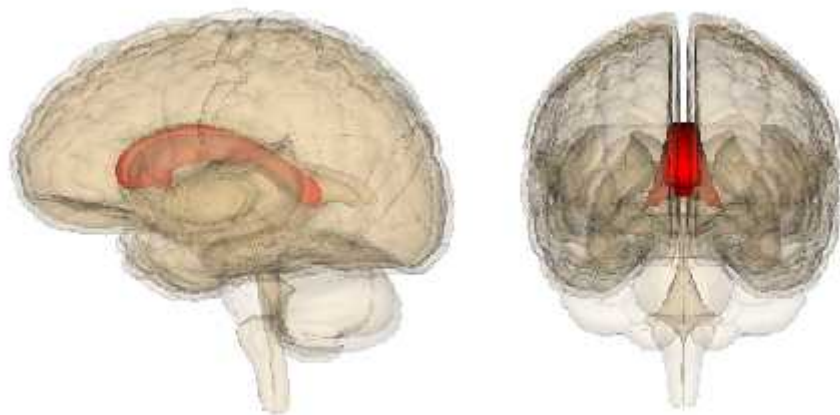
SPLIT BRAIN: TWO INDEPENDENT MINDS



"In my mind I am able to formulate thoughtful language, but what emerges from my mouth is often rote and repetitious."

~ Meaghan Buckley

Seven years after the publication of *The Man with a Shattered World*, in June 1979, a woman by the name of Vicky was undergoing brain surgery to split the two sides of her brain in half. The procedure, that lasted nearly 10 hours, was being performed in order to stop the terrible seizures that Vicky had suffered from since she was 16.



The doctors surgically sliced through the thick band of neural fibers that make up the corpus callosum, the structure that links the two hemispheres of her brain. This procedure may sound drastic nowadays, but at the time this split-brain operation, known as a corpus callostomy, was accepted practice. It was pioneered by Dr. Roger Sperry at the California Institute of Technology in the late 1950s.

Vicky's procedure was a success in that it stopped her epileptic seizures but, after she recovered, she discovered that she could no longer write. She could still speak and understand spoken language, but she could not write anything - not even her name.

This surprised her doctors because, up until that time they had assumed that all the language functions - speech, reading and writing - were all grouped together and located in the left brain.

Intrigued by this discovery, Dr. Michael Gazzaniga, head of the cognitive neuroscience program of Dartmouth College, tried an experiment.

Vicky or V.J (as she was referred to in the study) was put in front of a screen onto which words -- nouns, verbs and adjectives -- were flashed to each side of her brain independently. Her hands rested below the screen, shielded so that her eyes could not see them. Each hand held a pen over a tablet of paper. 21

When a word was shown to the left hemisphere -- the one with spoken language -- she could read the word and spell it out loud, but she could not write it down. Attempts at writing were illegible.

When words were shown to the right hemisphere, Vicky was stumped. She would look at the word and say, "Um, I think there's something there but I can't tell what it is." She could not read, speak or spell the words. But amazingly, she could write them down. 22

"She'd pick up the pencil and boom, write out the words, no problem," Dr. Gazzaniga said. "It's just astounding. Here is the executive writing system acting outside the system that can actually speak with all the usual phonological mechanisms." 23

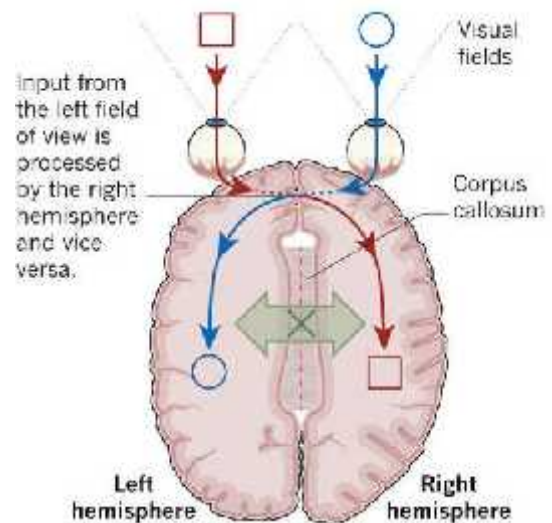
The researchers concluded that Vicky's (V.J.s) left hemisphere controlled her speech and reading, but not writing. Similar tests suggested that her right hemisphere controlled writing, but not reading, speech, or the neural functions that allow people to find the right word for an object. 24

In effect, what they discovered when they severed Vicky's brain to control her seizures, was that she was left with two separate brains, each one having abilities of its own, but neither one able to connect with the other to offer a complete, comprehensive picture. (This makes sense since the integrating corpus callosum was severed.)

These corpus callostomy studies were groundbreaking, because they gave evidence of two independently operating brains! A left and a right.

To get how this would work you have to understand that the brain is basically cross-wired with the body, so that the right hemisphere controls the left side of the body and visa versa.

The split brain studies showed that if an object was placed in the left hand (processed by the right hemisphere) it could be used but not named; whereas an object placed in the right hand (processed by the left hemisphere) could be named and described immediately. 25 It was astounding!



Meaghan is a fascinating example of this right-left brain disconnect - even though her corpus callosum is not technically split. She will often tell us one thing verbally and respond quite differently in writing. Her verbal responses are quick and rote. If shown a picture of something familiar, she will have no difficulty naming it verbally. But when we go beyond the familiar, the differences become clear.

The other day I put on a pair of her sun glasses that were lying on the table in front of us, looked at her and asked: What do you see?

She promptly answered: "glasses."

I then asked her to type her response. She typed:

"Mommy wearing my sun glasses."

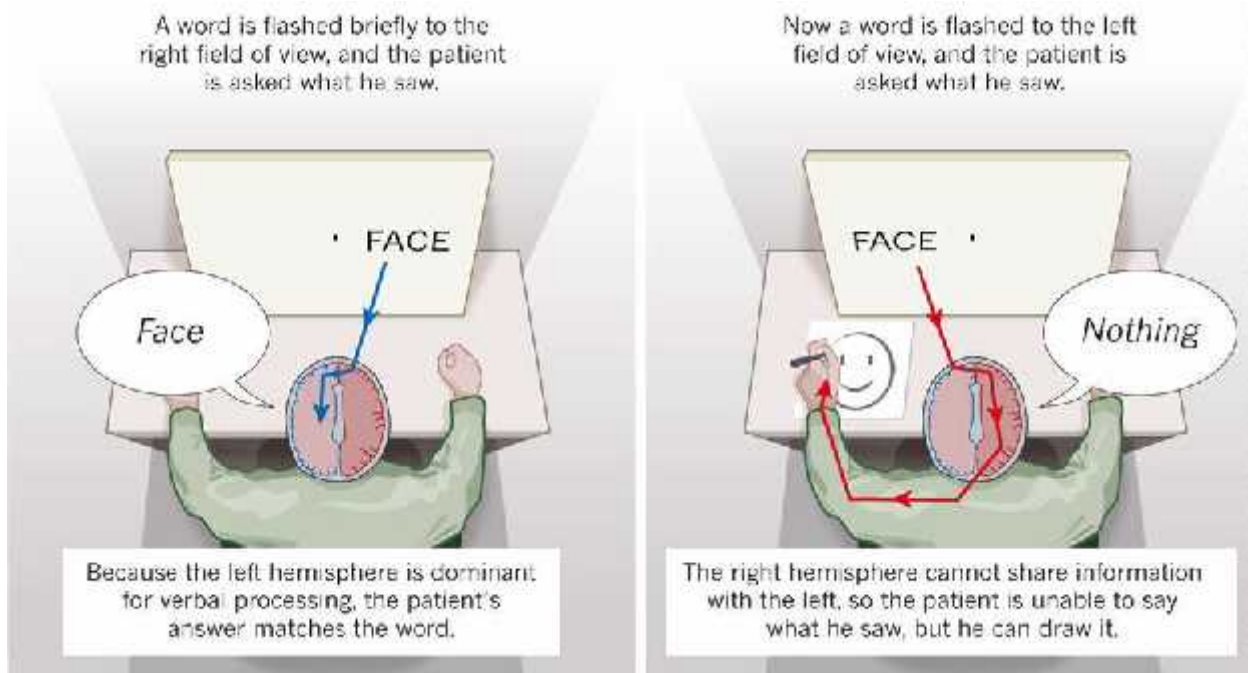
There was a blue and white decorative ceramic vase in the shape of a fish on the table. I asked her what it was.

She promptly answered: "milk."

When I asked her to type her response. She typed:

"A fish vase made out of clay."

It really is remarkable the difference in the two responses, and I could give hundreds more examples. The thing is, this dichotomy of answers does not faze her. She knows that her verbal answers are mostly "nonsense" (her term) and she says to ignore them. Unfortunately, many people don't. Many people think that they are all she is capable of. I'm sure she is not the only one caught in this trap.



Gazzaniga and Sperry found that several patients who had undergone a complete callosotomy suffered from a disconnection syndrome. In patients with a disconnection syndrome the right hemisphere, which controls the left hand and foot, acts independently of the left hemisphere and the person's ability to make rational decisions. This can give rise to a kind of split personality, in which the left hemisphere give orders that reflect the person's rational goals, whereas the right hemisphere issues conflicting demands that reveal hidden desires. 26

One of Gazzaniga and Sperry's child participants, Paul S, had a fully functional language center in both hemispheres. This allowed the researchers to question each side of the brain. When they asked the right side what their patient wanted to be when he grew up, he replied "an automobile racer." When they posed the same question to the left, however, he responded "a draftsman." Another patient pulled down his pants with the left hand and back up with the right in a continuing struggle. On a different occasion, this same patient's left

hand made an attempt to strike his unsuspecting wife as his right hand grabbed the villainous limb to stop it. 27

Through studies of this [split brain] group, neuroscientists now know that the healthy brain can look like two markedly different machines, cabled together and exchanging a torrent of data. But when the primary cable is severed, information — a word, an object, a picture — presented to one hemisphere goes unnoticed in the other. 28

There are clearly, in some people, separate areas in the brain for oral language and written language and it is entirely possible to communicate one thing vocally and entirely different thing verbally.

The implications of this are very important because, if there is a disconnect between the right and left brains in autism (a problem with the wiring of their corpus callosum) and visual information of forms and objects is processed on one side and writing on the other, this could result in selective aphasia. Meaning, they could look at a picture or object presented to them and know what it was, even be able to say what it was, but NOT be able to write or type what it was because the connecting network between the two sides of their brain that would enable the object recognition side to communicate with the writing side was not doing its job. This could work in reverse as well, where they would write what the object was but not speak it's name.

The shift in language processing from one side of the brain to the other has been proposed before for ASD children, but I think that Meaghan and others like her have language processing capabilities on both sides of their brain. This would help to explain the symmetry of their brains. It would also explain her two separate piles of words and why there is such a huge discrepancy in the language she writes and the language she speaks. She is using two completely different brains. Typically, these two sides of the brain would act together, but in autism, since the neural connecting wires of the corpus callosum are either jumbled or inefficient, the two sides of the brain operate essentially independently, much like the brains of split brain or severely brain injured persons.

Today, we can get a much better view of brain function by using imaging techniques, especially magnetic resonance imaging (MRI), a safe procedure that uses magnetic fields to take pictures of the brain. Using MRI to measure brain function is called functional MRI (fMRI), which detects signals from magnetic properties of blood in vessels supplying oxygen to brain cells. 29

These sophisticated imaging tools can show us just about anything we want to see when it comes to brain activity. **But what imaging scans can't show us is the human story behind the technology.** They can't show us, for example, a person

who may not be able to read aloud a word when it's presented to the right hemisphere, but who has no difficulty in pointing to the appropriate drawing and either writing or typing the word.

"This gives you a sense of the right hemisphere's ability to read, even if it can't access the motor system to produce speech," Richard Ivry, director of the Institute of Cognitive and Brain Sciences at the University of California says. "Imaging is very good for telling you where something happens," he adds, "whereas patient work can tell you how something happens."³⁰

In fact, it is possible to have no verbal language at all and still have the ability to write eloquently and intelligently. Why? Because we have two sides to our brain, each of which can work either together or independently, to a greater or lesser degree. I believe this is what is happening in some autistic brains.

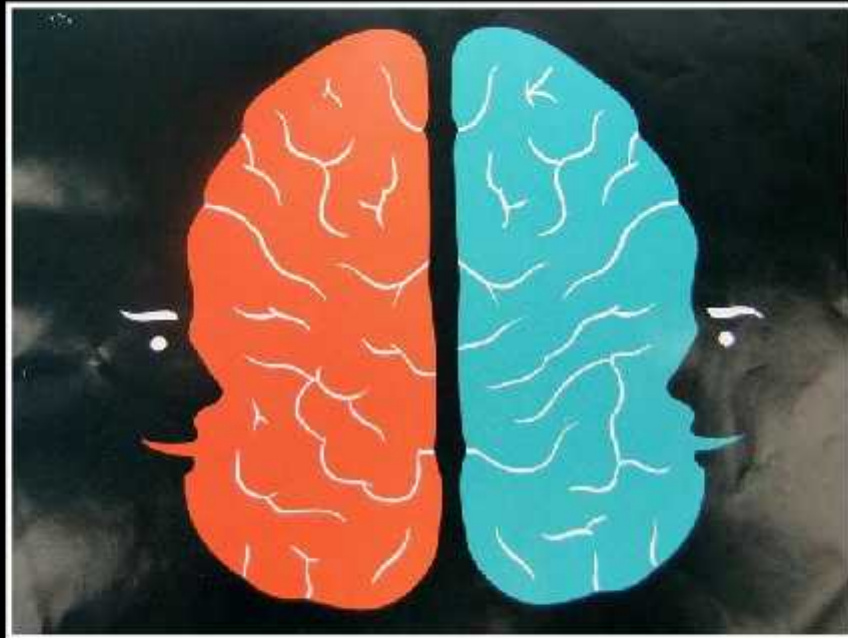
"With split-brain patients, you can see the impact of disconnecting a huge portion of that network, but without damage to any particular modules," says Michael Miller, a psychologist at the University of California, Santa Barbara. ³¹

I believe this separation of biology and ability is key if we are going to truly get to the bottom of what makes one human being different from another. It is all too easy to assume a disability if there is no understanding of exactly how each small idiosyncrasy in the brain alters a person's perception and ability.

I have autism. I am also very intelligent. These two things are completely compatible. My autism has no bearing on my intelligence. Autism makes it difficult to control my body but my mind functions fine. The problem is the disconnect between my mind and my body.

My mind tells my body one thing, my body does what it wants. So in my mind I am able to formulate thoughtful language, but what emerges from my mouth is often rote and repetitious.

LANGUAGE CENTERS ON BOTH SIDES OF THE BRAIN



"I can recall written words but my auditory memory is limited to rehearsed phrases. The word piles are different."

~ Meaghan Buckley

Kim Peek was born on November 11, 1951 with an enlarged head, a malformed cerebellum and the absence of a corpus callosum in his brain. ³² That's what he didn't have.

What he did have was a computer-like mind, which allowed him to have word-for-word memory of over 9000 books - including the Bible, note-for-note recall of classical music, encyclopedic knowledge of all US zip codes, all roads in the US and Canada, world and American history, sports, movies, geography, church history, the space program and more. ³²

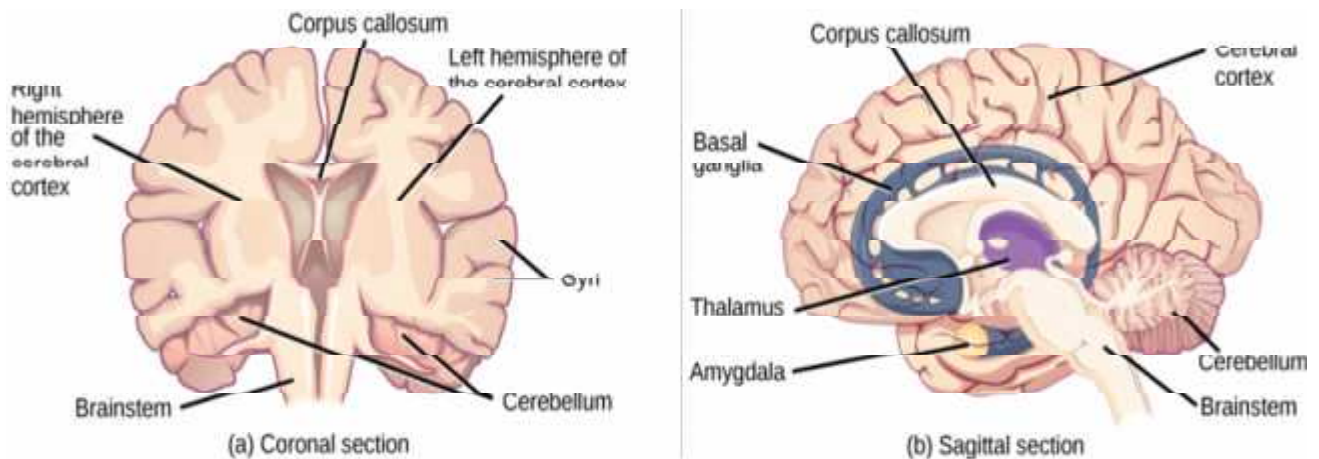
Peek could read the pages of a book in 8-10 seconds and retain the information. He was able to split his vision, so that each eye scanned its corresponding page in a book, allowing him to process both pages at once. The reason Peek could read so much information so fast was because he had developed language areas in both hemispheres of his brain. ³³

Reading typically involves a side to side, back and forth transfer of information before the brain can process what is being read. In Peek's case, since there was

no corpus callosum, there was no transfer ability. This led to the development of dual language centers and his extremely fast reading capabilities. 34

Meaghan also has this instant reading and comprehension ability. All she has to do is look at a written page for a few seconds to absorb its contents and she has perfect recall of everything she's read. So I assume she too is bypassing the traditional right brain-left brain transfer process.

Despite all these abilities, however, Peek was unable to button his shirt, and he had difficulties performing routine, everyday tasks. If someone just observed him and was unaware of his amazing savant abilities, they might have assumed he was mentally disabled, rather than just differently abled.



Individuals born without a corpus callosum, like Peek, have a congenital disorder known as *agenesis*, and many of them have trouble looking at faces and looking at others in the eyes. They also tend to have difficulty in social situations. This makes sense since, without an integrating corpus callosum, they would struggle with self awareness, making social judgments and participating in social interactions difficult. 35

Sounds like people with autism, doesn't it? And there is good reason for this because studies have shown that the corpus callosum in people with autism is atypical. It is either reduced or increased in size. Reduction in size could indicate fewer integrating connections; increase in size could mean more complicated, inefficient connections.

"If efficiency is the goal, you can have efficiency being diminished by the absence of connections, but you can also have efficiency being interrupted by too many overloaded connections," neurologist and founder of the Brain Research Program, Dr. Elliot Sherr says. 36

This lack of exchange of integrating information between the two sides of the brain could easily explain the left brain tendency of people with autism to get more bogged down by detail and have more difficulty separating out the forest from the trees.

I have an amazing memory for details. I remember all of my toys and all of my educational games in minute detail. You would be surprised at how much information I absorb just existing. Tiny itty bitty details. Every time mom read to us I envisioned the words.

But what about the right side of their brains? If the left side is acting as an independent agent, might not the right side be doing the same? In the past few years, imaging studies have shown that the right hemisphere is heavily involved in the processing of others' emotions, intentions and beliefs — what many scientists have come to understand as the 'theory of mind'. 37

In 2009, researchers presented two split-brain patients with a series of stories, each of which involved either accidental or intentional harm. The aim was to find out whether the patients felt that someone who intends to poison his boss but fails because he mistakes sugar for rat poison, is on equal moral ground with someone who accidentally kills his boss by mistaking rat poison for sugar. (Most people conclude that the former is more morally reprehensible.) 38

The researchers read the stories aloud, which meant that the input was directed to the left language processing hemisphere, and they asked for verbal responses, so that the left hemisphere, guided by the interpreter mechanism, would also create and deliver the response.

So could the split-brain patients make a conventional moral judgment using just one side of the brain? 39

It turns out they couldn't. They thought both scenarios were morally equal, which suggest that both sides of the brain working together are necessary for this type of reasoning task. And that if there is a problem in the connection between the two sides of the brain, then theory of mind might not be happening.

We know it isn't happening in people with autism, so we might assume that the **two sides of the autistic brain are not communicating as they should AND quite possibly each side is operating as an independent entity.**

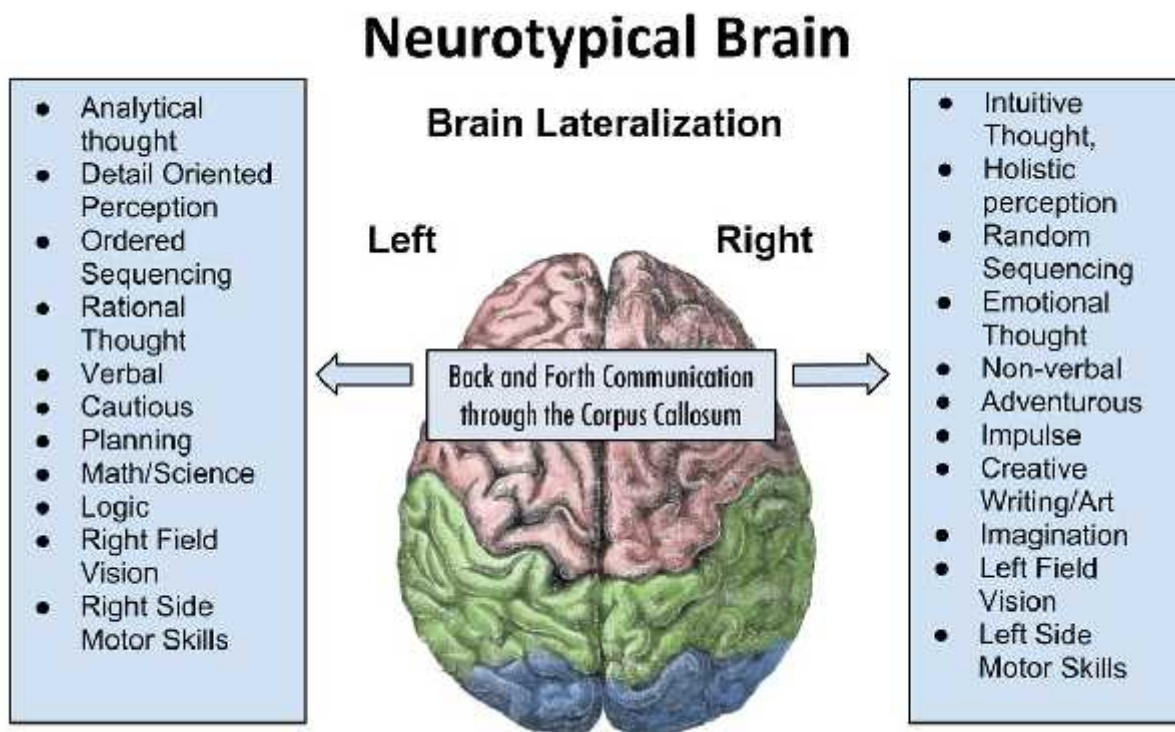
Let's explore this further. Postmortem studies have shown that autistic brains tend to be nice and symmetrical, with both the left and right sides being of equal size, while neurotypical brains tend to be asymmetrical or lopsided. 40

The reason for this could be because, in autism, the two sides of the brain are operating as independent systems, or because the functionality of each side is better balanced (i.e. there are language regions in both sides).

Functional MRI (fMRI) testing with young children with ASD found that when they listened to a bedtime story they displayed more (receptive language) activity on the right side of the cerebrum (in their frontal and temporal lobes) than neurotypical controls, who displayed more activity on the left side.

The 2007 study concluded that toddlers with autism might be on a deviant developmental trajectory characterized by a greater recruitment of right hemisphere regions during speech perception. 41

We now know that the stereotype of "right brained" and "left brained" people is false. Our understanding of the brain's complexity has shown us that there are just too many discordant variables. But still, most of us tend to have dominant sides. Sides that react faster, with smoother, more coordinated sensorimotor control. 42



For most of us righties, our left hemisphere typically has a greater cell-packing density and its neural links are more tightly connected, primarily due to the fact that the language speaking and processing capabilities that we use all the time are hardwired on the left.

This isn't true for left-handers, however. Their brains tend to be much more symmetrical and balanced than those of right-handers, and the size differences between the hemispheres less pronounced. Almost like autistic brains. 43

What I am getting at here is that perhaps some people with autism are mentally ambidextrous and their brains exhibit what British psychologist Chris McManus calls "random cerebral variation." He says, even in doing everyday tasks left-handers and mixed-handers tend to exhibit more varied, unpredictable and diffuse cerebral activity than right-handers. 44

Turns out, there really is not a hard and fast rule for brain wiring, especially when it comes to language.

Remember Dr. Gazzaniga's amazement at his split-brain patient Vicky's ability to write what she couldn't speak. "It's just astounding. Here is the executive writing system acting outside the system that can actually speak, with all the usual phonological mechanisms."45

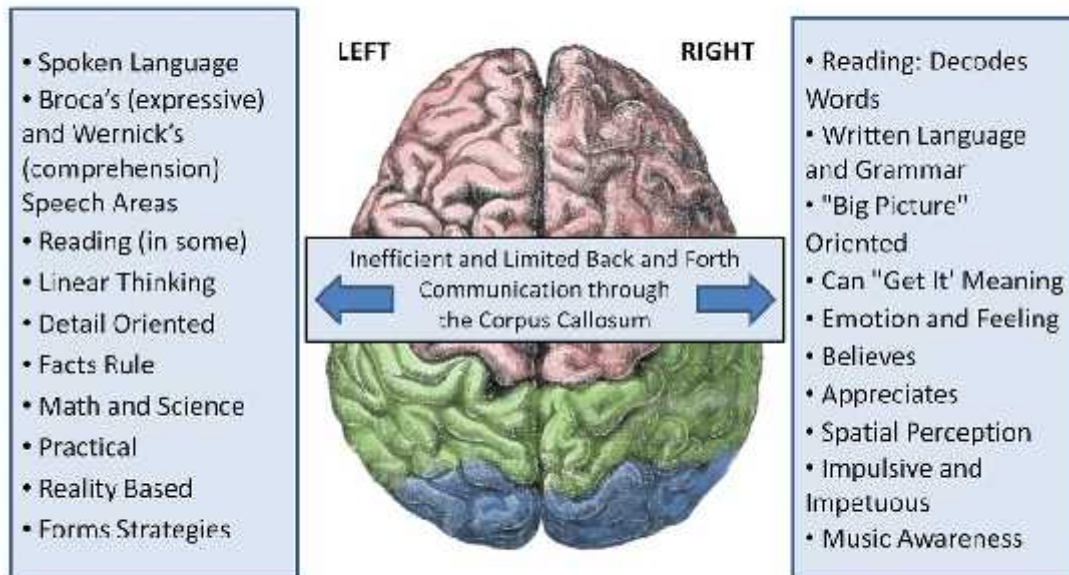
"That talking is in the left and writing in the right side of the brain in this woman is "really fascinating," said Dr. Steven Pinker, a linguist at MIT. "It suggests that reading and writing arose separately from spoken language and may be wired up in the brain wherever there are "spare areas."46

In point of fact, spoken language began about 100,000 years ago, whereas reading and writing evolved only a few thousand years ago so they are relatively new on the evolutionary timeline. Unlike speech, they are not hardwired into the brain as yet.

This means that while oral speech has been wired into established regions in the left hemispheres of our brains, reading and writing functions could be located anywhere. Theoretically, they could "hop around in your brain and even go from one side of the brain to another." 47

Children with autism, with their symmetrical and deviant brain structure, might well develop language functions in both hemispheres. Or, as Meaghan puts it, two separate piles. The left brain pile for spoken words and the right brain pile for written words. This would explain how she can use language so easily on the one hand and have such difficulty with it on the other.

Autistic Brain Lateralization



Functions More Like a "Split Brain"

Words have always had a special appeal to me. Early in my life I taught myself to read words and to understand them. When I hear words they appear in my brain as spelled out language.

I can hear all the conversations in a room all at once. Everything I hear feels like fat noise bubbles that are sitting at the top of my brain. I can read them and type them but I can not add them to my speech.

My brain is full of piles and piles of words piled up on each other. Written words.

I can recall written words but my auditory memory is limited to rehearsed phrases. The word piles are different. I think in your language but I verbalize in rote responses.

You see my brain has no problem with words and grammar. If language processing stopped at the thought level, I would get an A plus. The breakdown happens when it comes to combining words with sound, motor with sensory.

DYSMETRIA OF THE BODY AND MIND



"My mind is a slave to my body. I really don't want to do half the things I do, but my body makes me.

~ Meaghan Buckley

People should understand that autism is first and foremost a motor disorder.

Since his birth 33 years ago, Jonathan Keleher has been living without a cerebellum. This exceedingly rare condition has left Jonathan with a distinctive way of speaking and a walk that is slightly awkward. He also lacks the balance to ride a bicycle. 48

As a child, all Jonathan's milestones were late: sitting up, walking, talking. He got special education, speech therapy and physical therapy and finally, at age 5, he was referred to Dr. Jeremy Schmahmann at Massachusetts General Hospital. The neurologist took one look at his brain scan and pronounced: "He has a very big area of nothingness there where the cerebellum should be." 49

Jonathan also needed to be taught a lot of things that people with a cerebellum learn automatically: how to speak clearly, how to behave in social situations and how to show and understand emotions. 50

For decades, the cerebellum has been the "Rodney Dangerfield of the brain," says Dr. Jeremy Schmahmann, a professor of neurology at Harvard and Massachusetts General Hospital. "It gets no respect because most people only know about its role in balance and fine motor control." 51

If you've ever tried to walk a straight line while inebriated, you've experienced the effect alcohol can have on your cerebellum's control over your body, balance and coordination. If it is not doing its job right, our posture, muscle movements and sense of equilibrium can be thrown off.

"What we now understand is that what the cerebellum is doing to movement, it's also doing to intellect and personality and emotional processing," Schmahmann says. "Unless you don't have a cerebellum. Then, a person's thinking and emotions can become as clumsy as their movements." 52

Jonathan got a reminder of this at a busy intersection soon after he got his driver's license. There was a bus behind him, cars were whizzing by, and his brain simply couldn't coordinate all the information. In his confusion, he wound up totaling his father's car. 53

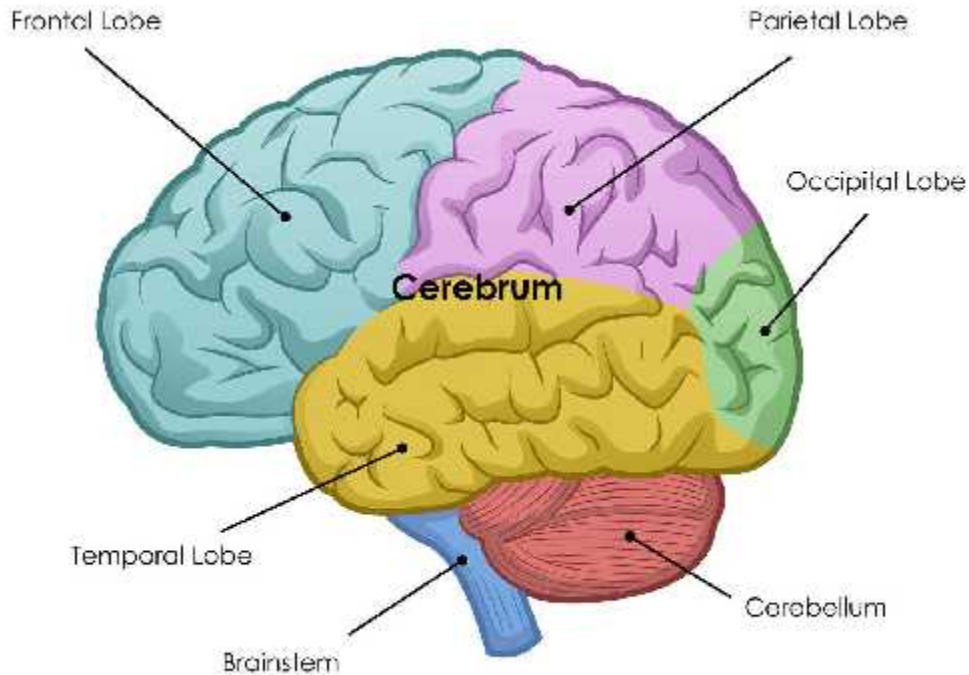
"Reaction time, not my strong suit," he concluded, adding that he doesn't drive anymore. 54

Thanks to wonderfully supportive parents and an exceptional doctor, Jonathan is managing to live pretty well these days, but it isn't as though things come easy for him. Without a cerebellum, planning and coordinating one's thoughts and actions takes a lot of effort.



Imagine if we had to go back to the days before computers. We would have a difficult time managing today, keeping track of everything we have to do and doing most of the stuff we do. Computers have taken a lot of the hard, tedious work out of our lives, so we can spend more time on things we enjoy doing.

The cerebellum is kind of like the computer system for our brain and body. It's job is to keep track of information about the movements and tasks that we do every day. Walking, talking, getting dressed, brushing our teeth etc. These routine activities and motions have been programmed into the cerebellum so we don't have to think about them any more.



The cerebellum is one of three main brain structures, the other two being the cerebrum and the brainstem. Although the cerebellum comprises only 10% of brain volume, it houses well over 50% of your brain's total neurons.

Cerebral Cortex - 16 billion neurons

Cerebellum - 69 billion neurons

For a long time it was believed that the cerebellum was primarily responsible for 'non-thinking' brain functions, such as balance, motor control and finely-tuned muscular coordination, and that the cerebral cortex was solely responsible for our higher cognitive functions. 55

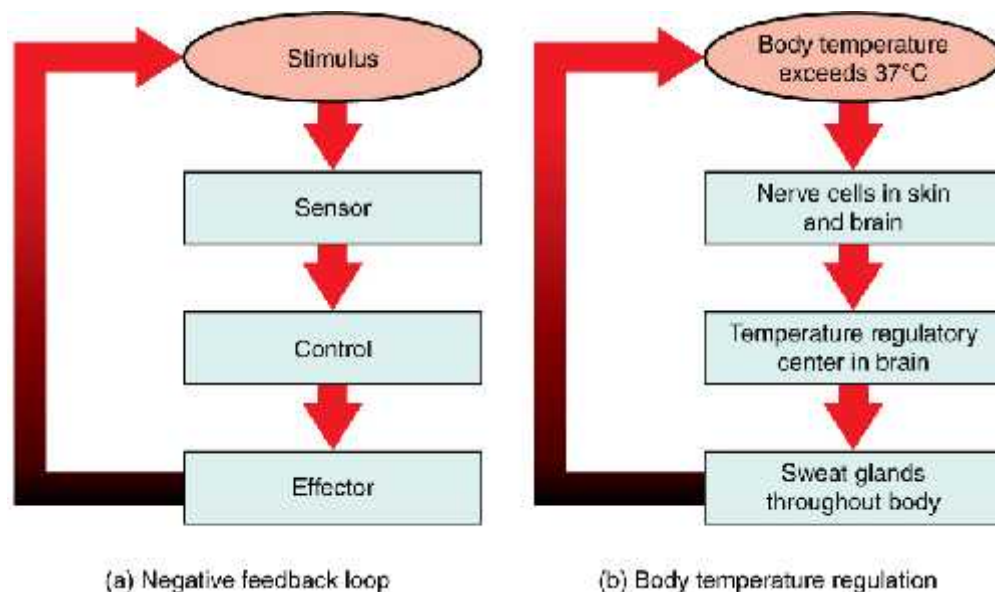
But this viewpoint has evolved in recent years and it is now believed that all those billions neurons in the cerebellum are there for a reason. It is now believed that they play a pivotal role in many cognitive and language functions, as well as in the regulation of our emotions and behavior. 56

"The big surprise from functional imaging was that when you do these language tasks and spatial tasks and thinking tasks, lo and behold the cerebellum lit up," Schmahmann says. 57

Through his research at Massachusetts General Hospital, Schmahmann has developed a theory he calls "Dysmetria of Thought." Basically, his hypothesis is that the cerebellum fine-tunes and coordinates our learning and thinking just like it fine-tunes and coordinates muscle movements. And that when there is structural or functional damage to a particular "microzone" of the cerebellum, it impacts the workings of the cerebral mind in a specific manner. 58

The definition of dysmetria is actually the lack of coordination or the undershoot or overshoot of movement. "Dysmetria of movement is matched, in the cognitive realm, by an unpredictability and illogic to social and societal interaction. The overshoot and inability in the motor system to check parameters of movement are equated with a mismatch between reality and perceived reality, and erratic attempts to correct errors of thought and behavior." 59

To understand how this works, we first have to understand how the cerebellum operates. I am going to simplify things here, because my intent is only to help you to understand the big picture. Basically the cerebellum regulates behavior around a homeostatic baseline. 60 Homeostasis, derived from the Greek words for "same" and "steady," refers to any process that living things use to actively maintain fairly stable conditions necessary for survival. 61

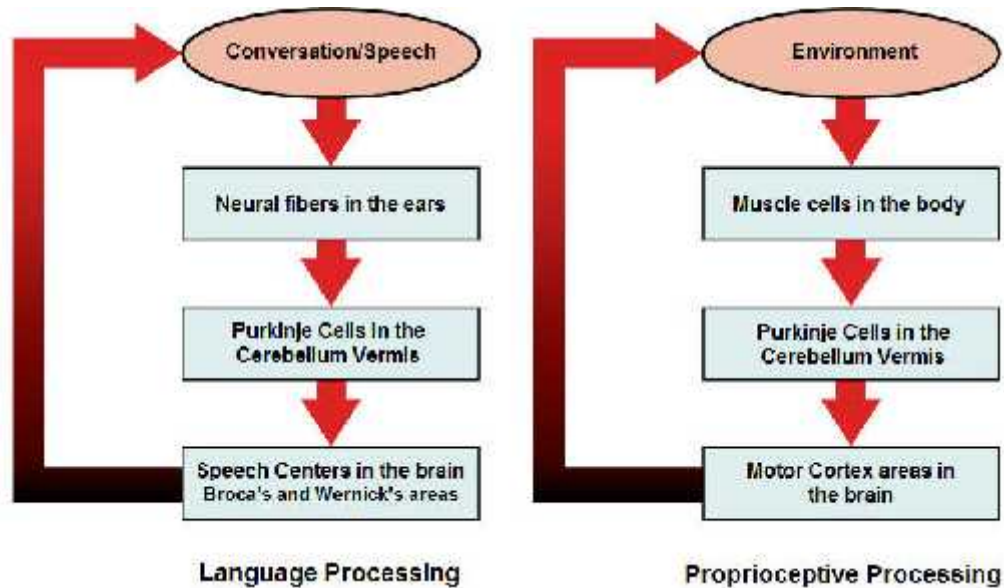


For instance, the human body uses a number of processes to control its temperature, keeping it close to the average norm of 98.6 F (37 C) degrees.

One of the most obvious physical responses to overheating is sweating, which cools the body by making more moisture on the skin available for evaporation.

I want to note here that Meaghan's homeostasis in this regard is not normal. When exposed to even the slightest heat, she sweats profusely.

Now, let's plug in some variables of our own into a hypothetical cerebellar homeostatic loop. Again, I am purposely keeping this model very simple.



What we see, is that the one area the two feedback channels, both of speech and movement, have in common is the cerebellum, in particular the cerebellum *vermis*. I think this is what Schmahmann is getting to with his dysmetria theory. The cerebellum, with all its billions of neurons, most of which are Purkinje cells, acts upon stimuli it receives in some way before moving it forward into the final centers in the cerebral cortex.

How the cerebellum acts on the stimuli depends on what form it receives it in.

If poor proprioceptive sensations are being fed into the cerebellum from the eyes, ears and vestibular system, the homeostatic balance of the brain and body is going to be off.

The cerebellum can only work with the information it is given, and if it is not getting enough data from the body, the data it relays to other parts of the brain is going to be flawed or insufficient.

1. If you feed incorrect or incomplete data into the control system, you are going to get incorrect or incomplete data out, resulting in dysmetria.
2. If you do this on a continuous basis, the dysmetria will get progressively more pronounced. (When movement dysmetria gets worse it results in a form of ataxia; when speech dysmetria gets worse it results in a form of apraxia.)
3. With so many billions of neurons at play, a genetic or abnormal "microzone" in the cerebellum vermis, could easily result in all the symptoms of autism.

The question is, which comes first, the abnormality causing the dysmetria or the proprioceptive dysfunction causing the abnormality? We will explore this further in the next chapter. (HINT: It happens in the womb.)

We can see evidence of the cerebellum's involvement in autism by the way they walk, talk and the difficulty they display with hand eye coordination. In fact, many individuals have symptoms of ataxia not just dysmetria.

Either way, control and coordination of movement does not come easy to many individuals with autism, and, as my daughter points out, the more complicated the movement, the more difficult it is for them.

I get so annoyed that I can't control my body. My mind is a slave to my body. I really don't want to do half the things I do, but my body makes me.

People think that I am stupid because I have difficulty with sports, but you try to learn sports when you can't feel or differentiate your body parts. It is not so easy. I understand what I am supposed to do perfectly well. But again, my body does not pay any attention to my mind.

If, like Jonathan, you lack a cerebellum, your master organizer for coordinating thought, emotion and movement is missing, BUT you still have all the sensations in tact. It is just going to take longer for everything to come together.

If, on the other hand, your sense of proprioception off or missing - the muscle sensory information your body takes in is not going to be reliable, so your cerebellum may be working, but it is working with bad information.

FIRE AND WIRE... AND THEN PRUNE



"I have even better eyesight and everything is not freaking me out.

~ Meaghan Buckley

The key to an efficient brain is "fire and wire," then prune.

The brain wants to be streamlined. So it builds connections through neuroplasticity and, as soon as a memory is formed or a skill is learned, it cuts the no longer necessary synapses and strengthens the connections between new brain regions that require more robust lines of communication. 62

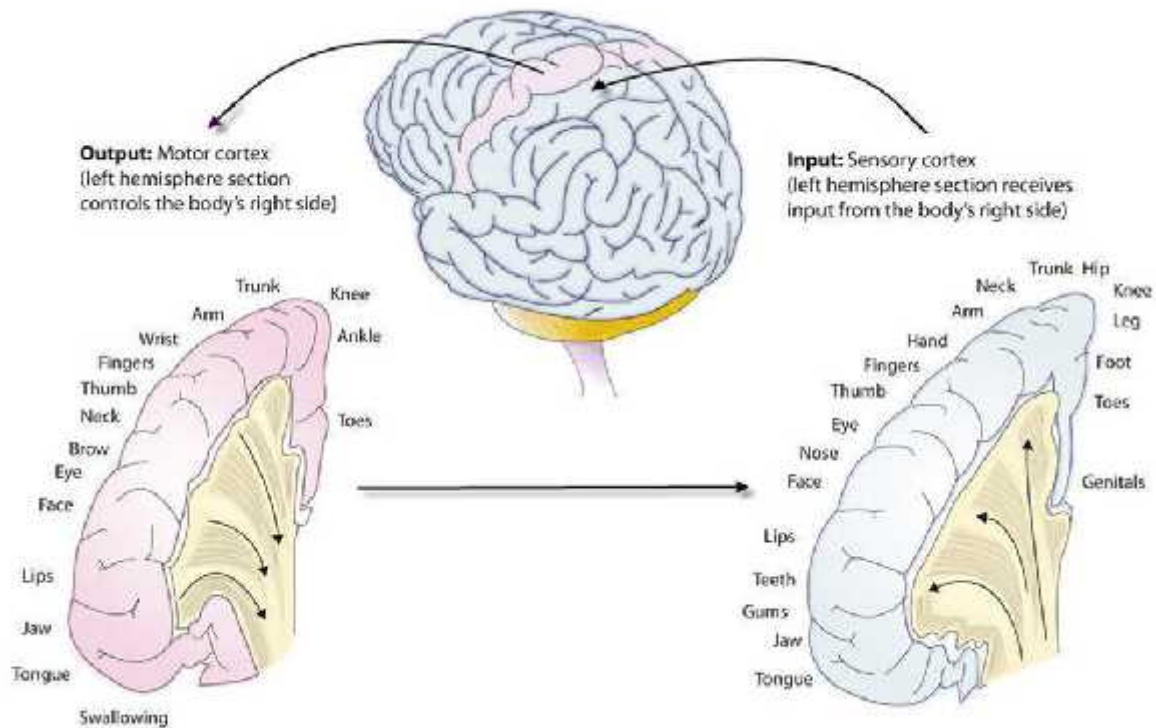
How does it know when to "fire and wire" and when to prune?

Like I've said, it basically operates on a feedback loop system. This means that information travels from one end of the brain and central nervous system (CNS) to the other, getting progressively more refined with each pass. This is true of all sensory and motor neural impulses.

So, if we know that "fire and wire" and prune makes a brain more efficient, it stands to reason that if this process is screwed up, a brain would become less efficient. If a brain just fired and wired, for example, this would lead to an excess of wires or neural connections that could get in the way of smooth processing.

This excess connectivity would be exacerbated if no pruning was taking place. The only thing that could make it worse would be if the same neurons were firing over and over again, so that the connections that were being made in the brain were not new, but were simply the same old, same old being reinforced over and over again.

Picture the operation of the brain and central nervous system (CNS) as a closed system feedback loop.

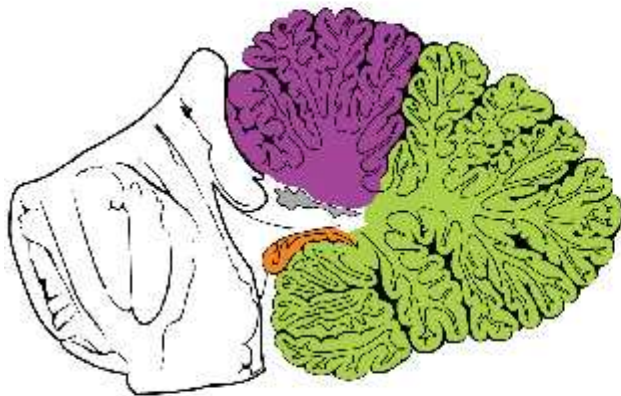


Information goes in at one end, circles around the various lobes and regions where it is progressively improved upon, and then makes its way back to the starting point where it is fine-tuned again before being sent out to make its way around the loop again for further refinement.

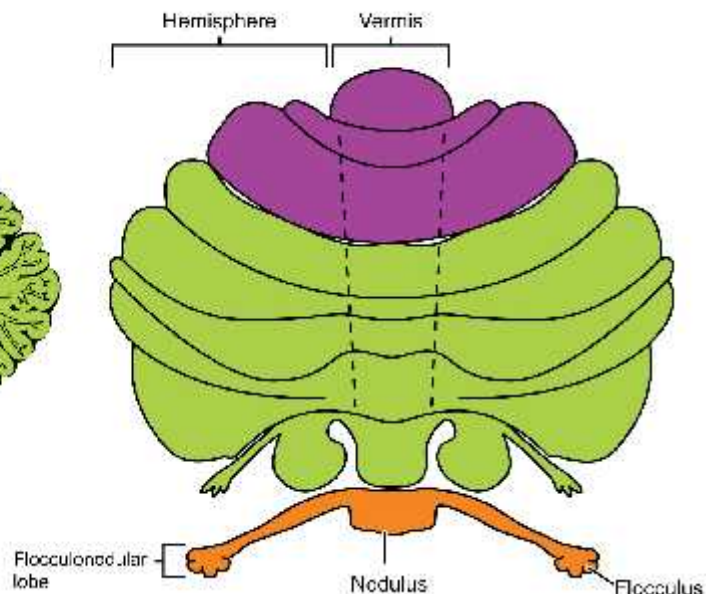
The cerebellum is the central, control cog in the closed system feedback loop.

More specifically the cerebellum vermis. As we said in the previous chapter, it receives input from our senses (eyes, ears, fingers and tongue) as well as from the muscles and joints in our body. These messages reach the cerebellum through a complex web of millions of neuronal projections called *climbing fibers*, which pulsate rhythmically, giving us an awareness of ourselves in space.

Midsagittal section of cerebellum



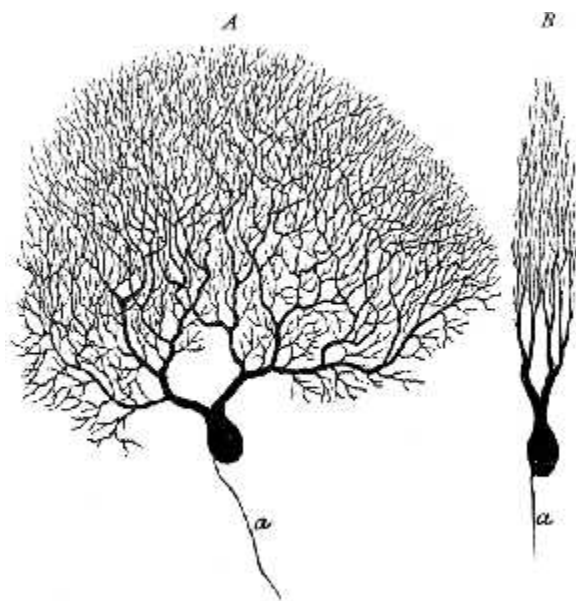
Superior view of an "unrolled" cerebellum



In a typical brain, thousands of *Purkinje neurons* tap into this *climbing fiber web* and, with each successive passage through the brain body feedback loop, they send back more fine-tuned, modulated messages, enabling us to execute coordinated actions like walking and talking and using body language to communicate.

Purkinje cells rely on connections with climbing fibers to receive an infinite number of fine-tuning updates that keep the cerebellum and cerebrum aware of when things are going right, and when there are errors or disturbances. 63

Signals from climbing fibers can trigger an appropriate sensorimotor response in milliseconds. When pruning is working normally, each Purkinje cell receives only one climbing fiber input. Tests with ASD model mice, however, show they possess an overabundance of climbing fibers which could make it more difficult to interpret an 'error signal.' 64



This means that in ASD mice, the climbing fibers are not getting pruned as they should. "Inefficient synaptic pruning seems to be a common motif in autism," Christian Hansel, PhD and professor of neurobiology at the University of Chicago,

concludes. "There are not many types of synapses in the brain where pruning can be measured easily, but climbing fibers provide an excellent model and allow us to make predictions about synaptic pruning deficits elsewhere in the brain as well." 65

Remember, ideally synapses that fire together wire together and those that are not used regularly are pruned. 66

If there is a problem with the rapid fire, ongoing interplay between the climbing fibers and Purkinje cells in the cerebellum vermis, this would impact the overall operation of the brain's feedback loop. There would be less fine tuning, less modulating of the sensory motor messages being recycled.

Currently, there appear to be three main cerebellar abnormalities observed in patients with ASD: diminished Purkinje cells, reduced cerebellar volume, and interrupted feedback pathways between the cerebellar and cerebral areas. Research on post-mortem ASD brains has shown that not only are their Purkinje cells reduced in size, but that many are defective. 67

Let's take a closer look at the key finding here: Purkinje cells that are reduced in size. The reason I am zeroing in on this is because it could be the root cause of the other three problems. Also because it fits in with our thesis of diminished or erroneous information being fed into the system.

1. If proprioceptive insensitivity and hypo or hyper sensory sensitivity is causing sensorimotor information to be under or over registered by Purkinje cells in the vermis, this could explain their reduced size and defective formation.
2. Since Purkinje cells release the inhibitory neurotransmitter GABA (*gamma-aminobutyric acid*), a reduction of these cells would result in a decrease in the inhibition of impulses going forward to the cortical areas, leading to more excitatory connections, more hypersensitivity and more impulsivity.
3. Purkinje cells that are reduced in size would have fewer synapses and connections to the climbing fibers that reach out into other regions of the brain. The fewer the connections, the more restricted the repertoire of one's thoughts, actions, emotions and behaviors.
4. And since the synaptic plasticity of Purkinje cells is dependent on old ones becoming inhibited and new ones forming as new skills are mastered, unless new learning is constantly taking place, pruning of old, defective, diminished cells is going to be stalled.

We talked about how learning something new takes a lot of "fire and wire" connections to start, but the more you master it, the fewer connections you need to retain it. **So the most efficient brains actually have fewer connections than the least efficient, unless you are literally "a master of all trades."**

But here's the thing - one of the most basic traits of people with autism is their restrictive range of interests and repetitive behaviors. Beginning in infancy they become obsessed with doing things a certain way - mouthing objects, stacking blocks, spinning wheels, flapping hands.

Perhaps this need for sameness is due to the fact that everything else in their lives is so uncertain. Since they cannot feel their bodies, they have no real sense of themselves as being real. But if you are doing the same thing over and over, it is going to trigger the same sensations in the body and brain. **Rather than expanding your neural connectivity, this is going to keep reinforcing the connectivity that already exists.**

So along with getting very little body sense information, the information the cerebellum is getting from their other senses: vision, hearing, touch etc. is pretty limited. While neurotypical children set out to explore the world, getting into anything and everything, ASD children retreat from it. They are content with their restricted repertoire of interests and activities. They are content to do the same thing over and over.

Why is this? What goes awry with the way their brain forms in the womb and early infancy that lays the foundation for problems to follow? Yes, the problem could be genetic but, since most autistic kids have a completely normal physical appearance, if genes play a part, it is not likely to be a major one. In Meaghan's case, all genetic testing came back normal.

However, what has definitely been abnormal is her primitive reflex profile. Most people haven't even heard of primitive reflexes, and that is understandable, because they are simple, automatic neural responses that help a baby survive in the womb and in the first few months of life. And they are typically gone by the age of six to nine months.

However, **primitive reflexes are the building blocks of the brain. They lay the ground work for all the neurological development that follows.** There are about twenty of them in all, and each one lays the foundation for a higher level motor and/or cognitive skill. If they are retained, that ability does not develop properly, if at all. ⁶⁹

Typically, primitive reflexes begin integrating into more mature postural reflexes as a baby becomes more active and begins to explore his/her environment.

These postural or response reflexes support a toddler's growing ability to control his balance, flexibility and movement as he begins to crawl and walk. 70

However, for some children, this transition process either doesn't happen or it is incomplete, so they wind up in a reflexive "no man's land" where traces of primitive reflexes or whole primitive reflexes remain. **This failure of the central nervous system to develop automatic movement, coordination and balance control contributes to a poor body sense or poor proprioception.** 71

In Meaghan's case, she had retained reflexes across the board, but the worst were those that impacted her vision and vestibular development. Of course, I hadn't a clue to any of this until she was in her 30s. So when I say "retained" reflexes, I am not kidding around. You would think that after all the various activities and therapies she's participated in over three decades, some of these reflexes would have integrated, but apparently not.

I can tell you that reflex integration therapy is by far, the best treatment you can give a child or adult with autism.

I use a low level laser form of reflex therapy with Meaghan called Quantum Laser Reflex Treatment. I'm not going to go into what it is (Google it) but she has responded very well to it. I was actually very surprised when I asked her how she was feeling after our first session, and she responded as follows...

Good. I can see much better. A light has been turned on in my brain.

The impact on her vision was not something I had expected at all. Here is Meaghan's description of how she felt after her 2nd Quantum Laser Treatment.

The treatments make everything easier. And I can see even better.

Meaghan's description of how she felt after 4th Quantum Laser Treatment.

I have even better eyesight and everything is not freaking me out. Yes, my goofy geeky personality really is starting to retreat.

Her vision is still over-sensitive and, when her eyes tire, she struggles a bit more with hand eye-coordination, but each week brings improvement.

Below is a chart of some of a few primitive reflexes and the symptoms of their retention, if you are interested. You can find a lot more information online.

Primitive Reflex	Purpose of Reflex	Appears	Should Integrate By:	Signs of Retention
Moro Reflex	Primitive Fight or Flight Reaction	Birth	2 to 4 Months	Hyper Sensitivity, Hyper Reactivity, Poor Impulse Control, Sensory Overload, Social & Emotional Immaturity
Rooting Reflex	Automatic Response to turn towards Food	Birth	3 to 4 Months	Fussing Eating, Thumb Sucking, Drooling, Speech and Articulation Problems
Palmer Reflex	Automatic Flexing of Fingers to Grab	Birth	5 to 6 Months	Difficulty with Fine Motor Skills, Poor Manual Dexterity, Messy Handwriting
ATNR	To Assist Baby Through Birth Canal and Develop Cross Pattern Movements	Birth	6 Months	Poor Eye-Hand Coordination, Difficulty with Handwriting, Trouble Crossing Vertical Midline, Poor Visual Tracking for Reading and Writing
Spinal Gallant Reflex	Assist Baby with Birth Process	Birth	3 to 9 Months	Unilateral or Bilateral Postural Issues, Fidgeting, Bedwetting, Poor Concentration, Poor Short Term Memory
TLR	Basis for Head Management and Postural Stability Using Major Muscle Groups	In Utero	3 1/2 Years	Poor Muscle Tone, Tendency to Walk on Toes, Poor Balance, Motion Sickness, Spatial Orientation Issues
Landau Reflex	Assist with Posture Development	4 to 5 Months	1 Year	Poor Motor Development
STNR	Preparation for Crawling	6 to 9 Months	9 to 11 Months	Tendency to Slump While Sitting, Poor Muscle Tone, Poor Eye-Hand Coordination, Inability to Sit Still and Concentrate

Since retained primitive reflexes can affect a person's sensory perceptions, causing hypersensitivity in some areas and hyposensitivity in others, a lot of children with autism have some retained reflexes. 72 And if they do, the sensory information that is being processed by their brains is going to continue to be over or under registered until the problem is addressed.

SENSORY SURVIVAL OF THE FITTEST



"I don't like doing things that involve my vision."

~ Meaghan Buckley

Even if we assume that the other five senses are not over or under sensitive and it is just the body sense that is "off," not being able to feel your body would definitely mess with your mind. And if this lack of body sensation began when you were an infant or toddler, then your brain would have to find ways to cope with and adapt to it.

Ian Waterman knows first hand how this feels. When he was only 19 years old he developed a flu-like virus that caused him to lose his proprioceptive sense almost overnight. He was later diagnosed with acute sensory neuropathy, a disease so rare that only a dozen or so similar cases are recorded in medical literature. ⁷³

The result of his total loss of proprioception was that, although his muscles worked perfectly, he was unable to control them. "Some months after his virus, Waterman was lying in bed applying all his mental energy to the fight for control of his body. He tensed his stomach muscles, lifted his head and stared down at the limbs that seemed no longer to belong to him. He willed himself to sit up." ⁷⁴

Later, he realized that it was the visual feedback that allowed his body to unexpectedly obey the mental instruction. "But the euphoria of the moment made me lose concentration and I nearly fell out of bed," he remembers. 75

From then on he learned to compensate for his deficit in proprioception with other forms of sensory feedback to help him understand where his limbs are, and thus control them. It requires constant, intense concentration, but now, despite his profound impairments, he can manage fairly normal movements.

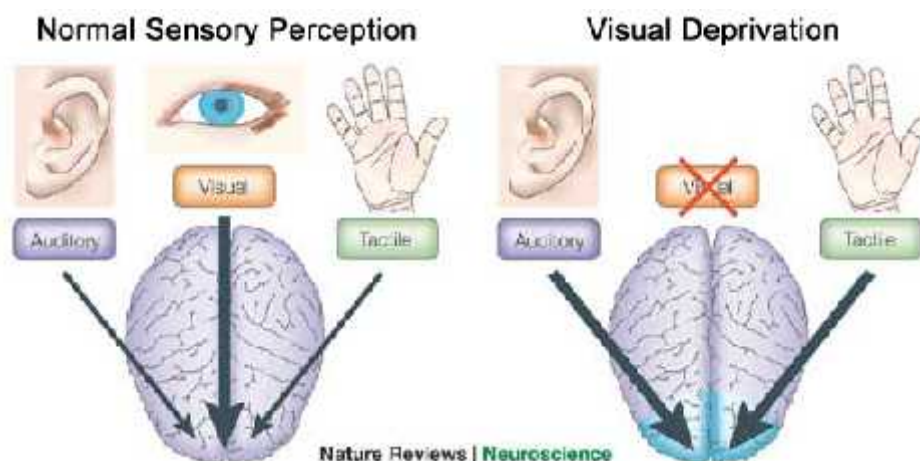
Most of the input that he relies on is visual - standing up with his eyes closed is still almost impossible. But he can tune in to the tug of a jacket sleeve to work out the direction his arm is moving or to the cool air on his armpit when he raises his arm in a loose shirt. 76

When I close my eyes, I feel like my body disappears.

What Ian's story tells us is that he compensated for his missing proprioception by using his other senses, primarily his vision. Could this be why so many children with ASD have such highly developed visual senses? And if so, how could this over-dependence on one sense over the others shape the brain?

Cross modal plasticity is the adaptive reorganization (or re-wiring) of neurons originally created for one sensory function to serve another function in the brain.

This adaptive network re-wiring generally follows long-term sensory deprivation, such as congenital blindness or deafness, but it can also occur if a person consistently tunes out a sense due to over-stimulation or sensitivity. 77



It is true that if you don't use neural networks, you lose neural networks. But it is also true that the regions of the brain do not disappear. Even though the blind are no longer able to see, the visual cortex is still in active use. It just isn't being used to process visual information. 78

I think you see where I am going with this.

If, like Meaghan, you are only using your eyes when you have to, for momentary glimpses of the world around you, how does this affect the overall development of your brain?

In Meaghan's case she has spent 30 years listening intently to every conversation that has taken place in her proximity. And all this verbal language has been imprinted in her brain as written language. It makes sense, with her auditory sense being so acute and her visual sense being under used, that some of the neglected visual processing circuits might be reassigned to the novel task of transforming speech into written words.

For kids with autism, if they are consistently tuning out visual or auditory information from a young age, it could be that their somatosensory cortex develops more like that of a blind or deaf person. By this I mean that regions of their brain that are not being used for their original purpose, simply re-wire themselves for another, more useful purpose.

Certainly this could explain some of the higher local connectivity and perhaps differences in that connectivity in the sensory regions that have been found in autistic brains. It could also explain some of the hyper-sensitivities and well as their savant-like capabilities.

But let's dig a bit deeper.

In his book, Reading and The Brain (2009), cognitive neuroscientist Stanislas Dehaene talks about how there are a lot of visual pathways that words can go through that are completely independent of the pathways that those same words go through when you are hearing them. But at some point these two pathways have to meet up. 79

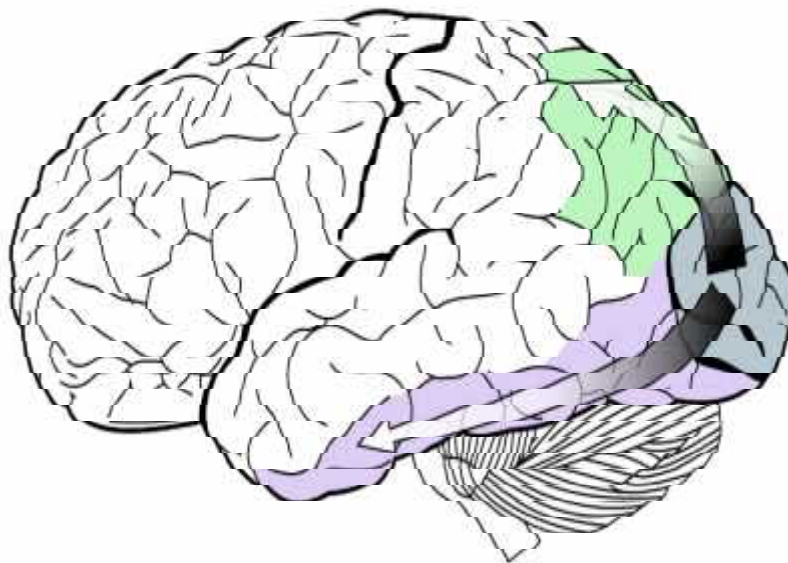
Just what happens when this co-mingling of sight and sound to form language occurs? It is actually quite interesting. Rather than discussing vision and hearing separately, I'm going to discuss the two pathways each sense takes once it enters the brain and the processing implications each pathway has for autism symptomology.

Information from our eyes and ears is routed from the cerebellum through the thalamus to the visual and auditory cortices. From here messages get split into two processing streams: one traveling up the back of the brain (dorsal), the other traveling down the back of the brain (ventral).

Both streams move forward toward the frontal lobe. In general, the farther away a stream gets from its starting point, the more complex the processing carried out by that area. 80

We're going to begin with the **ventral visual pathway**. **This pathway processes "what" information.** It goes from the primary visual cortex down to the temporal lobe and deals with form and object recognition and representation. It tells you whether you are looking at Donald Trump or an ape. 81

We talked earlier about how spoken language was hard wired into the brain, but reading and writing, being newer on the evolutionary timeline, might hop around in the brain and land anywhere there was space for them. Dehaene and others believe that the space for reading written words is in the left inferior temporal cortex (the area shaded light purple below). 83

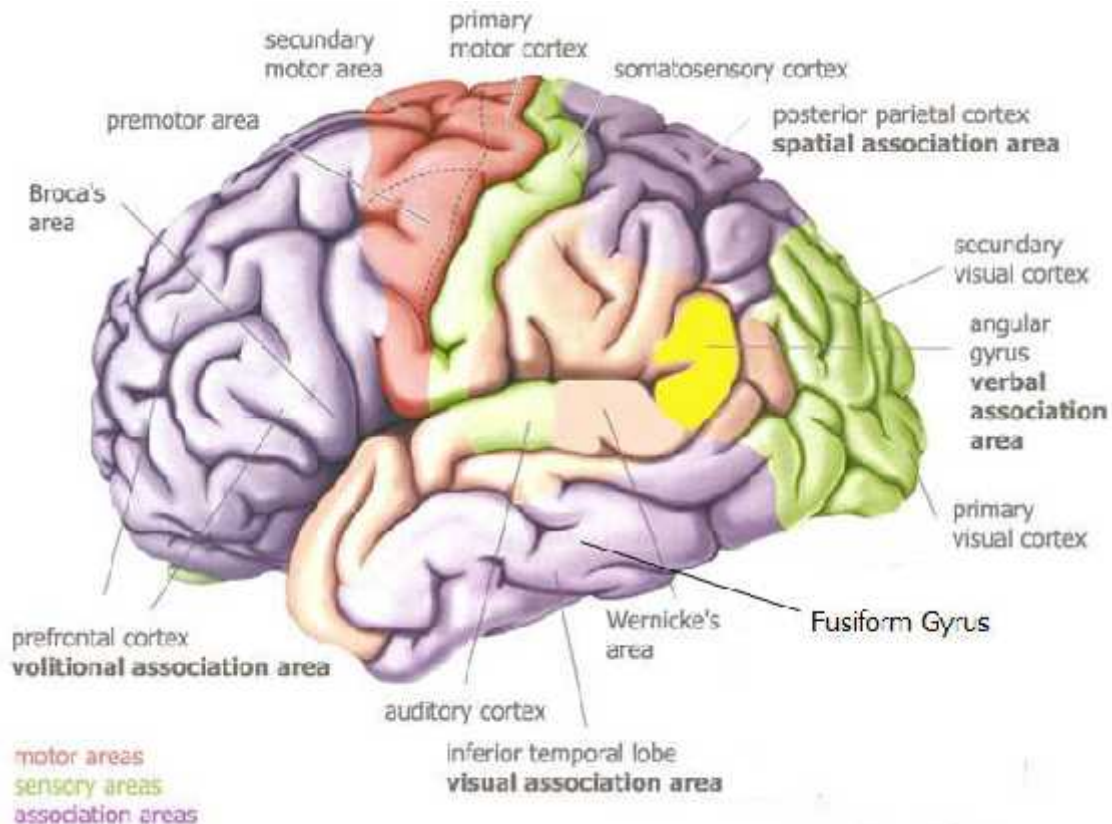


in functional MRI tests on neurotypical brains, this region, which they call the "visual word form area" (VWFA), was consistently activated during reading. They also found that when this region was surgically removed to treat patients with intractable epilepsy, reading abilities were severely impaired. 84

In the same vein, the area right above the inferior temporal gyrus, the fusiform gyrus, is considered by some to be the brain's "letter box." One reason for this is because it is situated in the lateral occipital-temporal area, which makes it a perfect candidate for "neuronal recycling." 85

The process of "neuronal recycling" causes brain circuits that originally evolved for one purpose to become re-trained to do another. So, since the occipital lobe is where line detection takes place and the lateral portion of the temporal

lobe is where object recognition takes place, it makes sense that the next evolutionary step up would be to recognize line drawings, which is essentially what words and letters are. 86



I said that the visual ventral stream passed through the temporal lobe, but specifically, it goes through the inferior temporal cortex, also known as the IT cortex. 87 This is the location of the aforementioned word form (VWFA) and "letter box" areas.

I don't like doing things that involve my vision.

When I hear words they appear in my brain as spelled out language. My brain is full of piles and piles of words piled up on each other. Written words.

I can recall written words but my auditory memory is limited to rehearsed phrases. The word piles are different. I think in your language but I verbalize in rote responses.

When I type I envision words as I go because they are actually fully evident in my brain.

Because Meaghan has tuned out so much visual input for so long and relied so heavily on her heightened auditory sense, it is possible that when auditory ventral input reaches this region in her brain that should be decoding sounds into spoken words, it is instead decoding them into written language.

Bear in mind, this could also work in reverse. Where Meaghan's brain converts visual and auditory input to written words, Temple Grandin's brain converts written and spoken words into pictures. She thinks in pictures, Meg thinks in written words. Two different variations of the same brain difference.

Here's another interesting thing about the ventral visual stream. All the areas in the stream are influenced by factors that include attention, working memory and stimulus salience,⁸⁸ So the "what" a person sees does not necessarily reflect all of the elements in the visual world around them. The significance attached to visual images, in fact, is largely a matter of personal choice.

It has always amazed me that Meaghan who essentially keeps her head down and doesn't look at anything, especially in large, crowded rooms, could somehow spy a lego block in a bag 50 yards away in the back corner of the room. There was no way I could have seen it if I had looked for over an hour. But she could zero in on it in a matter of minutes. And yet, when she was little she could never locate Waldo in the "Where's Waldo?" books. Why? Because he didn't matter to her.

This also might help explain Meaghan's perseverations and repetitions. Her mind gets stuck on certain things, primarily certain objects, but sometimes certain people or places. She keeps repeating their names because she keeps seeing them represented in her mind, and she cannot re-direct her focus to take her mind off of them. I know when I get a song stuck in my head, it's hard to stop singing it. I have to recognize the problem and consciously re-direct my attention. People with autism, on the other hand, take comfort in their repetitions and see no reason to stop them just because they might be driving other people around them crazy.

Damage to the ventral stream (particularly the fusiform gyrus) can cause difficulties with perceptual tasks as well as inability to recognize faces or interpret facial expression. ⁸⁹

I think we have a big clue here to why individuals with autism have a hard time with all three of the above.

I will end this section with a conversation Meg and I had about her vision. I have included it because it gives you an idea of just how differently her mind works. I asked her to complete these sentences:

This is how my mind registers what I see...

It uses information from my eyes to tell my brain the world is crazy.

This is what I see when I look around a room...

I see too much for me to take it all in, I usually focus on small details.

This is what I see when I look at a person. For instance, when you look at Uncle Paul, what do you see?

I see his drink. (We're an Irish family!)

What if he's not holding a drink?

I see his skin and hair.

You don't see his features?

No. Because people's features are slippery and they don't get the right trigger to turn on my brain.

This is why it is difficult for me to look in a mirror...

Because I can't be sure I am inside my body. I look pretty okay, but I feel very yucky.

Meg, how do you read?

All at once. I take in everything at a glance.

And you remember it all?

Yes.

APHASIA + ATAXIA = AUTISM



"You need to understand that with autism, what you see is not necessarily what you get."

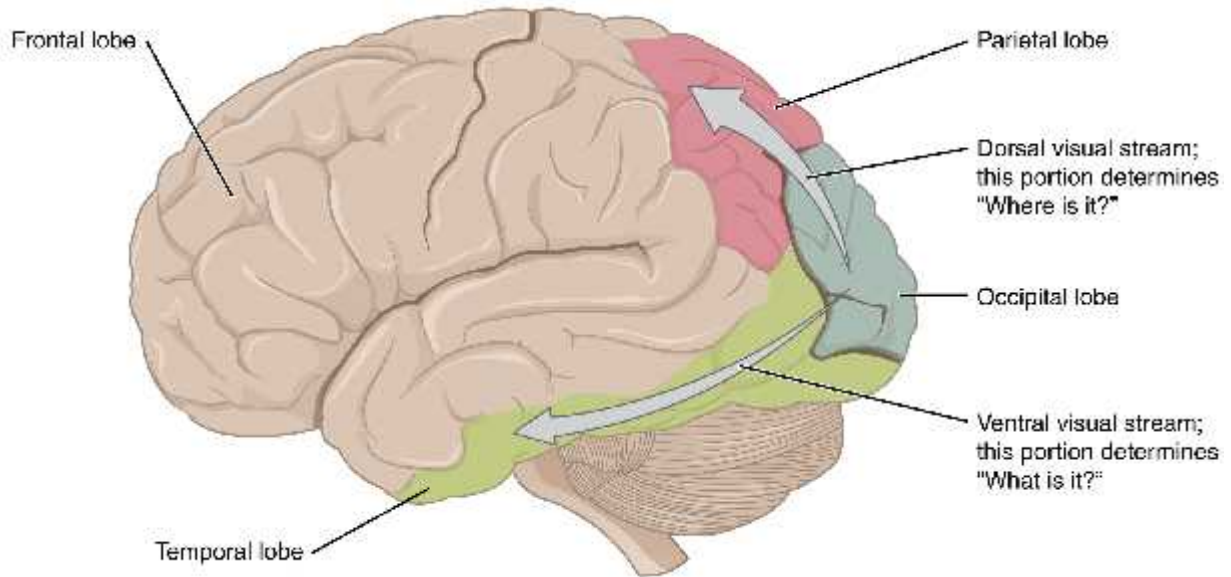
~ Meaghan Buckley

Can you see how the dominoes topple? If one sense is off, it throws off everything in its wake. The failure of even one reflex to integrate fully can cause sensory deprivation that can affect smooth neural network development and processing going forward. With Meaghan, it turned out the most of the reflexes that weren't fully integrated impacted the development of her vision. She can see, but it hurts her eyes to look at anything for any length of time.

This was why it was so surprising to us when she first started doing supported typing. Her eyes were riveted to the keys on the keyboard. For most kids with autism this would not be unusual but for Meaghan it was a miracle. And it is just further evidence of the point we made above about the importance of stimulus salience. As Meaghan says...

I look when it really matters to me. Typing matters.

It matters so much that she would not give up the battle until she mastered complete independence. And for her, hand-eye coordination was a fierce opponent. Let's see why by following the dorsal visual pathway.



It starts with purely visual functions in the occipital lobe before gradually transferring to spatial awareness at its termination in the parietal lobe, where bodily sensations such as touch are represented. It controls the eyes and arms, especially when visual information is used to guide eye and hand movement. 98

So here is one clue to Meaghan's difficulty with hand eye movement. Her difficulty coordinating her eyes and finger to precisely target the correct key when typing, her hesitation and hovering in doing so, could be the result of some problem in the dorsal end parietal lobe processing of her vision.

For those who wonder why touch is so important to people with ASD who are learning to type, here is one reason why. Their hand-eye sensory systems depend on it to function.

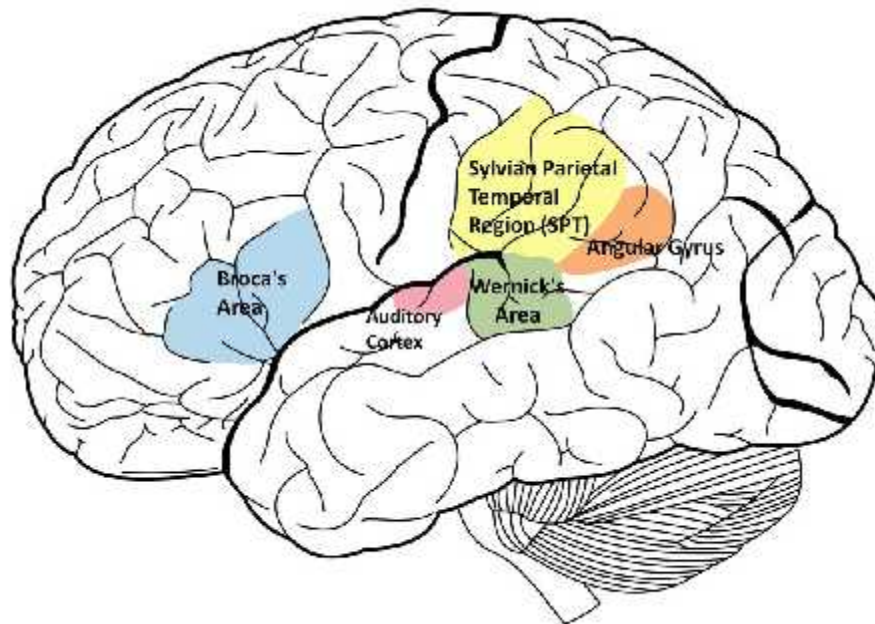
Imagine being terribly farsighted and attempting to read when you couldn't see the letters on the page. Now imagine having to locate and point to specific words on the page when you had little or no sensation in your arm, hand or finger. Both vision and touch work together in the Parietal lobe to support spatial awareness and fine motor ability.

The ventral "what" pathway for speech is equally intriguing as it too plays a role in sensory motor integration and control. Specifically for speech. The function of the auditory ventral pathway is to map auditory sensory representations into articulatory motor representations. 89

The sound pathway starts in the auditory cortex with tones and speech noise and the processing gets more refined the further you go along the pathway until

you reach frontal lobe motor regions that are selectively activated by words, transforming them into intelligible speech sounds. 90

But let's go back and focus our attention on the parietal temporal region, midway through the processing loop. It appears that parietal regions are fed a fast, temporally precise, but relatively rough "primal sketch" of auditory information by the auditory cortex. 91 From here sound passes on to the sensorimotor interface, located in the left Sylvian parietal temporal region (SPT).



The SPT (yellow area above) is important for acquiring new vocabulary and perceiving and reproducing sounds. It is responsible for routing auditory code on to the temporal and frontal lobes of the brain so that sound and text can be converted into speech in the motor cortex.

If there is a problem in the wiring of this area or a problem in the wiring going forward on to the articulatory network for motor, language acquisition will be impaired. Speech impairment is called aphasia and there are many types, depending on the region involved.

Conduction aphasia is an impairment of the SPT that results in the inability to reproduce or repeat speech, particularly multi-syllabic speech. This makes sense since the SPT is responsible for connecting the motor and auditory systems by making auditory code accessible to the motor cortex. This impairment has no influence on the subject's ability to comprehend spoken language. 92

Testing has shown that most conduction aphasiacs can repeat high-frequency, simple words, it is their ability to repeat low-frequency, complex words that is impaired. It appears that the motor cortex stores high-frequency, simple words (like cup) in order to more quickly and efficiently access them, while low-frequency, complex words (like Sylvian parietal temporal) require more active, hands on regulation by the SPT. 93

This explains why Meaghan relies on her rote language. It is easy to call up and use. The words she uses are definitely high-frequency, and she does struggle to articulate newer, longer phrases and sentences.

There are other types of aphasia as well, either the result of incomplete wiring or damage to the established language regions of the brain. With conduction aphasia, as we've said, the problem is in the Sylvian fissure or more specifically the arcuate fasciculus, a small region in the fissure vital for both speech and language comprehension.

Adjacent to the arcuate fasciculus are two other important language regions, Broca and Wernicke's areas. If Broca's area is impaired, a person has difficulty moving the tongue or facial muscles to produce the sounds of speech. People with Broca's aphasia have little problem understanding speech, but when they try to speak themselves, they are literally tongue-tied. 94

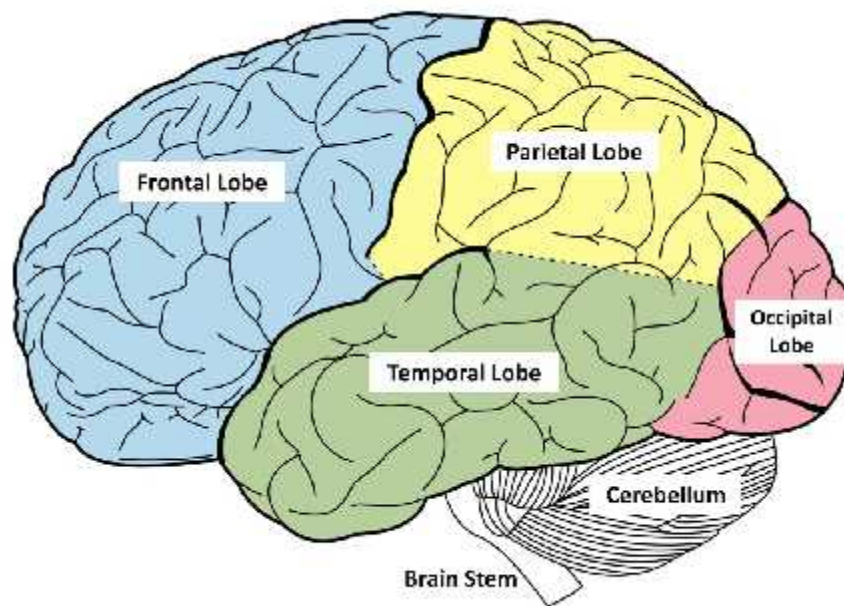
Damage to Wernick's area, on the other hand, has the opposite effect. Someone with this form of aphasia might speak in long, rambling sentences that have no meaning. They combine words that don't necessarily go together, creating "word salads." But while they have no problem speaking, they have difficulty understanding speech, so they are unaware of their mistakes. 95

There is also apraxia, which is a motor disorder that can affect both the motor planning of speech and of tasks or movements. This occurs when there is a problem in the posterior parietal cortex.

Of course, with autism there is more going on than just aphasia or apraxia or any of the other a-named disorders that have to do with the coordination of movement. The bottom line is, Meaghan is absolutely right when she says that...

People should understand that autism is first and foremost a motor disorder.

There are two very good reasons for this. First, **the dysmetria of the cerebellar purkinje cell programming** at the core of the cerebral processing loop and second, because the **motor processing regions are all in the frontal regions of the brain**, as far as you can get away from the cerebellum. So we are talking about a lot of long neural tracks.



Frontal Lobe	Temporal Lobe	Parietal Lobe
<ul style="list-style-type: none"> • Inability to plan a sequence of complex movements to complete multi-step tasks • Difficulty problem solving • Loss of spontaneity in interacting with others • Loss of flexible thinking • Persistence of a single thought (perseveration) • Mood changes (emotionally labile) • Inability to express language (Broca's Aphasia) • Loss of inhibition • Inability to focus on a task (attention) 	<ul style="list-style-type: none"> • Difficulty recognizing faces • Disturbance with selective attention to what the person sees and hears • Persistent talking (right lobe damage can cause this) • Increased aggressive behavior • Difficulty with identification of and verbalization about objects • Difficulty understanding spoken words (Wernick's Aphasia) • Short term memory loss • Interference with long term memory • Inability to categorize objects 	<ul style="list-style-type: none"> • Inability to attend to more than one object at a time • Difficulty drawing objects • Difficulty distinguishing left from right • Lack of awareness of certain body parts and/or surrounding space • Difficulty with hand-eye coordination • Inability to name an object (Anomia) • Inability to locate the words to write (Agraphia) • Problems with reading (Alexia) • Inability to focus visual attention • Difficulty doing mathematics
Cerebellum	Occipital Lobe	Brain Stem
<ul style="list-style-type: none"> • Dysmetria of thought and behavior • Loss of ability to coordinate fine movements • Difficulty speaking • Inability to make rapid movements • Tremors • Dizziness (vertigo) • Slurred speech • Loss of ability to walk • Inability to reach out a grab objects 	<ul style="list-style-type: none"> • Defects in vision (visual field cuts) • Difficulty locating objects in the environment • Difficulty identifying colors (Color Agnosia) • Hallucinations • Visual Illusions, or inaccurately seeing objects • Word blindness, or inability to recognize words • Difficulty recognizing drawn objects • Inability to recognize movement of an object (Movement Agnosia) • Difficulty reading and writing 	<ul style="list-style-type: none"> • Difficulty organizing and perceiving the environment • Problems with balance and movement • Difficulty swallowing (food and water) • Dizziness and nausea (Vertigo) • Sleeping difficulties (insomnia, sleep apnea)

The table on the previous page shows specific types of impaired function that can be traced to specific areas of the brain. The red functions are impaired in Meaghan's brain (or were impaired at some point). The blue functions are not. As you can see, the ratio of impaired to not impaired is greatest in the frontal lobe, which is most distant from the cerebellum.

Think of the inner workings of the brain, with its complex network of connections as an information super highway. In order for our brains and bodies to function properly, this highway system must be wide enough for multiple pieces and types of information to travel simultaneously. It must also be smooth, so that data can flow at a high rate of speed. And you don't want interruptions in the flow, so no obstacles, detours or stop lights.

The problem with autism is that, rather than information taking the super highway, some of it seems to detour along back roads. Neural tracts are at times too narrow, too crowded or too bumpy for normal processing to occur. And even when there is smooth going, the highway sometimes leads to a destination that isn't on any neurotypical GPS. Bottom line, the conversion of sensory input to motor output is either short-circuited or atypical.

This is not just true of speech information, although it makes sense since this is the most complex of all motor tasks. Every body movement from a smile to facial expressions, to throwing a ball, to writing, to drawing, to dancing. The list goes on and on. Yes, many kids with autism figure out how to do these things eventually, but it is a tremendous struggle for them.

Not because they don't understand what is expected of them. They do. They understand perfectly well the logistics of showing happiness and playing baseball and writing and dancing. Their minds get it. Their bodies just don't let them do what they want to do because neural messages are not making it all the way from the motor planning areas to the motor execution areas.

You have to know that my intelligence has opened the door to my communication.

A central problem in motor control, in the representation and perception of the body in space, is how the brain encodes the relative positions of body parts. This sense of limb position depends heavily on vision. 96

If you doubt this, try closing your eyes and reaching for a glass of wine. You can feel your hand and your arm, so your sense of proprioception is in tact and you probably took in the position of the glass of wine visually before you closed your eyes, but even so, odds are you are going to fumble and spill. Why? Because our brain needs both vision and proprioception to guide your movement.

How much trouble would a person have with motor planning and motor control if both their visual and proprioceptive senses were impaired so that vital cues from the head, eyes, arms, hands and fingers never reached the premotor cortex? How disoriented might a person become if the sensory input she received from her eyes, ears, muscles and joints was unreliable, disconnected or one if source was always conflicting with another.

I had to learn to use my eyes and control my impulsivity. That was almost impossible to do but my mom worked hard with me and together we worked it out.

This is why individuals with autism often appear awkward and have so much trouble with what to us seem like simple every day tasks. Without the ability to motor plan and coordinate movement, you would be stuck before you got started.

Does this mean that they are stupid or incapable of learning. Absolutely not. It just means that their intelligence lies elsewhere. They are wired differently. We don't presume blind or deaf people to be retarded. They might not be able to use their eyes or ears, but their mind still works. It's the same with people with ASD. They might not be able to feel their bodies, but their mind still works.

This is important. This is where there is so much confusion. Because when it comes to intelligence and memory and understanding, many people with ASD have brains that are far superior to ours. So **some neural impulses, the ones that have less to do with sense and motor and more to do with facts and information, are making it through to their destination unimpeded.**

Why is this?

We will look for the answer in the next chapter.

You need to understand that with autism what you see is not necessarily what you get. We seem a lot less capable than we are and if you don't know better we both lose out.

HIGH, YET UNBALANCED, INTELLIGENCE



“People do not think that we have thoughts and feelings of our own. They think we are stupid.”

~ Meaghan Buckley

They need to know that I am very intelligent. They need to challenge me more. I get bored really easily and when I am bored my mind shuts down. Also my mind is not engaged when I am using my rote speech.

Kim Peek had language areas in both sides of his brain and clearly had a prodigious memory. His missing corpus callosum or integrating network made it impossible for him to piece together all the bits of information he memorized into a meaningful whole, but he had outstanding detail or mechanistic cognition.

Whatever deficits he had in theory of mind or mentalism, the ability that allows most of us to relate to ourselves and others as mental beings, with feelings, motives, beliefs and consciousness of self, he more than made up for with his remarkable memory and mechanical capabilities. He had a remarkable mind for facts and details and the ability to relate to objects in the material world by means of manual, mathematical and visual-spatial skills. 97

Yes, his mind was different, but who is to say whether it was better or worse. People with autism might seem gullible because they are incapable of lying.

They are easily taken advantage of because they are childlike in their innocent belief that everyone is telling the truth. We may pride ourselves in our ability to win friends and influence people, but in the end, does our ability to con and manipulate others really give us the higher ground? Does it make us better?

If you look at the most extreme example of mentalism, you get someone who has superb social, political, and inter-personal skills, but has no qualms about lying and cheating his way to the top. Whereas the most extreme example of mechanism is an autistic savant or the IT experts in Silicon Valley.

Really where fear gets you misled is in being so easily distracted by the outward manifestations of autism. Inside we are unique individuals who have our own sense of reality. Our reality is one of swirling eye popping chaos. Outside. Inside it is less terrifying but it still takes getting used to.

If you had the choice of being born again with or without autism, which would you choose?

I would choose autism. Because I am unique and one of a kind. Everyone is too concerned about doing the same thing. So boring. It isn't a bad thing to be unconventional. It is only a problem when that unconventionality is misunderstood.

And how are you misunderstood?

I am going out of my mind really. Hard to appreciate how much frustration I feel going through the motions of living everyday. People do not think that we have thoughts and feelings of our own. They think that we are stupid.

But sometimes you act stupid, Meg.

Yes, because to act smart I would have to make myself crazy. My behaviors allow me to escape from myself.

Because I have my own idiosyncrasies. Everyone is different. Even when silly, my idiosyncrasies satisfy me.

I am your funny wiring daughter and to be really well I need to express myself in my own way.

In his article, "Autism As a Disorder of High Intelligence," Bernard Crespi hypothesizes that autism involves high, yet imbalanced, intelligence. This is why, although autism is genetically correlated with high intelligence, individuals on the spectrum tend to have substantially lower IQs than controls. 98

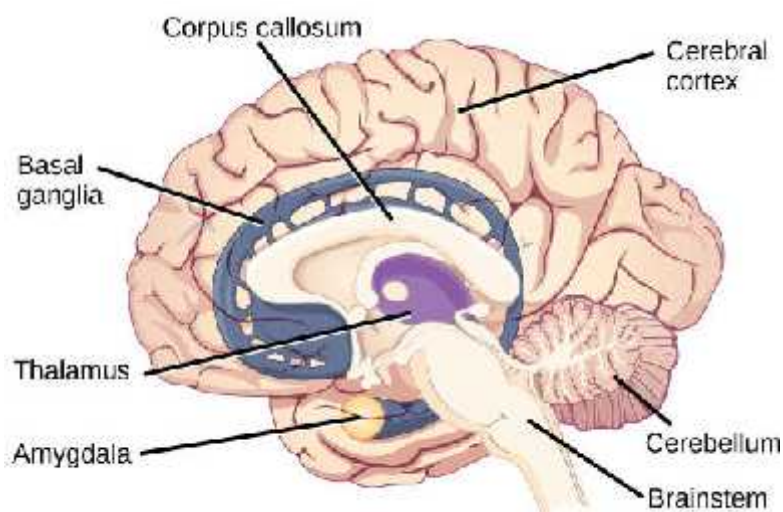
Crespi contends that some or most of the components of intelligence are increased in autism, but they are increased in such a way that overall performance is often reduced. What he means is that people with ASD have enhanced specific skills or interests but a reduced general integrative intelligence more common to neurotypicals. 99

Of course, another explanation is simply that standardized IQ tests were created by neurotypicals for neurotypicals. They were not created to take into consideration differences in brain types.

One explanation for autism intelligence could be their extraordinary memory capacity. Let's examine this further. Just like with computers, memory is a critical function of the brain. There are three types of memory: sensory, short term and long term memory.

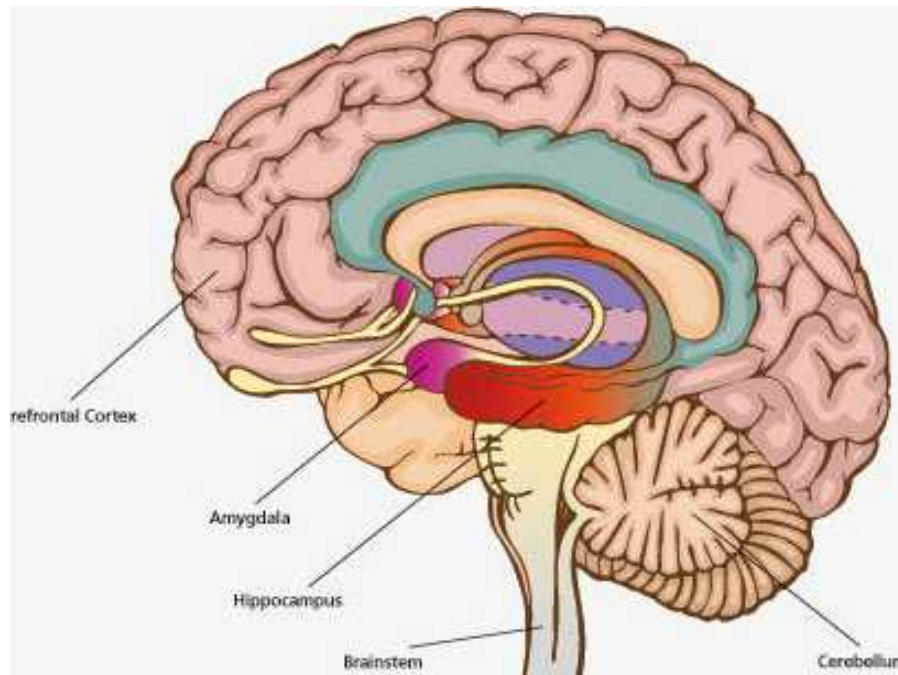
Each type of memory operates differently, but all contribute to the formation of lasting memories. The first two types of memory are limited in duration. For instance, you might remember a phone number for a few minutes but, unless you use it over and over again, it does not pass into long term memory. 100

There are also implicit and explicit memories. Implicit memories are actions or skills that we have learned but cannot verbalize. These memories typically operate on autopilot, without conscious awareness, such as how to tie your shoes, eat with a knife and fork and how to write or type. 101



The cerebellum and the basal ganglia are involved in the formation of these "motor" program memories.

Explicit or declarative memories, on the other hand, can be verbally expressed. These memories include facts, events and spatial memories of locations. These memories are easy to acquire and easy to forget... unless you have autism. 102



Many areas in the medial temporal lobe and prefrontal cortex play a role in the formation and storage of explicit memory, but the key structure involved for short term memory to be encoded into long-term memory is the hippocampus.

Because memory is so important, it does not remain stored in the hippocampus permanently. Instead, long term memories become integrated into the cerebral cortex. This process is known as cortical integration and it protects and preserves the information stored in the brain. 103

So it is quite possible that as fast and flexible as our neurotypical brains are, the autistic brain - like the very latest computer model - is capable of a lot more information storage. We might have more RAM, but they have a bigger, better hard drive, probably due to some form of neuronal recycling.

Areas of the cortex that are not being used for such things as planning, problem solving, impulse control and social skills are recycled for storing memory of just about everything an autistic person hears and sees. Since they don't fine tune or

filter out much information, more detail passed through the cerebellum to the hippocampus and from there to areas in the cerebral cortex.

I have an amazing memory for details. I remember all of my toys and all of my educational games in minute detail. You would be surprised at how much information I absorb just existing. Tiny itty bitty details.

We assume that people with autism are mentally handicapped because they are not able to speak like we do. They are not able to move as gracefully as we do. They sometimes behave strangely and are socially inept. How could they possibly be as smart as us, if they don't resemble us in every other way?

Unfortunately, this is the current state of mind of almost everyone where autism is concerned. **Everyone is understanding, but no one really understands.**

But, as Meaghan says, we have to start somewhere in setting the record straight, because the longer we go on assuming autism is a disability, rather than a remarkable ability that we would be wise to appreciate and learn from, the longer we will all miss out.

Autism easily resembles mental retardation if misunderstood. Really everything boils down to understanding.

THE AMAZING GIFT OF THE AUTISTIC BRAIN



“See it for the exciting possibilities that it brings to the table.”

~ Meaghan Buckley

Avital Hahamy of the Weizmann Institute of Science in Israel, conducted a study using fMRI scans of both neurotypical and autistic individuals. The purpose of the study was to show the relative inter-hemispheric connectivity of different brain regions. 104

For the neurotypicals in the study, the connectivity pattern was consistent. The frontal and temporal cortices, responsible for executive decision making, generally had reduced connectivity, while connectivity across the brain was increased in the occipital and sensori-motor cortices. In scan after scan, the neurotypical brains showed uniform patterns in relative connectivity. 105

Examining the ASD brains, however, was not as straightforward. While they all had some areas with over- or under-connectivity compared to the neurotypical brains, the regions where these differences occurred varied *for every individual*. There wasn't much of a pattern when the scans were looked at as a group, but when an individual's scan was compared to their list of ASD-related symptoms, very clear correlations were seen. 106

So what does this tell us?

Pretty much what we already know - **that each individual with autism is unique.** However, it also tells us that if we want to find out what makes them uniquely autistic, we have to go about it the same way Aleksandr Luria went about documenting the fragmentation of his patient and long time friend Zazetsky's brain. **We have to study the brains of one autistic individual at a time, guided by their input.**

Maybe not all individuals with autism can communicate what it feels like to be autistic, but I'd wager a lot more of them can than we are aware of presently. And those that can should be regarded as an amazing gift, because through their unique human experience we can understand much more about the human brain. Rather than starting with the biology and wondering where that takes us, we have to start with the person and work backwards.

What makes Meaghan uniquely autistic is her amazing ability to write - an ability that almost went unnoticed. An ability that is still largely unacknowledged by the people she encounters every day, because they think autism is a one-size-fits-all speech and behavior disorder. We know now that it is neither of those things. It is first and foremost a sensory motor disorder; a disorder that modifies the wiring of the brain so that it specializes in things that are outside the norm.

Typing has helped me get my words out so I can communicate to a few people but not to the people who I spend the most time with. You really don't erupt in words when right services aren't offered to us because people are afraid of what we might have to say. That is not right. But to make it right all the autistic people would have to become non autistic until they could speak up for themselves.

I have tried to teach the great mass of naysayers that autism is a positive thing, not a negative. See it for the exciting possibilities that it brings to the table.

As Meaghan's typing ability demonstrates, the autistic brain is an amazing resource. Thanks to her input, we now can piece together a brain where the speech component is housed in her left brain, subject to Broca's or conduction apraxia, while her textual language - her ability to spell, utilize grammar and use written words or type - are housed in her right brain. This explains the complete dichotomy between her two piles of language and a defective corpus callosum explains how each side of her brain could function essential independently.

Meg's ability to speed read, to take in all the words on a page at a glance, may also be the result of this split-brain like capacity, although whether this ability is

housed in both sides of her brain (like Peek's) or just one side is difficult to pinpoint. She can read single words aloud, but not whole sentences, primarily due to her apraxia. And she will not read traditional books...

Because I can't tolerate the visual stimulation. I can't stand books because they are written too small and written so academically. I get a dreadful headache being forced to look at things too long.

But you have no problem looking at the keyboard when you type?

Because I am communicating and that is more important to me than a headache.

Her vision is Meaghan's most sensitive sense and has been her biggest obstacle toward achieving typing independence. We have explored all options and all manner of keyboards. First, pinhole glasses helped, then we tried different colored lenses. I then learned from Meaghan's feedback that she found it much easier to distinguish between pictures than letters, so I found an iPad program (Abilipad) that would allow me to combine the two. She loved this and still uses it.

The pictures help me to distinguish the keys.

No doubt others with autism have some of these split brain capabilities as well, which is why we have to stop focusing so much on speech therapy and acknowledge the possibility that, like Meaghan, they may have the ability to communicate their thoughts using other functions of their brain - whether they be literary or creative.

This is what we have been missing when we think about autism. We have been fixating on the limitations and not the possibilities.

I think autism and OT really go hand in hand because of the sensory motor nature of the condition.

We know now that it is not unreasonable for people with autism to have brains with language regions on in both the left and right hemispheres and that is quite possible that they could not only be better at written language than verbal language, but that they could even have two different, incompatible, "voices."

Since the dawn of time, the hand and mouth have always been partners in communication, with one filling the role when the other could not. It is the same today. 106

[I can't speak] However I can point my finger, and I can use my mind to direct where that finger goes. Typing has opened the Pandora's box of my autistic mind...

For kids with autism, their finger is their best communicative tool and we should be starting them with picture boards and iPad apps at a young age. But then move on. Let them type. However they can do it, with support or not. Because only through the use of words can they express their thoughts. Pictures limit them to wants and needs. We need to stop limiting them.

To get from a typer to a communicator, you have to be able to express deep thoughts.

Make communication a priority, without it we are just going through the motions of living.

Teaching people with autism to communicate is much more complicated than you think. We operate on a different wavelength. You can't use normal teaching strategies for abnormal brains.

Anything that helps a person to share their thoughts with others should be allowed.

Requiring slight support does not mean that we are stupid or incapable. It just means that our defiant bodies make it much harder for our healthy minds to carry out some of the simple things that you take for granted.

How many hours and dollars have been spent on speech and behavioral therapy trying to get autistic children to conform to our norm of behaving and talking, when perhaps they are not wired to communicate verbally? And perhaps they are not wired for facial expression, flexible thinking or social interaction either? That is not necessarily a bad thing, that is just autism.

Why do we keep insisting on changing them when many of them are happy just the way they are? What we should be doing is figuring out exactly how they are wired and use their unique brain anatomy and their communicative input to learn and understand more about them, so we can give them the tools and services they require to lead their best lives.

There is still so much more we have to learn and that Meg can teach us. Why does she cry when she is happy? She loves to listen to music, but she will only

attempt to sing a verse or two of simple songs with repetitive lyrics, like "Happy Birthday To You." When asked why?

Because I can't synchronize my voice with the words.

There is so much more that we have to learn, that Meg and others with autism can teach us. And they want to do that.

Last May, Meaghan sat for an interview with Dr. Christopher McDougle, Director of The Lurie Center For Autism and Professor of Psychiatry at Massachusetts General Hospital and Harvard Medical School. He asked her what she thought about being autistic. She typed her response.

Autism is a kind of sick joke because those of us who have it are highly intelligent and yet we are denied the power to express that intelligence.

Dr. McDougle then asked if she ever dreamed of not having autism.

Yes. I dream that I can tell everyone exactly what I think.

How did she feel knowing that she could not do this.

It has made me feel awful, sub human. I have wanted to talk so badly to explain that I have feelings too.

Did she have anything to say to those who didn't believe in her abilities?

You need to learn to trust. If you let us, we will amaze you.

At the end of the interview Dr. McDougle asked Meg if she had any wishes for the future and, if so, what they were.

Yes. To help others with autism learn to communicate through typing. To go to college. Just to have people believe in me.

Pretty simple. I think that is all any of us ask for in this life. To be able to have a say in how we live our lives and to have others believe in us.

I envision a world where all people are treated as equals and some people are different from others but they are respected for their differences not denigrated.

I envision a world where everyone does what they want to and no one has to take orders from anyone else. A world where all the people have a say in shaping their future.

I envision a world where nobody is handicapped by not having a typical brain. Where crazy and unique are embraced rather than dismissed and autism is recognized as the gift that it truly is.



THE MEAGHAN REPORT

FOOTNOTES

1. https://en.wikipedia.org/wiki/Lev_Zasetsky
2. <http://medhum.med.nyu.edu/view/202>
3. <http://medhum.med.nyu.edu/view/202>
4. Barbara Arrowsmith-Young, *The Woman Who Changed Her Brain*, p.2
5. <https://drvitelli.typepad.com/providentia/2015/10/the-shattered-man.html>
6. <https://drvitelli.typepad.com/providentia/2015/10/the-shattered-man.html>
7. Barbara Arrowsmith-Young, *The Woman Who Changed Her Brain*, p.2
8. Barbara Arrowsmith-Young, *The Woman Who Changed Her Brain*, p.2
9. <https://io9.gizmodo.com/sensing-your-own-body-is-more-complicated-than-you-real-1473461740>
10. <https://www.nature.com/articles/442125a>
11. <https://io9.gizmodo.com/sensing-your-own-body-is-more-complicated-than-you-real-1473461740>
12. <https://io9.gizmodo.com/sensing-your-own-body-is-more-complicated-than-you-real-1473461740>
13. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC17903/>
14. <https://theconversation.com/how-our-brain-controls-movement-and-makes-new-connections-when-parts-are-damaged-63520>
15. <https://www.ilearnlot.com/proprioceptive-sense-language-learning/>
16. <https://health.usnews.com/health-care/for-better/articles/2018-04-11/proprioception-the-unsung-hero-of-the-senses>
17. <https://ilslearningcorner.com/2016-04-proprioceptive-dysfunction-causes-sensory-seeking-and-sensory-avoiding-behavior/>
18. <http://theconversation.com/what-brain-regions-control-our-language-and-how-do-we-know-this-63318>
19. <https://www.ilearnlot.com/proprioceptive-sense-language-learning/>
20. <https://brainworldmagazine.com/eyes-body-understanding-proprioception/>
21. <https://www.sciencemag.org/news/1998/05/split-brain-separates-writing-speech>
22. <https://www.sciencemag.org/news/1998/05/split-brain-separates-writing-speech>
23. <https://www.sciencemag.org/news/1998/05/split-brain-separates-writing-speech>
24. <https://www.sciencemag.org/news/1998/05/split-brain-separates-writing-speech>
25. http://www.oswego.edu/~delancey/471_DIR/Gazzaniga1.pdf
26. <https://www.psychologytoday.com/us/blog/the-superhuman-mind/201303/the-brain-the-real-rain-man>
27. <https://www.psychologytoday.com/us/blog/the-superhuman-mind/201303/the-brain-the-real-rain-man>
28. <https://www.nature.com/news/the-split-brain-a-tale-of-two-halves-1.10213>
29. <https://www.nature.com/news/the-split-brain-a-tale-of-two-halves-1.10213>
30. http://thebrain.mcgill.ca/flash/capsules/experience_bleu06.html
31. <https://www.nature.com/news/the-split-brain-a-tale-of-two-halves-1.10213>
32. https://en.wikipedia.org/wiki/Kim_Peek
33. <https://www.psychologytoday.com/us/blog/the-imprinted-brain/200908/the-symmetry-savantism>
34. <https://www.psychologytoday.com/us/blog/the-imprinted-brain/200908/the-symmetry-savantism>
35. <https://www.spectrumnews.org/news/cognition-and-behavior-corpus-callosum-smaller-in-autism/>
36. <https://www.spectrumnews.org/news/lack-of-corpus-callosum-linked-to-autistic-features/>
37. <https://en.wikipedia.org/wiki/Split-brain>
38. <https://www.sciencedirect.com/topics/psychology/split-brain-patient>
39. <https://www.sciencedirect.com/topics/psychology/split-brain-patient>

40. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3411722/>
41. [https://www.biologicalpsychiatryjournal.com/article/S0006-3223\(08\)00667-7/abstract](https://www.biologicalpsychiatryjournal.com/article/S0006-3223(08)00667-7/abstract)
41. https://www.huffpost.com/entry/autism-brain-symmetry_n_5841d0b1e4b0c68e0480b469
42. <https://www.rightlefttrightwrong.com/brain.html>
43. <https://www.rightlefttrightwrong.com/brain.html>
44. <https://www.rightlefttrightwrong.com/brain.html>
45. <https://www.sciencemag.org/news/1998/05/split-brain-separates-writing-speech>
46. <https://www.nytimes.com/1996/11/26/science/workings-of-split-brain-challenge-notions-of-how-language-evolved.html>
47. <https://www.nytimes.com/1996/11/26/science/workings-of-split-brain-challenge-notions-of-how-language-evolved.html>
48. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
49. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
50. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
51. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
52. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
53. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
54. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
55. <https://www.psychologytoday.com/us/blog/the-athletes-way/201611/how-does-brain-symmetry-influence-the-workings-your-mind>
56. <https://www.psychologytoday.com/us/blog/the-athletes-way/201611/how-does-brain-symmetry-influence-the-workings-your-mind>
57. <https://www.psychologytoday.com/us/blog/the-athletes-way/201611/how-does-brain-symmetry-influence-the-workings-your-mind>
58. <https://www.psychologytoday.com/us/blog/the-athletes-way/201611/how-does-brain-symmetry-influence-the-workings-your-mind>
59. <https://www.psychologytoday.com/us/blog/the-athletes-way/201503/the-cerebellum-deeply-influences-our-thoughts-and-emotions>
60. <https://www.burnswoodward.com/single-post/2016/11/13/The-Cerebellum-Modulates-Thought-Emotions-and-Relationships>
61. <https://www.scientificamerican.com/article/what-is-homeostasis/>
62. <https://www.psychologytoday.com/us/blog/the-athletes-way/201504/the-cerebellum-cerebral-cortex-and-autism-are-intertwined>
63. <https://www.psychologytoday.com/us/blog/the-athletes-way/201411/how-are-purkinje-cells-in-the-cerebellum-linked-autism>
64. <https://www.psychologytoday.com/us/blog/the-athletes-way/201411/how-are-purkinje-cells-in-the-cerebellum-linked-autism>
65. <https://www.psychologytoday.com/us/blog/the-athletes-way/201411/how-are-purkinje-cells-in-the-cerebellum-linked-autism>
66. <https://www.psychologytoday.com/us/blog/the-athletes-way/201411/autism-purkinje-cells-and-the-cerebellum-are-intertwined>
67. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4419550/>
68. <https://www.britannica.com/science/Purkinje-cell>
69. <https://www.inpp.org.uk/intervention-adults-children/more-information/reflexes/primitive-postural-reflex/>

70. <https://www.inpp.org.uk/intervention-adults-children/more-information/reflexes/primitive-postural-reflex/>
71. <https://www.inpp.org.uk/intervention-adults-children/more-information/reflexes/primitive-postural-reflex/>
72. <https://www.inpp.org.uk/intervention-adults-children/more-information/reflexes/primitive-postural-reflex/>
73. <https://www.nature.com/articles/442125a>
74. <https://www.nature.com/articles/442125a>
75. <https://www.nature.com/articles/442125a>
76. <https://www.npr.org/sections/health-shots/2015/03/16/392789753/a-man-s-incomplete-brain-reveals-cerebellum-s-role-in-thought-and-emotion>
77. https://en.wikipedia.org/wiki/Cross_modal_plasticity
78. https://en.wikipedia.org/wiki/Cross_modal_plasticity
79. <https://www.frontiersin.org/articles/10.3389/fnins.2016.00300/full>
80. <https://theconversation.com/some-people-cant-see-but-still-think-they-can-heres-how-the-brain-controls-our-vision-63323>
81. <https://theconversation.com/some-people-cant-see-but-still-think-they-can-heres-how-the-brain-controls-our-vision-63323>
82. https://en.wikipedia.org/wiki/Stanislas_Dehaene
83. https://en.wikipedia.org/wiki/Stanislas_Dehaene
84. <https://www.psychologytoday.com/us/blog/talking-apes/201501/the-brain-s-letterbox>
85. https://en.wikipedia.org/wiki/Neuronal_recycling_hypothesis
86. <https://www.physiology.org/doi/full/10.1152/jn.00793.2011>
87. <https://www.frontiersin.org/articles/10.3389/fnevo.2012.00007/full>
88. https://en.wikipedia.org/wiki/Two-streams_hypothesis
89. https://en.wikipedia.org/wiki/Two-streams_hypothesis
90. https://en.wikipedia.org/wiki/Two-streams_hypothesis
91. https://en.wikipedia.org/wiki/Two-streams_hypothesis
92. <https://neuroscience.stanford.edu/news/ask-neuroscientist-spoken-versus-written-language>
93. <https://neuroscience.stanford.edu/news/ask-neuroscientist-spoken-versus-written-language>
94. <https://mayfieldclinic.com/pe-anatbrain.htm>
95. <https://mayfieldclinic.com/pe-anatbrain.htm>
96. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC17903/>
97. <https://www.psychologytoday.com/us/blog/the-imprinted-brain/200908/the-symmetry-savantism>
98. <https://www.frontiersin.org/articles/10.3389/fnins.2016.00300/full>
99. <https://www.frontiersin.org/articles/10.3389/fnins.2016.00300/full>
100. <https://theconversation.com/were-capable-of-infinite-memory-but-where-in-the-brain-is-it-stored-and-what-parts-help-retrieve-it-63386>
101. <https://theconversation.com/were-capable-of-infinite-memory-but-where-in-the-brain-is-it-stored-and-what-parts-help-retrieve-it-63386>
102. <https://theconversation.com/were-capable-of-infinite-memory-but-where-in-the-brain-is-it-stored-and-what-parts-help-retrieve-it-63386>
103. <https://theconversation.com/were-capable-of-infinite-memory-but-where-in-the-brain-is-it-stored-and-what-parts-help-retrieve-it-63386>
104. <https://www.iflscience.com/brain/wiring-autistic-brains-shown-be-highly-individualized/>
105. <https://www.iflscience.com/brain/wiring-autistic-brains-shown-be-highly-individualized/>
106. <https://www.iflscience.com/brain/wiring-autistic-brains-shown-be-highly-individualized/>
107. <https://brainconnection.brainhq.com/2017/09/03/the-evolution-of-language/>